Challenges in Aviation Governance:

Implementation of Single European Sky and EU Emissions Trading Scheme

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Dedication:

Στον Ανδρέα και

σε όλους τους ανθρώπους

που με βοήθησαν να βρω αλλά και να χάσω τον δρόμο μου.

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ABSTRACT

Traffic growth, capacity constraints, climate change and the necessity to develop a more cost efficient system led to an ambitious initiative to reform the architecture of airspace management. This initiative, launched by the European Commission (EC), is called Single European Sky (SES). The four Key Performance Areas (KPAs) of SES are environment; cost efficiency; capacity; and safety. In the environment KPA Performance Indicators for Air Navigation Services Providers (ANSPs) are established to ensure that improvement in sustainability is achieved. In addition, aviation is included in the European Union's Emission Trading Scheme (EU ETS): the EC sets limits on CO_2 emissions and provides economic incentives to airlines to reduce emissions by establishing a market-based trading system. EU-ETS can be used to simultaneously promote economic efficiency and achieve environmental goals on a sustainable basis.

The PhD research examines the existence of cancel-out effects between supply-led, i.e. SES, and demand-led management, i.e. EU ETS, policies by following a holistic approach. Environmental economics theory and industrial economics are applied to identify factors that have a significant influence on the two policies. Interestingly, and in spite of common objectives, the two schemes are governed by different bodies, which may fail to streamline their communication process. Hence, the PhD thesis also addresses the issue of governance and its possible failure regarding the full implementation and efficiency of the schemes.

From a methodological perspective, Delphi is conducted in two rounds to encapsulate policy complexity at an in-depth level. The target population comprises stakeholders involved in SES and EU ETS. To select candidates purposive and snowball sampling was used. Thus, the sample consists of 39 senior managers/experts from Civil Aviation Authorities; ANSPs; aviation-related organisations and institutions; and airlines.

Based on the results of the Delphi and building on its theoretical background, the PhD thesis then develops a conceptual model to address governance failure, thus effectively linking supply- to demand-oriented aviation policies in a holistic manner.

Key words: Single European Sky, Emissions Trading Scheme, Air Navigation Service Provider, Performance Indicators in aviation, Aviation Policy and Governance

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ACRONYMS AND ABBREVIATIONS

A4A	Airlines of America
AAIASB	Air Accident Investigation and Aviation Safety Board
AAUs	Assigned Amount Units
ACC	Area Control Centre
ACCRI	Aviation Climate Change Research Initiative
A-CDM	Airport Collaborative Decision Making
ACE	ATM Cost-Effectiveness Benchmarking Reports
ACR	American Carbon Registry
ADS-B	Automatic Dependent Surveillance – Broadcast
AEA	Association of European Airlines
AER	Annual Emissions Report
AGE	Aviation-Grade Ethanol
AIC	Aeronautical Information Circulars
AIM	Aeronautical Information Management
AIP	Aeronautical Information Publication
AIREG	Aviation Initiative For Renewable Energy" In Germany
AIS	Aeronautical Information Services
AMC	Airspace Management Cell
ANSP	Air Navigation Service Provider
AO	Aircraft Operator
AOC	Air Operator Certificate
AoR	*Area Of Responsibility*
APP	Approach Control Unit
APU	Auxiliary Power Unit
ARN	Airspace Route Network
ARTCC	Air Route Traffic Control Centre

ASA	Air Services Agreement
ASKs	Available Seat Kilometres
ASM	Available Seats Miles
ASM	Airspace Management
ASMA	Arrival Sequencing And Metering Area
ATAG	Air Transport Action Group
ATC	Air Traffic Control
ATCEUC	Air Traffic Controllers European Union's Coordination
ATCO	Air Traffic Controller
ATFCM	Air Traffic Flow And Capacity Management
ATFM	Air Traffic Flow Management
ATM	Air Transport Management
ATM	Air Traffic Management
ATS	Air Traffic Service
ATSU	Air Traffic Service Unit
BTL	Biomass-To-Liquid
BULATSA	Bulgarian Air Traffic Services Authority
CA	Competent Authority
CAA	Civil Aviation Authority
CAAFI	Aviation Alternative Fuels Initiative
CAEP	Committee On Aviation Environmental Protection
CAP	Civil Aviation Publication
CARF	Charges For Airports And Route Air Navigation Facilities
CBAs	Cross-Border Areas
CCD	Climb, Cruise And Descent
CCM	Command And Control Measures
CCO	Continuous Climb Operations

CCS	Carbon Capture And Sequestration
CDA	Continuous Descent Approach
CDM	Clean Development Mechanism
CDM	Collaborative Decision Making
CDO	Continuous Descent Operations
CDR	Conditional Route
CEC	Carbon Emissions Calculator
CER	Certified Emissions Reduction
CFIT	Controlled Flight Into Terrain
CH_4	Methane
CJEU	Court of Justice of the European Union
CLEEN	Continuous Lower Energy, Emissions And Noise
CNS	Communications, Navigation And Surveillance
CO	Carbon Monoxide
CO2	Carbon Dioxide
COOPANS	COOPeration between Air Navigation Services
CORSIA	Carbon Offsetting and Reduction Scheme For International Aviation
COSIA	Carbon Offsetting Scheme For International Aviation
CRCO	Central Route Charges Office
CTL	Coal-To-Liquids
CV	Coefficient of Variation
DCs	Deducted Costs
DCT	Direct Routing
DEHSt	German Emissions Trading Authority
DFS	Germany - Deutsche Flugsicherung
DG CLIMA	Directorate-General Climate Action
DG MOVE	Directorate-General Mobility And Transport

DNL	Day-Night Average Sound Level
DoT	Department Of Transport
DSNA	Direction Des Services De La Navigation Aérienne
DUR	Determined Unit Rate
EANS	Estonian Air Navigation Services
EASA	European Aviation Safety Agency
EC	European Commission
ECAA	European Common Aviation Area
ECAC	European Civil Aviation Conference
ECCP	European Climate Change Programmes
EEA	European Economic Area
EEA	European Environmental Agency
EEX	European Energy Exchange
EFT	European Transport Workers Federation
EIG	Emissions Inventory Guidebook
EIT	Economies In Transition
ELFA	European Low Fares Airline Association
ENAC	Italian Civil Aviation Authority
ENAV	Ente Nazionale Di Assistenza Al Volo
EP	European Parliament
ERA	European Regions Airlines Associations
ERNIP	European Route Network Improvement Plan
ERU	Emission Reduction Unit
EU	European Union
EU ETS	European Union Emissions Trading Scheme
EUAAs	Eu Aviation Allowances
EUAs	European Union Allowances

FAA	Federal Aviation Administration (Usa)
FAB	Functional Airspace Block
FAF	Final Approach Fix
FAIR STREAM	FABEC ANSPs and AIRlines in SESAR TRials for Enhanced Arrival Management
FDP	Flight Data Processing
FEP	Flight Efficiency Plan
FIAs	FAB Improvement Areas
FIRs	Flight Information Regions
FLOSYS	Flight Optimisation System
FRAM	Free Route Airspace Maastricht
FSNCs	Full Service Network Carriers
FSTD	Flight Simulation Training Device
FUA	Flexible Use Of Airspace
GCAA	General Civil Aviation Authority
GCD	Great Circle Distance
GCI	Global Competitiveness Index
GCM	Global Climate Model
GCR	Global Competitiveness Report
GDP	Gross Domestic Product
GEF	Global Environment Facility
GFAAF	Global Framework For Aviation Alternative Fuels
GHG	Green House Gas
GMBM	Global Market Based Measures
GS	Gold Standard
GTL	Gas-To-Liquids
GWP	Global Warming Potential
HAF	Hellenic Air Force

HAF/SAR	Hellenic Air Force- Search and Rescue Service
HANSA	Hellenic Air Navigation Supervisory Authority
HANSP	Hellenic Air Navigation Service Provider
HCAA	Hellenic Civil Aviation Authority
HCAA/REGS	Hellenic Civil Aviation Authority – Regional Services
HEFA	Hydroprocessed Esters And Fatty Acids
HFC	Hydrofluorocarbons
HGCC	High Level Group On International Aviation And Climate. Change
H-MANSOD	Hellenic Military Air Navigation Services Oversight Division
HNMS	Hellenic National Meteorological Service
HRJ	Hydrogenated Renewable Jet Fuel
IAA	Irish Aviation Authority
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICB	Industry Consultation Body
ICCT	International Council On Clean Transportation
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IPCC	Intergovernmental Panel On Climate Change
ISIS	Implementation Of Single European Sky In South East Europe
ITAKA	Initiative Towards Sustainable Kerosene For Aviation
ITC	Institutional Transaction Costs
JI	Joint Implementation
KEA	Key Performance Environment Indicator Based on Actual Trajectory
KEP	Key Performance Environment Indicator Based on Last Filed Flight Plan
KPA	Key Performance Area
KPI	Key Performance Indicator

KRIs	Key Result Indicators
LAQ	Local Air Quality
LCA	Life-Cycle Assessment
LCC	Low Cost Carrier
LGS	Latvijas Gaisa Satiksme
LR	Liability Rules
LSSIP	Local Single Sky Implementation
LTO	Landing-Take Off
LULUCF	Land Use, Land Use Change And Forestry
LVC	The Netherlands Air Traffic Committee
LVNL	Air Traffic Control The Netherlands
MAA	Military Aviation Authority
MATS	Malta Air Traffic Services
MB	Marginal Benefit
MBM	Market Based Measures
MEC	Marginal External Cost
MEP	Member Of European Parliament
MET	Meteorological Services For Air Navigation
MFUR	Most Frequent Used Route
MITaN	Ministry of Infrastructure, Transport & Networks
MND	Ministry of National Defence
MoD	Ministry of Defence
MoI&M	Ministry of Infrastructure and the Environment
MoU	Memorandum Of Understanding
MP	Monitoring Program
MPC	Marginal Private Cost
MRV	Monitoring, Reporting And Verification

MS	Member State
MSC	Marginal Social Cost
MSG	Multi-Stakeholder Governance
MSR	Market Stability Reserve
MUAC	Maastricht Upper Area Control Centre
N_2O	Nitrous Oxyde
NADP	Noise Abatement Department Procedure
NCP	Nsa Coordination Platform
NGOs	Non-Governmental Organisations
NM	Network Manager
NMVOC	Non-Methane Volatile Organic Compounds
NOTAM	Notice To Airmen
NOx	Nitrogen Oxides
NSA	Navigation Service Authorities
O3	Ozone
OAG	Official Airline Guide
OCC	Operational Control Centres
OECD	Organisation For Economic Co-Operation And Development
OLDI	On-Line Data Interchange
Pax	Passengers
PCA	Prior Coordination Airspace
PCI	Gross Domestic Product (GDP) Per Capita Income
PEL	Planned Entry Level
PFC	Perfluorinated Hydrocarbons
PI	Performance Indicators
PKPs	Passenger Kilometres Performed
PM	Particulate Matter

PPP	Private Public Partnership
PR	Property Rights
PRB	Performance Review Body
PRC	Performance Review Commission
P-RNAV	Precision-Area Navigation
PRU	Performance Review Unit
PSO	Public Service Obligation
QAS	Quality Assurance Standard For *Carbon Offsetting*
R&D	Research And Development
RAD	Route Availability Document
RCA	Reduced Coordination Airspace
RED	Renewable Energy Directive
REDD+	Reduced Emissions From Deforestation And Degradation
RF	Radiative Forcing
RIMS	Ranging And Integrity Monitoring Station (GNSS-1/EGNOS)
RIs	Result Indicators
RNLAF	Royal Netherlands Air Force
ROMATSA	Romanian Air Traffic Services Administration
RP	Reference Period
RPKs	Revenue Passenger Kilometres
RSD	Relative Standard Deviation
RSO	Route Per State Overflown
RVSM	Reduced Vertical Separation Minimum
RVT	Remote and Virtual Tower
SA	Stakeholder Analysis
SAAM	System For Traffic Assignment And Analysis At A Macroscopic Level
SAFA	Safety Assessment Of Foreign Aircraft

SAFUG	Sustainable Aviation Fuel Users Group
SAM	Supply Adjustment Mechanism
SAR	Search And Rescue
SARPs	Standards And Recommended Practices
SD	Standard Deviation
SEA	Strategic Environmental Assessment
SES	Single European Sky
SESAR	Single European Sky ATM Research
SF_6	Sulfur Hexafluoride
SFC	Specific Fuel Consumption
SID	Standard Instrumental Departure
SLA	State Level Agreement
SO2	Sulphur Dioxide
SOX	Oxides Of Sulphur
SRA	Safety Risk Assessment
SSC	Single Sky Committee
SSP	State Safety Programme
STAR	Standard Terminal Arrival Route
SUA	Special Use Airspace
SWAFEA	Sustainable Ways for Alternative Fuels and Energy for Aviation
TC	Transaction Cost
TCE	Transaction Costs Economic
TEC	Total Economic Cost
TED	Total Environmental Degradation
TMA	Terminal Manoeuvring Area
TOD	Top-Of-Descent
TRAs	Temporary Reserved Areas

TSU	Terminal Service Unit
TWR	Terminal Control
UHC	Unburned Hydrocarbons
UIR	Upper Information Region
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission For Europe
UNFCCC	United Nations Framework Convention On Climate Change
USA	United States Of America
USOAP	Universal Safety Oversight Audit Programme
VCS	Verified Carbon Standard
VCS	Voluntary Carbon Standard
VER	Voluntary Emission Reductions
VOC	Volatile Organic Compounds
WCI	Western Climate Initiative
WEF	World Economic Forum
ΔCV	absolute difference of the Coefficient of Variation

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1 Introduction

The air traffic control is the mainstay of civil aviation. Aviation is a cross-border activity, yet the air traffic management is organised in a fragmented way. This fragmentation impacts safety, limits capacity, increases costs and slows down the decision-making process. The airspace should therefore be organised according to the requirements of "Functional Airspace Blocks" regardless of national borders. 'Functional Airspace Block' means an airspace block based on operational requirements, reflecting the need for integrated management of the airspace regardless the existing boundaries of Flight Information Regions (FIR's) (EC 549/2004).

The fragmentation of European Union airspace into 27 national systems of air traffic gave rise to a number of problems (EC, 2015). For this reason, the creation of a ‘Single European Sky’ (SES) was promoted. The aim of this reform is to meet the needs for improved capacity and safety. The main objectives are to restructure the European airspace traffic, to create additional capacity and to increase the overall efficiency of the Air Traffic Management (ATM) system. Its four pillars are: a) to achieve better performance and more efficient response to environmental challenges, b) to increase the levels of flight safety, c) to utilise new technology, and d) to increase airport capacity, efficiency and safety.

Functional Airspace Blocks (FABs) are directly related to the Single European Sky and environmental performance. The establishment of Functional Airspace Blocks was aimed at the efficient use of airspace, improving system efficiency of air traffic management, reducing costs, which would be achieved by saving fuel, reducing distances and improving service quality for passengers. The process of creating and operating FAB's is extremely difficult and time-consuming, as it requires the consent of the countries concerned, as well as civil and military cooperation.

An equally important issue is the air pollutant emissions. In 2009, the European Union decided to include aviation in the EU Emissions Trading Scheme (EU ETS). By 2012, the airline industry set out a CO_2 emission ceiling, initially set at 97% of 2005 emission levels by 2013 and then at 95%. All carriers flying to and from the European Economic Area (EEA) must pay an amount for each excess tonne of CO_2 emitted on a flight to and from (and within) the EEA. Airspace users are required to monitor the annual emissions for each flight. These data should then be aggregated to an annual emissions report to be audited by an independent accredited verifier. The operator should provide the corresponding number of allowances. If actual emissions are lower than the operator's rights/allowances, they can sell their excess allowances on the market or "bank" them to cover future emissions. If they predict that their emissions will exceed their rights, they can take action to reduce their emissions and/or buy additional rights/allowances. Airlines can also buy emission credits from clean energy projects carried out in third countries under the mechanisms of the Kyoto Protocol. The existence of a market in which these rights can be traded allows businesses to manage their emissions in a cost-effective way.

1.1 Rationale of the research

Air transportation traffic from 1945 to 1973, which is the first oil crisis, grew at double-digit rates according to IATA.org (2016a). Due to technological improvements and technical innovation, mainly the introduction of turbo-propeller aircraft in the early 1950s, transatlantic jets in 1958, wide-bodied aircraft and high by-pass engines from 1970 onwards, the air traffic grew even further. A number of factors, including higher speeds, greater size, and better unit cost control offered more affordable air tickets, in combination with an increase in passengers' purchase power, led to explosion in demand for air travel.

According to Oxford Economics (2011), air transport generates three distinct types of economic benefit. Aviation creates jobs and tax revenues, contributes to Gross Domestic Product (GDP). Air transportation is vital for remote regions. The increased connectivity due to aviation represents an important infrastructure asset that enhances direct investments, economic agglomeration and other spill over impacts on the production capacity of an economy. For all those reasons, air transportation plays an extremely important social role. It connects people. It connects core regions with periphery regions. In 1948, there were 120 flights across the Atlantic per week, whereas nowadays there are more than 1,200 flights per day in the North Atlantic airspace alone (ATAG, 2014).

Having said that, this traffic increase is not considered sustainable. The rapid air transport growth has created a series of environmental problems from noise pollution to climate change. The negative externalities caused by aviation are in parallel in proportion to the traffic growth. Aviation produces around 2% of the world's man-made emissions of carbon dioxide (CO_2), according to the United Nations Intergovernmental Panel on Climate Change (IPCC). The IPCC (1999) forecasts that the aviation's share of global man-made CO_2 emissions will increase to around 3% in 2050. According to the Aviation Environment Federation (2016), aviation is one of the most energy- and carbon-intensive forms of transport, whether measured per passenger, per km or per hour of travelling.

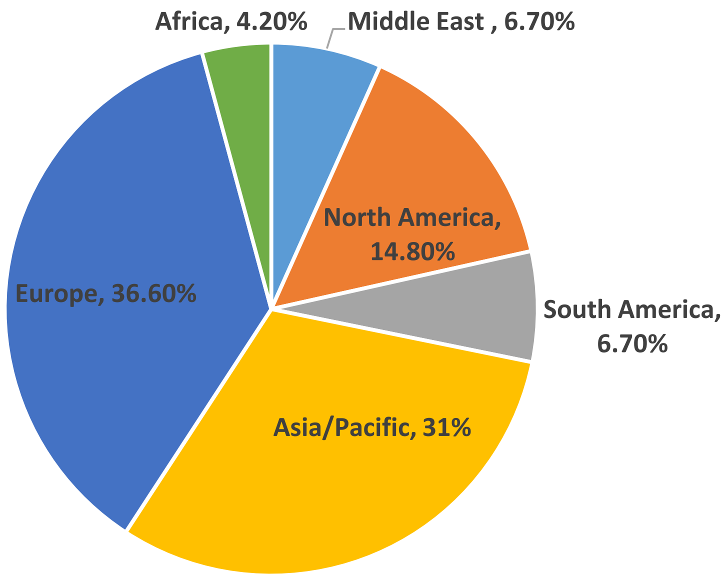

Figure 1: Estimated regional share of CO_2 from international aviation in 2020 without a regulatory intervention (Based on ICAO Doc 10018, 2013)

Climate change is affecting aviation operations in many ways according to a European Aviation Environmental Report of 2016 (EASA, EEA and EUROCONTROL, 2016). Due to climate change, there will be more frequent heavy rain in Northern Europe, reducing the number of landings and take-offs at airports. The increase in the air temperatures affects the performance of the aircraft as well as the airports' surface areas. Storms can become larger, more frequent and powerful leading to more flight delays or cancellations. Changes in snow cover can, on the one hand, reduce the snow-related delays, but on the other hand, there might be more severe snow-incurred incidents in areas previously unaccustomed to such weather phenomena. The long-term rise of the sea level will affect coastal airports. Finally, climate change leads to constant changes in the wind direction. This increases runways crosswinds reducing airport capacity and increasing delays in flight movements.

The second pillar of the lack of sustainable development is that the growth in traffic is not paired with the necessary infrastructure development. The traffic is putting pressure to the airports and to the Air Navigation Service Providers (ANSPs). The number of flights has increased by 80% between 1990 and 2014, and is forecasted to grow by a further 45% between 2014 and 2035 (EASA, EEA and EUROCONTROL, 2016). The number of the airports though is not increasing at the same pace. In addition, the airspace size cannot be increased.

Passenger arrivals constitute evidence of the increase in traffic over the last decades. The number of airports, the available aircraft and the number of airlines are not always considered representative indicators of the traffic growth. The number of USA airports in 1980 was 15,161. There were 4,814 public use airports and 10,347 private use airports. In 2014, there were 19,299 airports, out of which 5,145 were for public use and 13,863 were private use airports, according to the Bureau of Transport Statistics of the Department of Transportation (2016). The available airplanes for service (domestic and international) in 1960 were 2,135 operated by 55 carriers and, in 2006, there were 6,758 available airplanes operated by 66 carriers. In 1960, there were 2,566 thousands of passenger arrivals and in 2006 the same figure reached 62,951 thousands of passenger arrivals in USA airports (DoT, 2016).

The USA case proves that the rate of growth in passenger traffic is not the same with the rate of growth in the number of airports and airlines. The number of runways has increased and qualitative improvements have been made, but this does not eliminate the congestion in some airports. Nowadays, airplanes offer more Available Seats Miles (ASM), since there are more wide-bodied aircraft available or two-deck airplanes, such as Airbus A380 that offers around 550 seats. Due to competition, airlines experienced consolidation through mergers and acquisitions. On the other hand, expanding or developing an airport is considered a highly expensive investment, thus emphasis seems to be given to optimal utilisation of existing airports.

This is the problem that the aviation is facing nowadays: growth is not sustainable. The question that arises is whether there is any solution to this. The solution is two-fold, supply management policies and demand management policies. The supply chain management focuses on time-efficient movement of resources and on the integration of the various functions and pressures. Expansion in structural elements like buildings requires large capital investments that are difficult to reverse (Bozarth, 2016). Building new airports might be expensive but sometimes it is necessary. In the case of airspace though, expansion is not an option. The only solution in this case is to optimise the use of the airspace.

From the demand management point of view, sustainable growth can be achieved by revenue management or by taxation. In terms of revenue management, congestion pricing or peak pricing can be a solution. Congestion pricing can be applied as charging more for longer and complex routes. In terms of peak pricing, this can be applied as charging more for routes operated during peak hours. Another alternative can be taxation on the fuel consumption or economic incentives for better environmental performance, such as Market Based Measures (MBM). All those demand management strategies aim to improve the environmental performance of aviation.

Performance is a complex concept that describes the capability of generating results. Figure 2 depicts a causal model that links the outcome (often reduced to output and results), the processes and the foundations. This model is portrayed as a tree to illustrate how an organization goes through the process of performancing. The analogy to a tree helps to capture process complexity and characteristics of growth and change.

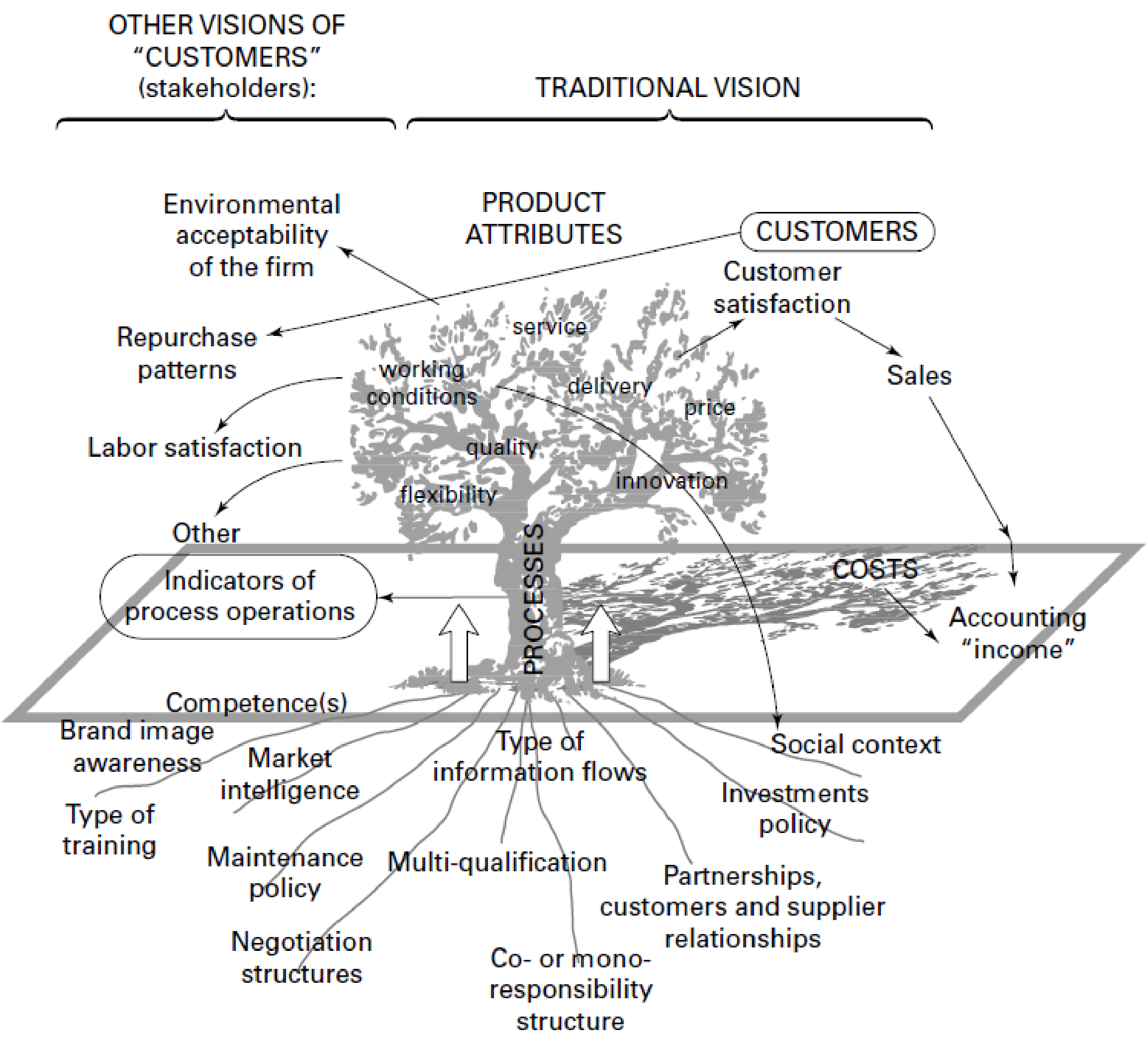

Figure 2: The performance tree (Source: Adapted from Lebas, l995 (Neely, 2004: 69)

Performance can be expressed as a set of variables or indicators that are complementary, or occasionally contradictory. Performance measures can be classified as follows (Parmenter, 2015):

1. Performance Indicators (PIs) express what needs to be achieved.
2. Key Performance Indicators (KPIs) express what needs to be achieved to drastically improve performance.
3. Result Indicators (RIs) express what has already been achieved in general.
4. Key Result Indicators (KRIs) express what has been achieved according to a certain perspective or critical success factor.

Another approach of describing performance indicators is given by Samsonowa (2012). In general, Performance Indicator (PI) can be described as an auxiliary metric that partially reflects the performance of an organizational unit. Regulation 390/2013 considers performance indicators as indicators used for the purpose of performance monitoring, benchmarking and reviewing of performance schemes for air navigation services and network functions.

Both supply management policies and demand management policies intent to address sustainable development. They seek to achieve the same target through different means. An important element is the possible cancelling-out and/or overlapping effects, that one scheme can cause to the other. The aim should be to develop synergies between the two policies and have a systemic approach to environmental problems.

Single European Sky (SES) focuses on the provision of Air Navigation Services (ANS) related to the supply management. ANS include the following services: air traffic management (ATM), communications, navigation and surveillance (CNS), meteorological services for air navigation (MET), search and rescue (SAR) and aeronautical information services/aeronautical information management (AIS/AIM), as stated in ICAO Document 9161 (2013). Air Navigation Service Providers are offering ANS to airlines during all phases of operations, i.e. approach, aerodrome and en route. The European Commission implemented SES to regulate ANS and improve the efficiency of ANSPs towards a more sustainable growth. One of the Key Performance Areas (KPAs) SES is focusing on is the Environment. Through the creation of Functional Airspace Blocks (FABs), the SES aims to improve the airspace architecture and optimise its use by airspace users.

On the other hand, the inclusion of aviation in the European Union Emissions Trading Scheme (EU ETS) is related to the demand management. EU ETS is a Market Based Measure for handling emissions. The EU ETS is based on the 'cap and trade' principle. A 'cap', or limit, is set on the total amount of certain greenhouse gases that can be emitted by the airlines operating between aerodromes in the European Economic Area (EEA). The cap is reduced over time so that total emissions decrease. Within the cap, airspace users receive or buy emission allowances that they can trade with one another as needed. They can also buy or sell limited amounts of international credits from emission-saving projects around the world. The limit on the total number of allowances available ensures that they have a value. As a result, airspace users in the European airspace are regulated through a demand management policy. The regulator in EU ETS is the European Commission and the Competent Authorities.

Both SES and EU ETS aim to tackle the negative externalities of aviation. The European Commission (EC) in collaboration with the Member States regulates both regulatory schemes. However, the problem that arises is that, although both schemes are centralised to the EC, they are handled by different departments/directorates. The Commission is divided into several departments and services. The departments are known as Directorate-Generals (DGs). SES is regulated by Directorate-General Mobility and Transport (DG MOVE) and EU ETS is regulated by Directorate-General Climate Action (DG CLIMA).

The research gap that can be detected in the schemes concerns the potential existence of any cancelling-out and/or overlapping effects in the supply management, that is the SES, and demand management, that is the EU ETS policies. Moreover, the rationale of the present thesis is to research whether there is any governance failure in the full implementation and efficiency of the schemes following a holistic view, by simultaneously examining demand and supply management.

1.2 Research Aim and Research Questions

This study aims to analyse the aviation governance in terms of the environmental regulation of aircraft operators and Air Transport Management (ATM) and determine the effectiveness of the Single European Sky and European Union Emissions Trading Scheme in the area of environment. Finally, this research seeks to uncover any implementation issues for the Single European Sky and EU Emissions Trading Scheme reforms and provide suitable recommendations for policy makers.

In order to achieve this aim the study will seek to provide answers to the following research questions:

1. Are aviation operations sustainable and what are the factors leading to sustainable growth?
2. How does the market environment and structure, in which the Single European Sky (SES) and the European Union Emissions Trading Scheme (EU ETS) are implemented, affect the efficiency of the schemes?
3. Can the inclusion of aviation in the European Union emissions Trading Scheme and/or Single European Sky lead to carbon-neutral growth?
4. Can the effective implementation of SES render the EU ETS redundant and are the environmental targets overlapping?
5. What do the research findings reveal about any issues the SES and the EU ETS reforms are facing and how can these findings be used to improve the aviation environmental performance and achieve a more sustainable growth?

To address the above research questions, it was necessary to examine the literature review, to better understand the nature of the problem as well as the nature of the market. Emphasis has been given to the theoretical overview and critical analysis of carbon trading and airspace management and harmonisation (charges, operating benefits, conditions for success, practical obstacles and addressing their legislative-regulatory framework, economic and technical issues, etc.). In order to get a better insight into the management of the scheme, the researcher held a post at EUROCONTROL in Brussels for 18 months.

EUROCONTROL is the Network Manager of SES and is responsible for Monitoring and Reporting of EU ETS (aviation area). Additionally, experts from different countries were interviewed and asked about their opinion on the efficiency of the schemes. This process is described in detail in the Methodology Chapter.

1.3 Research Context

The first step for this study was to set the boundaries within which it would be carried out by identifying the stakeholders involved in the reform of the European sky and the regulation of the negative externalities. A stakeholder is defined as any entity with a declared or conceivable interest or stake in a policy matter. Moreover, stakeholders are those who are affected by the outcome or those who can affect the outcome of a proposed development intervention (World Bank, n.d.). The range of stakeholders relevant to consider for analysis varies according to the complexity of the area targeted. Stakeholders can be of any form, size and capacity. They can be individuals, organisations or unorganised groups. In most cases, stakeholders fall into one or more of the following categories: international actors (e.g. EUROCONTROL), national or political actors (e.g. legislators, governors), public sector agencies (e.g. EASA), interest groups (e.g. trade unions, airline associations), commercial/private for-profit and non-profit organizations (NGOs, foundations), civil society members, and users/consumers.

Moreover, aviation plays a crucial social role for a country or region. Aviation offers connectivity to states with other states or periphery/semi-periphery regions to core regions. After/Following the airlines' liberalisation, the air transportation became widely available due to lower ticket/fare prices. The passenger is one of the main stakeholders in aviation and constitutes a central point of consideration in the regulations. The aviation is quite a complex industry due to its multidimensional role. Aviation can act as a mechanism for a country's defence, but at the same time, airplanes are used for bombing attacks by the state itself. The military dimension of aviation is different from one country to the other and it depends by the geopolitical position of a state.

The current environment is highly deregulated and this has led to a very competitive environment for the airlines. The role and value of airports is currently growing, as they contribute to agglomeration and economic development of the destination and the surrounding area. The Air Navigation Service Providers are the ones offering the navigation services and one of the main players that will be discussed in this PhD thesis.

Furthermore, the regulators are one of the most important players in this ‘game’. The regulators of aviation are the European Parliament and the European Council, the European Commission and its supporting agencies. At national level, the regulators are the Civil Aviation Authorities, the Ministries of Transport and the National Supervisory Authorities. The employees in the aviation industry through the trade unions and the passengers through their respective passenger associations also exercise influence over the Parliament and the national authorities for passing regulations.

The **International Civil Aviation Organisation (ICAO)** is a specialised agency of the United Nations (UN). It was created after the Convention on International Civil Aviation (the Chicago Convention) of 1944 and it was ratified in 1947. ICAO together with its Member States and a number of global aviation organisations develop international Standards and Recommended Practices (SARPs).

The **European Parliament** is the EU's law-making body. EU voters directly elect the parliament members every 5 years. The Parliament has three main roles: legislative, supervisory and budgetary. The Parliament passes EU laws, together with the European Council, based on European Commission proposals. The number of Members of the European Parliament (MEPs) for each country is approximately proportionate to its population, but no country can have fewer than 6 or more than 96 MEPs and the total number cannot exceed 751 (750 plus the President). Moreover, MEPs are grouped based on political affiliation, rather than nationality.

The **European Commission (EC)** was established in 1951. It is the executive body of the European Union (EU), the only one that can propose legislation, and it is also responsible for implementing decisions and upholding the EU treaties. The EC operates as a cabinet government with 28 members (also called Commissioners). The EC is divided into 33 departments and services. The departments are known as Directorate-Generals (DGs). The DG that deals directly with Aviation is Mobility and Transport (DG MOVE). The other DGs are also related with the aviation sometimes, for instance, DG CLIMA is responsible for the Emissions Trading Scheme.

The EC was set up from the beginning to act as an independent supranational authority separate from governments; hence, it should act independently and remain neutral to external influences. It should be noted though that the Commissioners are proposed by the Member States' governments. The EC proposes the legislation, the Council and Parliament approve/pass the legislation and the EC is responsible to ensure, with the help of Member States and EC Agencies (like EASA), that it is implemented.

The **Civil Aviation Authorities (CAAs)** is a generic term used in many countries, notably the UK, and refers to national regulatory bodies responsible for aviation. The CAA implements the ICAO SARPs in national legislation and are responsible for regulatory oversight. On the other hand, the **National Supervisory Authorities (NSAs)** were established by request of the EC. NSAs ensure the supervision of the regulatory framework. Their main responsibilities include certifying and overseeing Air Navigation Service Providers as well as preparing/drafting the national performance plans of the Member States concerned (Reg. No 550/2004). In some states, the NSA is incorporated within the CAA, whereas in some others it is a separate agency. The NSAs should be independent from the ANSPs, in order to be allowed to have an effective oversight. Only in 4 out of 28 cases, a functional separation has been achieved, meaning that both NSA and the ANSP are part of the same organisation, but are internally separated to ensure independence of the NSA (SkyBrary, 2014). In order for NSAs to convene and discuss issues pertinent to the SES, the NSA Coordination Platform (NCP) was established at European level in 2009.

Airlines and airports rely on the **Air Navigation Service Providers (ANSPs)** for the management of air traffic. Hence, Air Navigation Services (ANS) provision is considered as a core element for air transportation. Air Navigation Services include five broad categories of services provided to air traffic during all phases of operation (area control, approach control and aerodrome control). These services are the following: Air Traffic Management (ATM), Communication services, Navigation services and Surveillance services (CNS), Meteorological services for air navigation (MET), Aeronautical Information Services (AIS) and Search and Rescue (SAR) (ICAO Doc 9161, 2013).

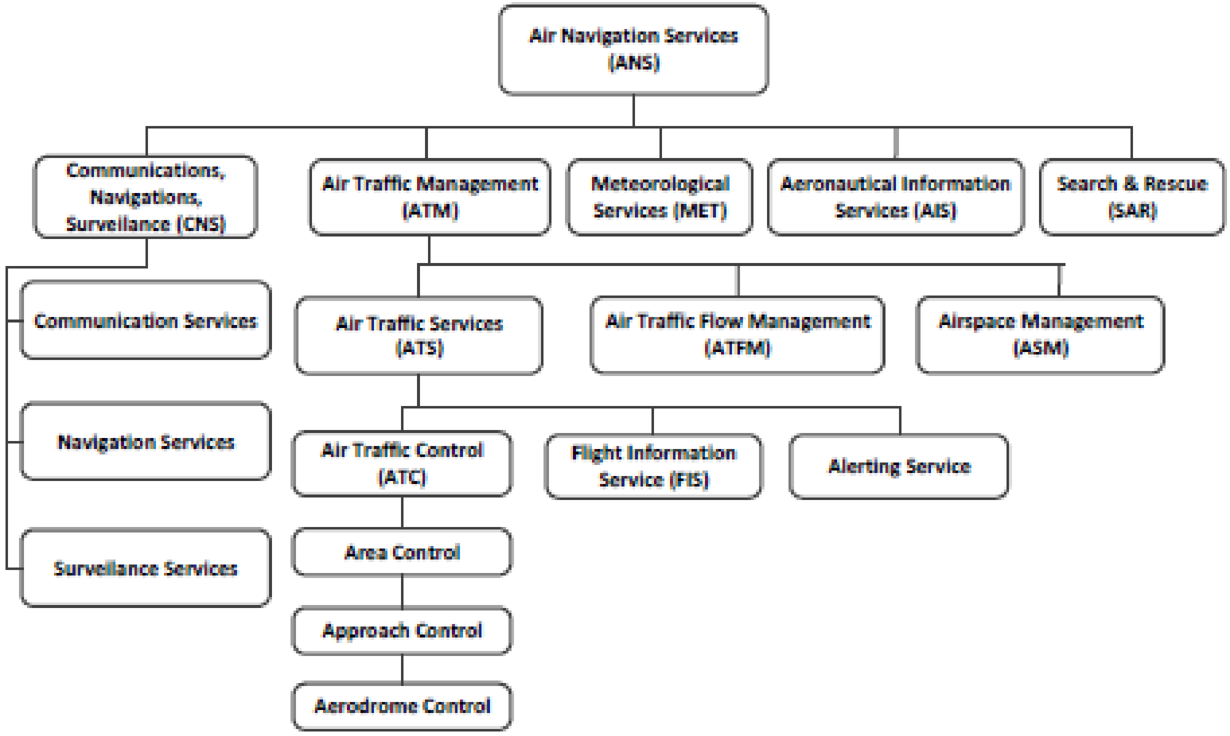

Figure 3: Air Navigation Services categories

Aeronautical Information Services (AIS) provide information on the availability of air navigation services and their associated procedures necessary for the safety, regularity and efficiency of air navigation (i.e. AIP, AIC, NOTAM, etc.). Communications, Navigation and Surveillance (CNS) includes communication facilities, navigation services and surveillance systems. Communication facilities have two main categories: aeronautical fixed service and aeronautical mobile service.

In Europe, there are 37 ANSPs. Most of them are government-owned. NATS is a Private Public Partnership (PPP). Nevertheless, according to Article 28 of the Chicago Convention, the State is ultimately responsible for the provision and operation of air navigation facilities and services

The European Organisation for the Safety of Air Navigation, commonly known as **EUROCONTROL**, is an international organisation working to achieve safe and seamless air traffic management across Europe. EUROCONTROL is the Network Manager for

Single European Sky and is responsible for the Monitoring, Reporting and Verification (MRV) of EU ETS.

The Performance Review Commission (PRC) was established in 1998 by the Permanent Commission of EUROCONTROL. It advises EUROCONTROL's Governing Bodies and supports the effective management of European ANS through target-setting and the establishment of a transparent and independent performance review system. This system addresses all aspects of ANS, including policy and planning, safety management at and around airports and in the airspace, as well as financial and economic aspects of services rendered.

The PRC is responsible for enforcing implementation of the performance and target-setting system throughout/in all EUROCONTROL's Member States. The PRC reports directly to the EUROCONTROL Permanent Commission through the Provisional Council on its activities. These activities include providing advice on ANS performance issues, including performance targets. The PRC deliverables include:

- Annual performance review reports (PRR);
- ATM Cost-effectiveness benchmarking reports (ACE);
- Special reports on issues such as comparisons of ATM-related operational performance in the United States and Europe.

The Performance Review Body (PRB) is composed of the 12 Members of the PRC, plus the PRB Chairman, appointed by the European Commission. The PRB reports directly to the European Commission. The purpose of the PRB is to assist the European Commission in the implementation of the performance scheme and to assist the National Supervisory Authorities (NSAs) on request. The PRB's complete list of tasks is described in Article 3 of

Regulation No 691/2010 and Regulation No 390/2013. The PRB tasks include but are not limited to the following:

- collection, examination, validation and dissemination of performance-related data;
- definition of new or adaptation of key performance areas and the related key performance indicators;
- setting up or revision of EU-wide performance targets;
- consistency assessment of adopted performance plans, including performance targets, with the EU-wide targets;
- assessment of the revised performance targets or the corrective measures taken by the EU Member States;
- monitoring, benchmarking and reviewing of the performance of air navigation services, at national or FAB and European Union level;
- monitoring, benchmarking and reviewing of the performance of the network functions;
- assessment of the achievement of the performance targets;
- assistance to NSAs with regards to national or functional airspace block performance issues.

The **Performance Review Unit (PRU)** is the supporting Unit of the PRC and the PRB. In terms of administration, it is part of the EUROCONTROL Agency's Single Pan European Sky Directorate. The PRU is responsible for monitoring and reviewing the performance of the European ANS System. Based on its analysis, the PRU supports the PRC and the PRB for performance improvements in the European ANS system (EUROCONTROL.int, 2016a).

1.4 Research undertaken in aviation and the environment and research gap

The PhD thesis aims to highlight and fill the literature gap in the area of the implementation process and the problems associated with the policy design of the inclusion of aviation in the European Union Emission Trading Scheme (EU ETS). ETS is well researched in the energy industry but not in aviation. The focus of this thesis is aviation and the published research around aviation limits on the effects of ETS for airlines. No in-depth research has been previously undertaken regarding the implementation issues and no related suggestions for policy makers have been made in the past.

Moreover, in the area of Single European Sky, the published research is even more limited. Very few papers are published and those focus on general aspects of SES and not on the environmental aspect. Table 1 lists the published papers on the area of this research, i.e. aviation and EU ETS and SES and the environment. No published work is found on the relation of SES and EU ETS.

Table 1: Research about Aviation and the environment

Author(s) and paper	**Focus**	**Methodology**
	Aviation and EU ETS	
Xu, J., Qiu, R. & Lv, C., 2016. Carbon emission allowance allocation with cap and trade mechanism in air passenger transport. *Journal of Cleaner Production*, 131, pp.308–320.	Government allocation decisions and airlines aircraft selection decisions[1]	Theoretical economic model

[1] The statement that the developed model has the ability to describe the interactions of multiple stakeholders and balance their conflicts is not realistic since it addresses only the government authorities and the airlines with focus on aircraft selection.

Author(s) and paper	Focus	Methodology
Zanin, M. et al., 2016. Towards a secure trading of aviation CO 2 allowance. *Journal of Air Transport Management*, 56, pp.3–11.	Secure Multi-party Computation framework for confidential information in aviation emissions auction.	Conceptual model for cloud-based computational service
Meleo, L., Nava, C.R., Pozzi, C., 2016. Aviation and the costs of the European Emission Trading Scheme: The case of Italy, *Energy Policy*, 88, pp. 138-147.	Calculation of the EU-ETS direct costs for Italian airlines and effects on airfares, revenues, and social costs	Theoretical economic model
Malavolti, E. and Podesta, M., 2015. Strategic Reactions of Airlines to the European Trading Scheme. *Transportation Research Procedia*, *8*, pp.103-113.	Economic analysis difference between passengers carried without regulation and when the regulation is put in place. Emphasis given on the selection of aircraft	Theoretical economic model
Miyoshi, C., 2014. Assessing the equity impact of the European Union Emission Trading Scheme on an African airline. *Transport Policy*, 33(C), pp.56–64.	Equity issues by measuring the impact of the EU ETS on an African airline compared to airlines in an Annex I country.	Case study and BADA and logit models
Sheu, J.-B., 2014. Airline ambidextrous competition under an emissions trading scheme – A reference-dependent behavioral perspective. *Transportation Research Part B: Methodological*, 60(C), pp.115–145.	Airline fare adjustments due to EU ETS and consumers perceptions	Hotelling model with reference dependence theory
Barbot, C. et al., 2014. Trade-offs between environmental regulation and market competition: Airlines, emission trading systems and entry deterrence. *Transport Policy*, 33(C), pp.65–72.	Effects on potential airline competition and entry deterrence	Theoretical economic model

Author(s) and paper	Focus	Methodology
Girardet, D. & Spinler, S., 2013. Does the aviation Emission Trading System influence the financial evaluation of new airplanes? An assessment of present values and purchase options. *Transportation Research Part D: Transport and Environment*, 20, pp.30–39.	Impact of the CO2 costs for short- and long-haul aircraft based on present values and on purchase options	Econometric model
Kopsch, F., 2012. Aviation and the EU Emissions Trading Scheme—Lessons learned from previous emissions trading schemes. *Energy Policy*, 49(C), pp.770–773.	Brief discussion on design issues (allocation, liability, inter-temporal trade, trade barriers, hot spots)	Case studies
Malina, R. et al., 2012. The impact of the European Union Emissions Trading Scheme on US aviation. *Journal of Air Transport Management*, 19(C), pp.36–41.	Economic impacts on US airlines due to EU ETS.	Emissions Prediction and Policy Analysis (EPPA) model (General Equilibrium Model)
Preston, H., Lee, D.S. & Hooper, P.D., 2012. The inclusion of the aviation sector within the European Union's Emissions Trading Scheme: What are the prospects for a more sustainable aviation industry? *Environmental Development*, 2, pp.48–56.	Whether the policy has the potential to significantly reduce aviation emissions and contribute to a sustainable future for the industry in terms of climate change	Calculations with the Future Aviation Scenario Tool
Vespermann, J. & Wald, A., 2011. Much Ado about Nothing?-An analysis of economic impacts and ecologic effects of the EU-emission trading scheme in the aviation industry. *Transportation Research*	Ecologic and economic impacts of EU ETS and effects on competition structures	Simulation model

Author(s) and paper	Focus	Methodology
Part A: Policy and Practice, 45(10), pp.1066–1076.		
Anger, A., 2010. Including aviation in the European emissions trading scheme: impacts on the industry, CO 2 emissions and macroeconomic activity in the EU. *Journal of Air Transport Management*, 16(2), pp.100–105.	Impacts on CO2 emissions and the macroeconomic activity in the EU	Energy–Environment–Economy Model (dynamic simulation model)
Scheelhaase, J., Grimme, W. & Schaefer, M., 2010. The inclusion of aviation into the EU emission trading scheme-Impacts on competition between European and non-European network airlines. *Transportation Research Part D: Transport and Environment*, 15(1), pp.14–25.	Impacts on competition, operating costs, ticket prices and cargo rates for European and non-European aircraft operators	Model-based empirical estimations
Scheelhaase, J.D. & Grimme, W.G., 2007. Emissions trading for international aviation: an estimation of the economic impact on selected European airlines. *Journal of Air Transport Management*, 13(5), pp.253–263.	The possibilities on how aviation could be included in existing emissions trading schemes and overview on the current political discussion[2] and the impacts on operating costs and transport demand	Simple mathematical module with 3 scenarios
Morrell, P., 2007. An evaluation of possible EU air transport emissions trading scheme allocation methods. *Energy Policy*, 35(11), pp.5562–5570.	Methods of allocation of emissions permits	Case studies

[2] *This objective wasn't addressed in the paper*

Author(s) and paper	Focus	Methodology
Forster, P.M. de F., Shine, K.P. & Stuber, N., 2006. It is premature to include non-CO 2 effects of aviation in emission trading schemes. *Atmospheric Environment*, 40(6), pp.1117–1121.	Non-CO2 effects, Radiative Forcing and global warming potential	Mathematical calculations
Single European Sky		
Nava-Gaxiola, C.A. & Barrado, C., 2016. Performance measures of the SESAR Southwest functional airspace block. *Journal of Air Transport Management*, 50, pp.21–29.	Expected benefit in saving flight distance after introducing the Free Route Airspace in Southwest FAB.	Traffic simulation
Baumgartner, M. & Finger, M., 2014. European air transport liberalization: Possible ways out of the single European sky gridlock. *Utilities policy*, 30, pp.29–40.	The process and the main actors' interests, and explains the current gridlock of the SES as a result of conflicting objectives among the main players[3]	Overview
Baumgartner, M. & Finger, M., 2014. The Single European Sky gridlock: A difficult 10 year reform process. *Utilities Policy*, 31, pp.289–301.[4]	The process and the main actors' interests, and explains the current gridlock of the SES as a result of conflicting objectives among the main	Overview

[3] The paper gives a rather confusing description of Single European Sky and references to three Key Performance Areas whereas the Regulation 691/2010 refers to four areas. The identification of the stakeholders' interests is accurate.

[4] This paper is the same as the Baumgartner, M. & Finger, M., 2014. European air transport liberalization: Possible ways out of the single European sky gridlock. *Utilities policy*, 30, pp.29–40. In terms of content. It simply has a different title and it is published twice.

Author(s) and paper	Focus	Methodology
	players[5]	
Button, K. & Neiva, R., 2013. Single European Sky and the functional airspace blocks: Will they improve economic efficiency? *Journal of Air Transport Management*, 33(C), pp.73–80.	Potential economic efficiency of functional airspace blocks	Data Envelopment Analysis
Pellegrini, P. & Rodriguez, J., 2013. Single European Sky and Single European Railway Area: A system level analysis of air and rail transportation. *Transportation Research Part A: Policy and Practice*, 57(C), pp.64–86.	Similarities and difference in operations and strategic planning of air and rail transportation	Comparison of rail and air transport based on some characteristics

1.5 PhD Thesis Layout

The PhD thesis consists of nine chapters. In this chapter, the theoretical framework on which the study is based was introduced. Moreover, the motivation of the research as well as the aim and the research questions and objectives were stated and the stakeholders were introduced. The remaining chapters are organised as follows. The main focus of chapter two is sustainable aviation. The growth of aviation is not considered sustainable, due to the negative externalities caused by aviation operations to the environment and the social welfare. The three affected areas are the climate, the levels of noise and local air quality.

[5] The paper gives a rather confusing description of Single European Sky and references to three Key Performance Areas whereas the regulation refers to four areas. The identification of the stakeholders' interests is accurate.

Chapters 3 and 4 contextualise the study in the relevant literature. The concepts of European Union Emissions Trading scheme and the Single European Sky are explained. These chapters can be seen as two extensive case studies of environmental and economic regulation of civil aviation. Chapter 5 further elaborates on the literature review and experts' consultation. This chapter states the theoretical basis underpinning some parts of the research and discussion of the findings. The key areas examined in this chapter are the Transaction Costs and the multi-stakeholder governance and management theory.

Chapter 6 provides an account of the research methodology and method used in this PhD thesis. The research philosophy, the design of the instrument, the ethical considerations and limitations of the researcher are discussed in this chapter. Chapter 7 elaborates on the findings of the Delphi method and juxtaposes the two rounds to identify whether a consensus was achieved among the stakeholders.

Chapter 8 builds upon the theoretical and practical foundation laid down in the previous chapters and focuses on the discussion of the EU ETS and SES reforms. In this chapter, the critical issues for the success of the schemes are elaborated/examined in detail, leading to Chapter 9, namely the conclusions drawn and the recommendations of this research thesis. The recommendations are separately proposed for EU ETS and SES, but a common approach is developed taking into consideration how the policies interact. Lastly, the last part of Chapter 9 presents the limitations of the PhD thesis, as well as the contribution that this thesis attempts to offer to the body of knowledge on the specific academic field. Proposals for further research projects and are also out forward.

The Appendices provide additional information for a better comprehension of the research thesis. The Appendices include the definitions of key terms, the first draft questionnaire, the SES and EU ETS questionnaire of the first and the second round, the draft performance plan of DANUBE FAB, and the permissions to use copyrighted material.

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2 Sustainable Aviation

In the introductory chapter, it was argued that the rationale for this research is the non-sustainable growth of aviation. Therefore, the first step of this study is to examine in more depth the sustainability of aviation. The chapter concludes that aviation is not sustainable since it leads to climate change and the negative externalities are not taken into account.

A simplified way of considering aircraft operators is described by Banner (2008). He argued that today the air is full of flying objects; commercial jumbo jets, helicopters, small private planes, model rockets, etc. should share a sky, which once seemed unlimited (Banner, 2008). This rapid spread is due to the reduction of the cost of air travel (Piermartini & Rousova, 2008). With each new use of the air, the law must be adapted. The airspace is divided both vertically and horizontally into different areas, with different rules governing each area (Banner, 2008).

This chapter deals with sustainable development and environmental economics. Aviation creates negative externalities, such as lowering the local air quality, creating noise pollution and causing climate change due to the emissions of Green House Gases (GHG). This chapter’s focus is the identification of the problem and its nature from an economic point of view.

2.1 Sustainable Growth of Civil Aviation

The air transport industry services are considered essential. Occasional shocks like the oil price shocks, pandemics, wars, security threats did not decrease traffic. The traffic continued to grow on average at 5% annually. Europe’s GDP grew by 1.4% in 2014 and is forecast to grow 1.8% annually through 2034 and aviation growth is expected to continue (Boeing, 2016).

According to a study prepared for EC the growth in terms of Revenue Passenger Kilometres (RPKs) was +5.2% on a worldwide basis in 2013 and 3.8 at Europe. On the other hand, the airline capacity growth, measured in Available Seat Kilometres (ASKs) was slightly slower (Mott MacDonald, 2015:7) As far as the Passenger Kilometres Performed (PKPs) is concerned, Europe (inclusive of Turkey and Russia) is expected to grow at 5.4% to 5.9% annually according to ICAO Medium Term Forecast 2014. The traffic growth across the EU28 countries was +1.6% in 2013 (Mott MacDonald, 2015).

Moreover, there is a year-on-year decrease in aviation fatal accidents. In 2013, the number of accidents decreased by 10% compared to 2012 according to ICAO Safety report 2014. An audit protocol related to Universal Safety Oversight Audit Programme (USOAP) was established acting as comprehensive checklist covering all areas of a State’s safety oversight system, i.e. aerodromes, Air Navigation Service (ANS), Accident investigation, Airworthiness, Operations, Licensing, Organisation and Legislation (ICAO, 2014a). In 2013, 26 fatal commercial accidents were reported worldwide causing 281 fatalities.

Another important aspect in aviation industry is cost. As far as the cost of infrastructure is concerned according to IATA (2013a) “Airlines and passengers are estimated to have paid at least USD92.3 billion for the use of airport and air navigation infrastructure globally in 2011, equivalent to 14.4% of the cost of transport”. Cost efficiency is quite critical for an airline to compete and survive in such a competitive market.

Economies depend on natural resources, as an essential input. Environmental and natural resource economics is the application of the principles of economics to the study of how environmental and natural resources are developed and managed. According to EC (2015) one way of using economics is to ensure that the costs and the benefits of environmental measures are well balanced. Although it is difficult to estimate costs and benefits, there is an increasing demand that this is done before environmental policy is decided on a European level. With the use of market-based instruments, environmental goals can sometimes be reached more efficiently than with traditional command and control regulations.

Environmental policy is designed to tackle market failures, by controlling pollution, regulating resource use and protecting and managing the natural environment. It aims to achieve a more efficient use of resources in the economy, maintaining the environmental assets, which people value and which support a healthy economy and society, while reducing the costs to people and businesses of environmentally damaging activities.

The environmental economics and natural resources has sailed at a parallel course with the general economic theory at least since the 18th century, and all the great classical economists have expressed, directly or indirectly, aspects concerning the management of goods and environmental services. Environmental Economics are the discipline that studies the environmental problems, in light of the analytical techniques of the economy (Field, 1994).

The environmental economics are based on the assumption that all the functions provided by the natural environment, have an economic value, which would be evident if operations were integrated into a real market (Turner, Pearce, & Bateman, 1994). Factors holding a key role in the failure of market mechanisms are the problem of ownership of the commons and the difference between value and price, ultimately leading to the existence of externalities (Tietenberg, 2010; Harris and Roach, 2016).

2.2 Negative external economies

Air transportation is contributing to economic prosperity, facilitating growth particularly in developing countries. Air transportation facilitates world trade by transporting goods of high value. The main benefit that aviation offers is the connectivity that encourages investments and improves productivity. Aviation has direct, indirect, induced and tourism catalytic economic impacts. Aviation according to ATAG (2014) is a major employer offering 58.1 million jobs globally (8.7 million direct jobs, 9.8 million indirect jobs and 35 million aviation-enabled tourism jobs).

Apart from the positive economic impact of aviation, aviation contributes to society. Aviation facilitates the transportation of people and goods. It increased cross-border travel which contributed to a closer relationship between states. The improved social and economic networks, encourages social and economic integration. Furthermore, it improves the living standards, alleviates poverty and increases revenues from taxes. Finally, air transportation is necessary for places with poor road or rail connections and offers connectivity in case of an emergency, like natural disasters, health epidemics or wars.

If markets could solve all their problems, there would not be the need for state regulation. Environmental externalities are the proof that markets fail (Rao, 2003). External economies occur when the behaviour of a person or a company causes profit or loss to a third party (person or company), without having a mechanism that will internalize these effects through prices. A typical example is the pollution of the environment.

There are two types of externalities, public e.g. air pollution, water which affects the welfare of many people and private e.g. a person throwing garbage in the garden of the neighbour (this move affects the welfare neighbour and nobody else). The cases where the activity of an individual or business to impose other costs referred to as negative externalities or external costs.

According to Rao (2003) there are different kinds of externalities. For instance, there is Stock externality, i.e. the externality that arises from changes or accumulations of the inventory or stock of a specific commodity or other physical entity; a similar concept holds for a ‘flow’ externality. For example, atmospheric concentrations of greenhouse gases are a stock pollutant with negative externalities. Urban smog is a stock externality as well as a flow externality. Strategic externality is the impact of strategic behaviour on other components of a system in relation to specific activities undertaken by direct participants; this occurs especially in resource-to-resource consumption with limited liability or cost sharing.

One of the possible ways to address externalities in aviation is by imposing restrictions on travelling (Forsyth, 2008). The implementation is very difficult and the society loses the surplus from the sale of this service. On the other hand, the airlines can continue the volatile work, but to use more expensive inputs. For example, they use cleaner types of fuel that will emit less GHG. The use of more expensive input is also a cost to society.

In the absence of corrective action, those who pollute will continue doing so up to the point where the marginal private benefit from production equals marginal private cost (Morgan et al, 2009). The company that pollutes incurs no additional cost as a result of its negative production externalities if there is no external regulation. In this case, negative production externalities are not due to the failure, but due to the absence of the market, since there is no market for clean air or property rights (Morgan et al, 2009).

All production activities generate pollutants, and therefore the requirement should not be to have zero pollution if that means a complete lack of production, but to have the "right amount of pollution"(Morgan et al, 2009).To address these externalities some actions must be taken. There must be private and/or state/government reaction. Private reactions associate with mergers, social contracts, negotiations, etc. (Morgan et al, 2009). State/government reactions involve control policies, redress taxes, market creation, etc. (Morgan et al, 2009).

One way the government can intervene in a market with externalities is through a system of "standards and charges". Whereby the government decides a fixed size of damage caused by the externality and then charges to force the responsible ones to reduce the externality to a desired level (Scotter, 2008). Some countries have imposed taxes such as the Air Passenger Duty (APD) in the UK (IATA, 2006).

Maximization of social welfare does not imply the elimination of exogenous influence. That would mean the end of air transport, which is not considered socially desirable. To address the inefficiencies created by external influences various policy measures have been invented, which fall into two categories, management (CCM, Command and Control Measures) and measures work through the market mechanism (MBM, Market Based Measures/Instruments).

Many countries follow a policy control to reduce external economies (e.g. Environmental Problems) (Morgan et al, 2009). Under the Command and Control regulation area, the polluter is obliged to reduce its emissions in order to avoid incurring legal penalties (Morgan et al, 2009).

Taxes are one of the best-known MBM. Pigouvian tax is a tax levied on each unit of production that pollutes and is exactly equal to the marginal damage that creates the optimum level of production (Morgan et al, 2009). The theory assumes that the state is able to know the marginal rate of substitution of emissions and tax level, i.e. how much the negative externality costs, something that is not feasible in practice. The purpose of Pigouvian taxation is to act using the tax system to impose a cost on economic externality equal to the additional cost of a given effect.

Taxes levied on passengers depending on the flight length and the class travel could only reduce emissions through their effect on air travel demand, and they would give rise to some leakage effects (Forsyth, 2008). Adopting a Pigouvian tax on aviation, carriers would be forced to take into account the cost of the external economies they create; hence, carriers will be forced to produce in the optimum level of production.

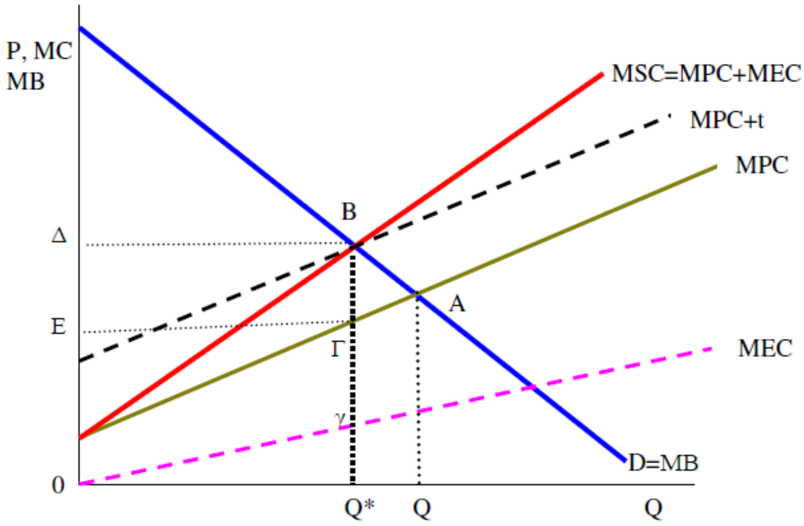

Figure 4: Implementing tax to correct the impact of negative externalities

The equilibrium of the market if it runs smoothly is at point A, which is not optimal in Pareto. It is assumed that marginal private benefit equals to marginal social benefit, i.e. there is no demand side externalities and all externalities are related to production. Point B is an optimal point and the difference between social and private costs is BΓ. When imposing a tax t per unit in good/service that pollute and which is equal to BΓ, then the private cost curve is shifted to the position of the curve (Marginal Social Cost) MPC +1, which passes through the optimal point B.

However, there are several practical problems in the enforcement of this tax. First, someone must define what activities produce pollution and how much. In addition, which polluting units actually cause damage and what is the value of the damage being caused (Morgan et al, 2009). The Pigouvian taxes aim at bringing marginal private costs, as these influence choice, into line with social costs, as these are objectively measured. Only with objective measurability can the proper corrective devices be introduced.

The existence of externalities like government intervention documentation was challenged by Coase theorem according to which if there are no transaction costs (TC) and negotiations, individuals affected by an externality will agree themselves in a distribution that is Pareto-optimal and independent of property rights. The presence of deficiency enables the parties involved to gain from working together to eliminate it (Morgan et al, 2009). The rationale is that if the benefits to someone from an activity that has externalities exceed the costs incurred by the other, then the first can compensate (bribe) the second and improve the position of both. However, there are some practical problems with the theorem of Coase. Initially there is a cost of trading and the logic that each person has an incentive to let others bear the cost, when he enjoys the benefits (Morgan et al, 2009). Finally, there is difficulty in determining the source of loss and asymmetric information (Morgan et al, 2009). The assumption that TCs are negligible or equal to zero leads to a frictionless economic system according to Rao (2003). Coase aimed to examine the implications of such a system on efficient functioning and to throw light on the sub-optimality of certain stipulations in a non-zero TC world (Rao, 2003).

The problem of externalities is not that one part is harming another. The problem is how to use a scarce resource. In the case of air pollution, producers wish to use the air to emit, while residents wish to breathe clean air (North, 1992).

Finally, a very important way of state regulation of external economies is creating market. The government increases economic efficiency by selling emission permit to producers (Morgan et al, 2009). Thus, a market for clean air is created. The price paid for the license to emit is called emission allowance (Morgan et al, 2009). According to Figure 5, the government decides to sell emission permits Z * and firms compete to buy the right to hold an allowance. The price charged is the one that equates the market supply and demand and so is set by government (P1). The offer of permits is perfectly inelastic in Z *.

Businesses that are not willing to buy at this price must either reduce their production or change their technology (Morgan et al, 2009).

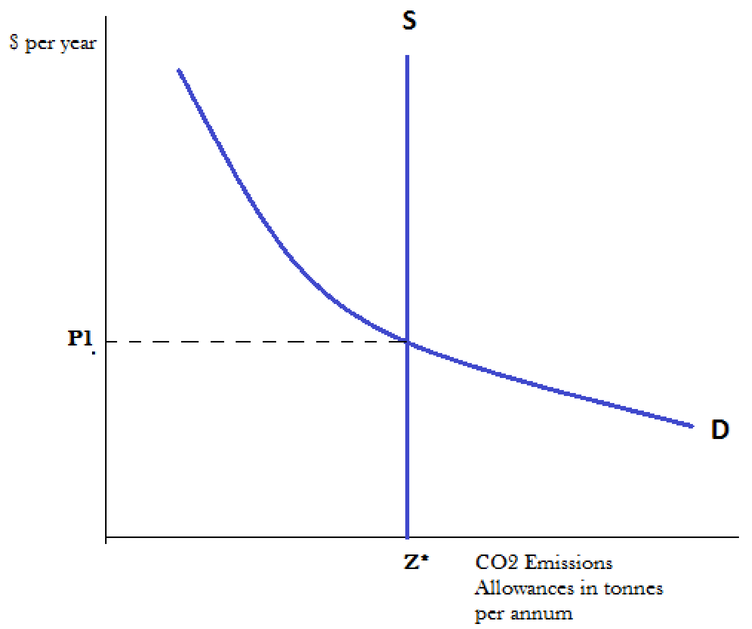

Figure 5: Market for pollution permits

The creation of a market to be effective requires that someone knows who pollutes and in what quantities. Auctioning reduces the uncertainty on the upper level of pollution and acts as an economic incentive (Morgan et al, 2009). The problem of time inconsistency concerns situations where someone creates an expectation with the intention of inducing another in specific options, and then does not fulfil the expectation. Of particular interest is the case that the time inconsistency improves the position of all. A typical example is the EU ETS and «stop the clock».

The main difference between the Pigouvian and Coasian approaches to this issue arises in their methods of dealing with economic externalities. The role of the state in assigning property rights versus the levying of taxes and/or subsidies has been the underlying difference between them. According to ATAG air travel is the only means with access to remote and isolated areas and therefore performs social work (ATAG, 2005).

Welfare economics is the part of the economic, where the possible effects of different kinds of economic policy on the welfare of society are studied (Nath, 1969). Welfare economics allow the separation of situations under which markets can bring good results from situations where they will produce undesirable results (Morgan et al, 2009). Pigou could be considered the founder of welfare economics. Pigou argued that it is obvious that any transfer of income from a relatively rich to a relatively poor man of similar temperament, should increase overall satisfaction, since it enables the overall satisfaction in being able to meet more pressing needs at the expense of less pressing needs, which provoked strong reactions from Robbins (Nath, 1969).

A very important aspect of welfare economics is the social welfare function. Bergson in 1939 was the first to introduce the concept of social welfare function (Nath, 1969). A general form of the function is:

$W=W(A^1,\ldots..A^m)$

Where W is the social welfare and A is the variables which determine the social welfare (Nath, 1969).

A Pareto-social welfare function can be expressed as follows:

$Fn=f\ (U_1,\ldots U_n)$

Welfare economics is based on two fundamental theorems (Scotter, 2008). The first argues that any competitive equilibrium is a Pareto optimal balance for the economy. Thus, demand equals to the production when the economy reaches the competitive allocation. The second fundamental theorem is in a sense the opposite of the first, which tells us that each Pareto optimal allocation of an economy can be achieved as a competitive equilibrium for an appropriately defined distribution of income.

A situation is Pareto efficient if someone cannot be brought in a better situation without worsening someone else's. An example can be the airlines that pollute the environment and create a negative externality on society.

According to the Coase theorem 'in the markets with externalities if property rights are clearly defined and if the parties can negotiate inexpensively, then the parties will reach a Pareto-optimal outcome regardless of who owns the property rights' (Scotter, 2008: 579). A method of government intervention to mitigate the effects of externalities caused by pollution is creating tradable pollution permits (Scotter, 2008). Each permit allows a company to pollute up to a certain degree. The advantage of this method is that because firms can pollute only if authorized and because the government decides how many licenses will be available, knows exactly the amount of pollution after the sale of licenses (Scotter, 2008).

For example, there are two airlines, A and B. Figure 6 shows the functions of the marginal cost of reducing pollution. The regulator decides that pollution should be reduced and decides to give allowances to allow a certain amount of pollution. Any company can choose whether to buy allowances to continue polluting or reduce its activities to comply with the regulation or take other measures (like operational improvements) to comply with the pollution limit.

If airline A does not purchase further allowances, it will have to pay $ 4 for an equalizer with the first unit of pollution and $ 6 for the second, so $ 10 in total. Airline B has a higher marginal cost of reducing emissions, and will have to pay $ 14 to equal the emissions.

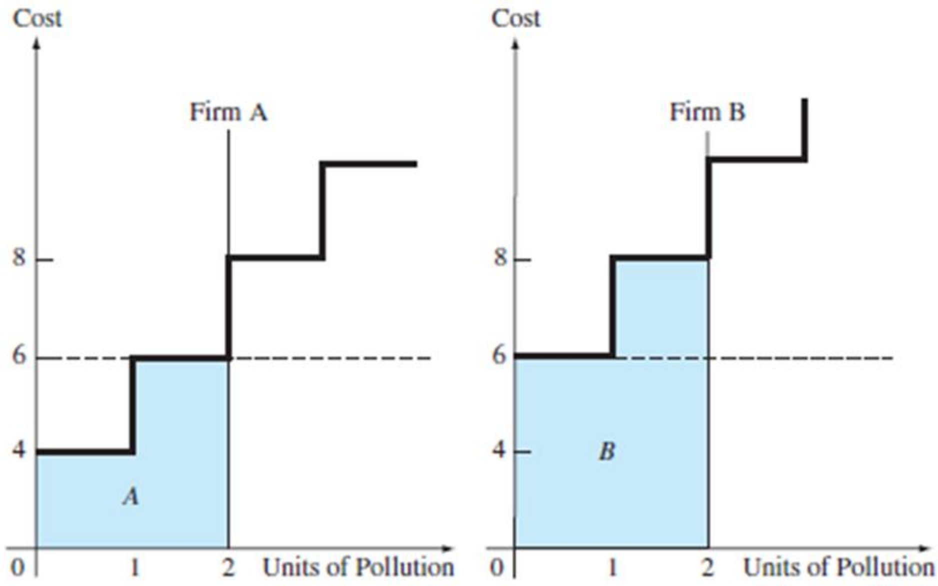

Figure 6: Functions of the marginal cost of reducing pollution for two airlines

When these rights are auctioned for airlines A and B, Company A will reach up to $ 10, after that amount the company will not "bid" anymore since that would be the cost to "clean up" its emissions. Company B could bid up to $ 14, but since Company A will stop at $10, company B can earn additional rights with a price slightly above $ 10. By this way, a reduction of emissions for the society is achieved at the lowest possible cost.

Because of the existence of external economies, people and companies do not pay the true social costs for specific resources, but fewer (Allen et al, 2012). The more a company pollutes the environment, the greater the social cost. The government can control the output by imposing an emission charge (effluent fee) or by issuing transferable emissions permits (Allen et al, 2012).

2.3 Principal Environmental issues in aviation

This section presents the principal environmental issues in aviation. Those issues are the production of greenhouse gases that contribute to climate change, which is a global phenomenon. The other issues are the noise pollution and the lowering of local air quality.

2.3.1 Greenhouse Gases

The combustion of fuel in the engines of airplanes results in emissions of carbon dioxide (CO_2), nitrogen oxides (called NOx) and water vapour and particles. Carbon dioxide is a greenhouse gas and alters the balance of incoming and outgoing radiation from the earth's surface and contributes to the warming of the atmosphere. Emissions of carbon dioxide from the air have the same effect on the climate, such as terrestrial broadcasting, from power plants, industries etc. Carbon dioxide has an atmospheric lifetime of up to 200 years, so it reaches the lowest point of the atmosphere for all that time and it does not matter where it is emitted from (Archer, 2011; Seinfeld and Pandis, 2006).

Emissions of nitrogen cause a series of chemical reactions in the atmosphere. Nitrogen oxides form ozone (O_3) in the presence of light, and as the light intensity is higher in altitude, the more ozone is formed because of altitude than from terrestrial sources of NOx. The nitrogen oxide emissions from subsonic aircraft accelerate local production of ozone in the lower atmosphere, where the aircraft usually flies. The increase in ozone concentration will generally be proportional to the amount of nitrogen oxides emitted by airplanes.

Ozone is a powerful greenhouse gas, whose concentration is highly variable and controlled by the atmospheric chemistry and dynamics. The increase in the retention of radiation by ozone is greater than that of carbon dioxide emissions. However, ozone is responsible for the destruction of atmospheric methane (CH_4). Methane is also a powerful greenhouse gas, with an atmospheric lifetime of 14 years. The destruction of methane as a direct result of civil aviation leads to the reduction of global warming caused by aviation emissions (Seinfeld and Pandis, 2006).

Water vapour is also an important greenhouse gas, but emissions of water vapour only by air have little direct impact on the planet. Water vapour have short atmospheric lifetime and is controlled by the hydrological cycle. The vapour emissions at high altitudes produce contrails, a cloud-like trail behind the aircraft and are visible from the ground. These contrails also trap heat in the atmosphere and their thermal effects are believed to be equivalent to that of carbon dioxide. The contrails are not formed at lower altitudes, so they could be avoided if the planes flew lower. This however could not be done because the density at lower altitudes is greater and airplanes will burn more fuel (Archer, 2011; Seinfeld and Pandis, 2006).

Emissions of sulphate and soot from burning also have little effect on the temperature of the atmosphere. Traces of sulphate are present in the combustion and form aerosols of sulphate compounds. Those reflect the incoming solar radiation back into space, and thus have a small cooling effect. Conversely, small particles are produced from combustion (soot) trap outgoing infrared radiation into the atmosphere and thus have little effect on global warming. These are quantitatively insignificant and it is believed that they almost cancel each other (Archer, 2011).

The key feature that is affected by "greenhouse gases" is radiation balance. This is the balance between incoming solar radiation and microwave outgoing long-wave infrared radiation. Any disturbance to the balance is called Radiative Forcing, RF and is expressed as the change in energy flow in W / m2 (Committee on Radiative Forcing Effects on Climate et al, 2005;Karakoc et al, 2016).

The RF does not account for the influence of a single flight a day, but the overall impact of all known historical aviation emissions. IPCC has estimated that the change in RF emissions from aviation in the pre-season is 0,049 W / m2 (Karakoc et al, 2016). The effect of RF on aviation in terms of contribution to the general RF was estimated to be 3.5% in 1992 and 5% in 2050 (IPCC, 1999). The Aviation Climate Change Research Initiative (ACCRI) researches the RF and claims that a 2% increase in fuel efficiency and a decrease in NO_x emissions thanks to advanced aircraft technologies and operational procedures, combined with alternative fuels use, will decrease significantly the aviation's impact on climate change (Brasseuer et al, 2016).

To provide lift to an aircraft, thrust is produced by means of the combustion of an energy source. This combustion produces noise due to the explosion processes of the energy carrier, combined with that of moving parts of the engine, and chemical pollutants. The exhaust composition is known to be 70% carbon dioxide (CO2), 29% water vapour (H2O) and 1% of other pollutants such as the various oxides of nitrogen (NOX), carbon monoxide (CO), oxides of sulphur (SOX), unburned hydrocarbons or volatile organic compounds (VOCs), soot or particulate matter (PM) and other trace compounds (EEA, 2016). These are considered to be local air quality (LAQ) pollutants or greenhouse gases (GHGs) depending on whether the emissions occur near the ground or at altitude respectively; though CO_2 is always a GHG, not an LAQ pollutant.

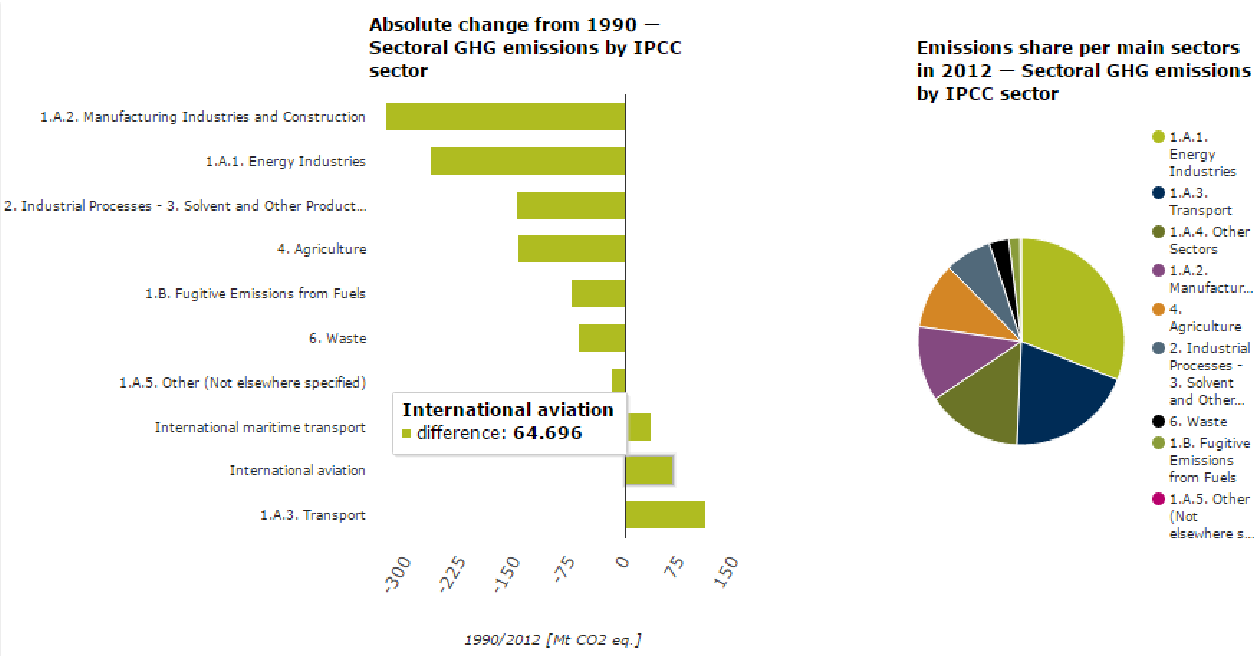

Figure 7: Sectoral GHG emissions by IPCC sector (EEA, 2016)

Efforts to reduce NOX increase fuel consumption and other pollutants, while reducing noise increases NOX and fuel consumption. The combustion of 1kg (1.25 litres) of conventional jet fuel emits 3.15 kg of CO_2. There are also indirect effects – warming and cooling - due to contrails (though there are still major uncertainties regarding their precise impact) (FAO, 2011).

2.3.2 Noise Pollution and Local Air Quality

Aviation noise negatively affects many people living around an airport or under a flight path. Although noise performance has improved over the past fifty years, community perception of noise pollution due to airlines' operations is becoming more negative.

The traditional definition of noise is "unwanted or disturbing sound". Sound becomes unwanted when it either interferes with normal activities such as sleeping, conversation, or disrupts or diminishes one's quality of life. The perception of noise pollution differs from person to person. The measurement of noise follows a standardised approach and noise reference points for aircraft operations are established, but the effect person by person differs. For instance, when a house is located far from a main road and it does not have any traffic noise, the residents of this house might be more annoyed by aircraft noise than others that are close to road traffic. For instance, when the noise is occurring when a person is sleeping can be perceived as more annoying than when a person is eating.

Noise reference points from aircraft are (ICAO, 2010):

1. Fly over: 6,5 Km from the point that airplanes push the brake during the take-off flight path
2. Sideline: the greater noise intensity recorded at any point of 450m from the runway during take off
3. Approach: 2Km from the threshold of the runway during the approach.

According to Figure 8, in 2006 21.2 million people worldwide were exposed to noise due to air transport at the level of 55DNL. While in 2036 the population exposed to that noise level ranges from 26.6 to 34.1 million people (using a prediction based on the year 2006) (ICAO, 2010: 23). Scenario 2 is considered quite possible and contains a number of initiatives such as NextGen and SESAR.

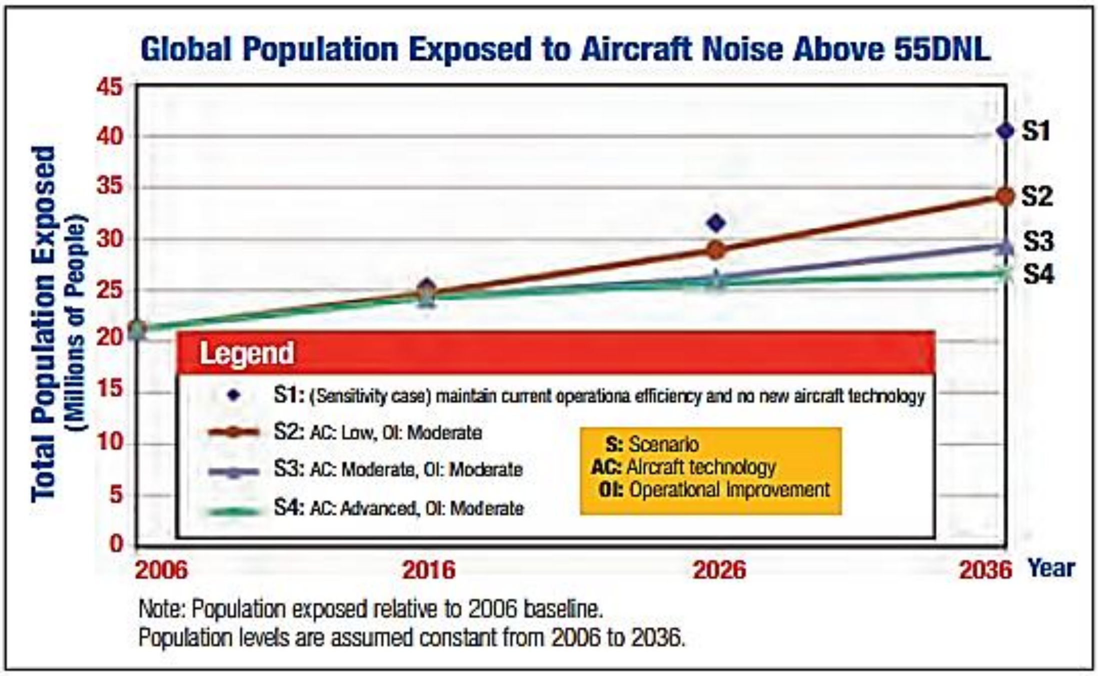

Figure 8: World population exposed to noise exceeding 55DNL (ICAO, 2013a)

Noise-related charges are one of several types of airport charge. According to CAA CAP 1119 (2013) it is desirable that the airport authorities to consult the aircraft operators regarding the proposed charges and to consider their views as well as the effect the charges will have on them. Agreement between airports and operators is desirable, but where it is not reached, the airport is free to impose the charges proposed, subject to a right of appeal. According to ICAO Doc 9082 about the policies on Charges for Airports and Air Navigation Services, noise-related charges should:

- be levied only at airports experiencing noise problems;
- designed to recover no more than the costs applied to the alleviation or prevention of actual noise problems;

- be associated with the landing fee, possibly by means of surcharges or rebates, taking into account the noise certification provisions of ICAO Annex 16 in respect of aircraft noise levels;
- be non-discriminatory between users and
- not be established at such levels as to be prohibitively high for the operation of certain aircraft.

Apart from noise, aviation operations are influencing the local air quality (LAQ). Whilst CO_2 is the greatest contributor towards climate change, at a local level several emissions are known to be contributors to local air quality problems. The main contributors according to CAA (2016) lowering the local air quality are a) nitrogen dioxide (NO_2), b) nitric oxides (NOx) and particulate matter (PM). Air pollution at airports arises from a combination of aircraft and road traffic emissions (both passenger vehicles and vans and lorries collecting air freight). The largest source of NOx at airports is usually not the aircraft but the surface access routes. Unlike CO_2, the production of NOx is not directly linked to fuel burn, and therefore there has been a strong push from industry to regulate and minimise NOx production (Independent Transport Commission, 2016).

The ICAO technical design standards limit emissions of NOx, carbon monoxide (CO) and unburnt hydrocarbons (UHC). A specific EU legislation for aviation emissions contributing to lowering the local air quality does not exist, but the general EU legislation establishing limit values for the concerned pollutants (mainly NOx and particulates in the case of aircraft emissions), being Directive 2008/50/EC on ambient air quality and cleaner air for Europe and developing legislation, applies at and around airports just as they do everywhere else in the EU according to EC (2016). Different airports have differing obligations for monitoring and reporting air quality (CAA, 2016).

2.4 Measuring environmental impact

Negative externalities are an area that becomes more and more regulated. In order to measure the efficiency of the regulations the externalities after they are identified they need to be measured in order to monitor and evaluate the result of the implementation of any solution. The environmental impacts of air transportation can be measured by certain indicators. One of those according to IPCC (2007) is:

$\Delta Ts = \lambda \ \Delta RF$

The linear relationship between the change in global mean RF multiplied by the constant λ and the global mean disordered surface temperature (ΔTs), where lambda is the parameter of the climate sensitivity ($K(W\ m^{-2})^{-1}$). The climate parameter sensitivity, lambda, is found to be relatively stable in a Global climatic model (Global Climate Model, GCM) but differ from GCM to GCM (CE, 2005: 29-30).

$$\mathbf{GWP_x} = \frac{\int_0^{TH} \mathbf{a_x}[\mathbf{x}(\mathbf{t})]\mathbf{dt}}{\int_0^{TH} \mathbf{a_r}\,[\mathbf{r}(\mathbf{t})]\mathbf{dt}}$$

Where TH is the Time Horizon, a_x is the radiative efficiency arising from a unit increase in atmospheric abundance of the substance (x) in question (in $W\ m^{-2}\ kg^{-1}$), [x(t)] is the time-dependent decay in the abundance of the instantaneous release of the substance, and r refers to the reference substance in the denominator (CE, 2005: 30). The GWP is defined as the ratio of the time-integrated RF resulting from the instantaneous release of 1kg of trace element, relative to that of 1 kg of the reference gas (IPCC, 1999, CE, 2005: 30).

TED=P*PCI*ED

The above equation is used to measure the environmental degradation (Janic, 2007: 2).

Where:

TED is the total environmental degradation in monetary units

P is the population (number of people)

PCI is the Gross Domestic Product (GDP) per capita income (monetary units per inhabitant)

ED is environmental degradation per unit gross domestic product

The above equation in case of examining carbon dioxide emissions can be modified as follows (Janic, 2007: 13):

TE=P*D*FC*SE

Where:

TE is the total GHG emissions (tonnes)

P is the number of passengers

D is the average travel distance (kilometres or miles)

FC is the fuel consumption (tons per P / D)

SE are the specific emissions (tonnes of pollution per tonne of fuel consumed)

The Specific Fuel Consumption (SFC) is the quantity of fuel that produces a thrust unit in a given moment of time. It is expressed in kilograms (Kg) of fuel per kiloNewton (kN) of thrust per hour (Janic, 2007: 25). The SFC depends on the size of the aircraft (capacity) and the number of engines. The largest aircraft have greater thrust produced by engines.

Furthermore, for large civil aircraft fuel consumption represents a large proportion of operating costs, about 30%. Airlines therefore look to reduce costs by exploiting the engine efficiency (η_e). Lower fuel consumption per machine means lower consumption of non-renewable source of energy and therefore lower emissions of pollutants.

The Life-Cycle Assessment (LCA) method for quantifying the emissions, resources consumed and environmental and health impacts associated with products (good and services) has been internationally standardised since 1997. LCA takes into account a product's full life cycle from the extraction of resources, through production, use and recycling, to the disposal of waste. Indicators help quantify the contributions to environmental and health impacts such as climate change, smog, acidification, or cancer, as well as the resources consumed and their scarcity.

The framework of an LCA is defined by a system boundary and a life-cycle inventory that can vary according to the goals of a particular survey. The system boundary is defined by the spatial, temporal and production chain limits (start and end points) of the process that is being analysed. For example, the GHG balance of a crop grown for biofuel depends on the size and location of the cultivation area (space boundary), the number of growing seasons considered (time boundary), and whether fertilizer inputs and post-harvest transport are considered (start and endpoint boundaries). Each step of the biofuel production process involves energy and GHG uptake (inputs, e.g. uptake by plants and by soil) as well as energy use and GHG emissions.

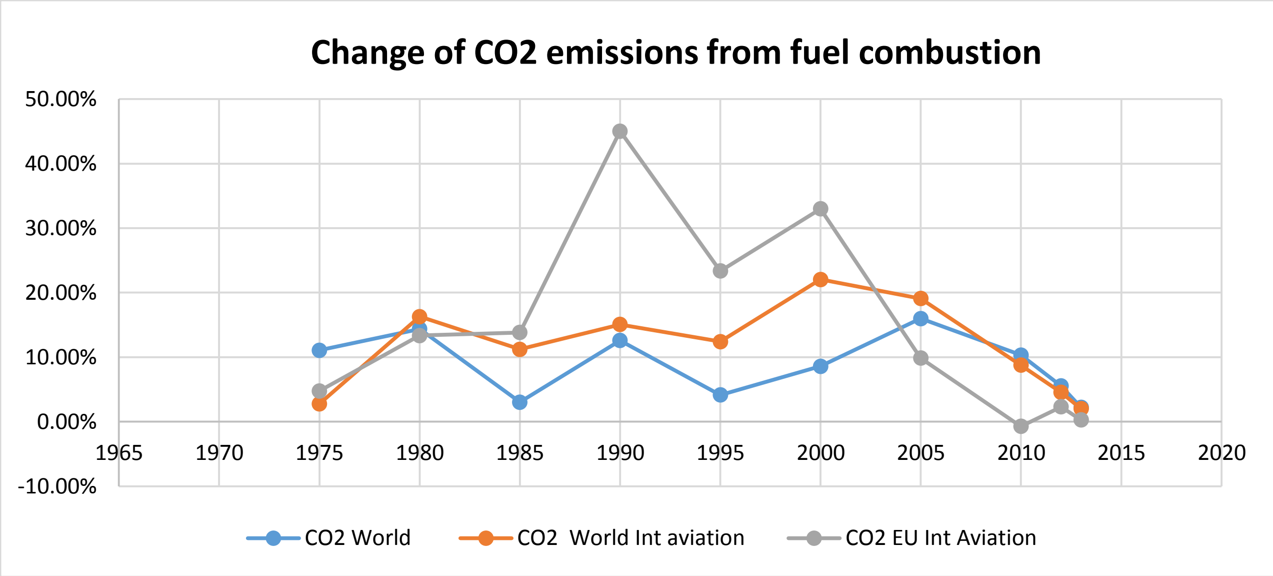

Figure 9: Changes in the proportion of CO2 emissions from EU and World international aviation and total CO2 emissions from all the industries (Data based in IEA statistics, 2015)

Table 2: CO2 emissions from EU and World international aviation and total CO2 emissions from all the industries (IEA statistics, 2015)

Year	World CO2 emissions	World Intl aviation bunkers CO2 emissions	EU Intl Aviation bunkers CO2 emissions
1971	13994.7	169.2	36.32
1975	15543.9	173.9	38.05
1980	17779.6	202.2	43.13
1985	18319.2	224.9	49.09
1990	20623	258.8	71.19
1995	21478	290.9	87.82
2000	23321.6	355	116.8
2005	27047.6	422.8	128.3
2010	29838.2	459.8	127.39
2012	31490.5	480.7	130.32
2013	32189.7	490.4	130.69

Table 2 shows the changes in CO2 emission indicator from international aviation in relation to fossil fuel use, the EU and the world. In the EU, emissions from fossil fuels reduce by about 5% in 1990-2009 (Leggett et al, 2012), while the emissions from aviation fuel sold in the EU increased by approximately 89.5% for the period 1990-2013. This was more than the increase in total emissions from Spain. Globally, also, aviation emissions have increased faster than the total emissions of fossil fuels. ICAO estimates that CO2 emissions from all air transport (not only international) almost doubled in 1990 - 2006 (Leggett et al, 2012).

2.5 Fuel

The fuel cost is perhaps the biggest cost for the operation of a flight. The average price for fuel for 2013 was just under $125 a barrel to IATA (2014a). After labour, fuel represents the largest component of the cost for airlines. An effective and efficient way to reduce costs is to consume less fuel. The fuel consumption differs considerably from route to route compared to the weight of the aircraft, the wind conditions, altitude and more. In an hourly flight, fuel costs are not accurate but estimated approximately. Fuel costs include all relevant taxes for fuels established by each government and by some airport authorities (Wensveen, 2007: 306).

Fuels account the global aviation industry is projected to reach $ 207 billion in 2012 (representing 33% of operating expenses at $ 110.0 / barrel of oil type Brent). This is an increase of $ 31 billion for 2011. Operation of new, more direct routes, the realignment of unprofitable routes and the improvement of traffic flow in the ground can reduce the cost of the industry by 2.5 billion dollars annually. Individual efforts of airlines to improve their own operational efficiency can yield significant savings. Each 1% improvement in fuel efficiency across the industry can reduce the fuel bill by about $ 700 million per year according to IATA (2014a).

The combustion of fuel depends on the stage / phase of the flight and the aircraft consumes different amount of fuel. Emissions during a) the landing and take-off (landing and take-off cycle, LTO), which includes all activities under 3,000 feet (1,000 meters) and requires a lot of fuel consumption, and b) phase the ascend, the fixed altitude and descent

(Climb, Cruise and Descent cycle, CCD), which concern all activities at over 3,000 feet and fuel consumption depends on the distance of the route.

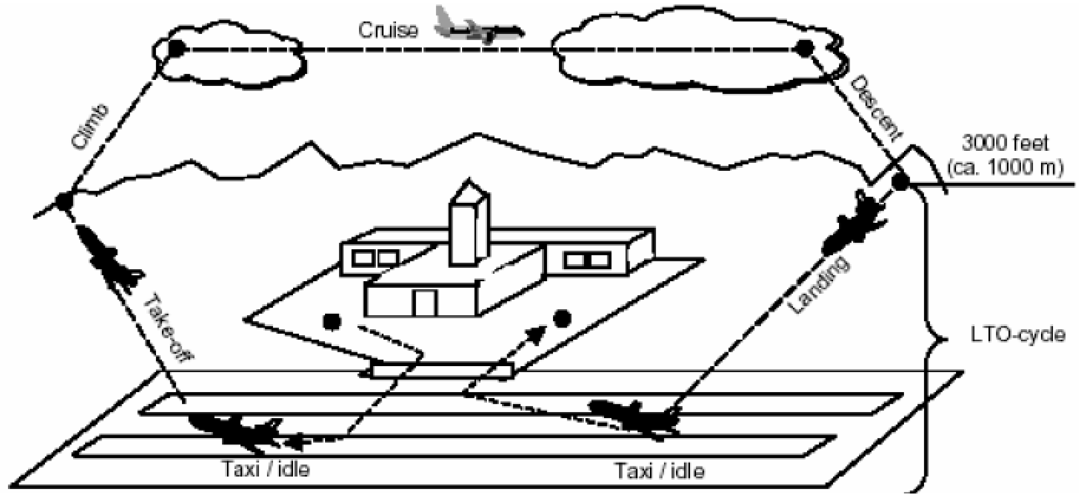

Figure 10: The stages of a flight (Emission Inventory Guidebook, 2001)

Airplanes is calculated that are related to 70-80% of emissions from aviation, since they pollute and affect air quality at altitudes below 3,000 feet, while increasing their GHG at higher altitudes (Goodman, 2009). There is currently little information available to estimate emissions from start-up of engines and these are not included in the LTO cycle. This is not of great importance for total national emissions, but they may have an impact on the air quality near airports.

Auxiliary Power Units (APUs) are used where no other power source is available for the aircraft and may vary from airport to airport (Winther et al, 2015). This is the case, for example, when the aircraft is parked away from the terminal building. The APU fuel use and the related emissions should be allocated based on aircraft operations (number of landings and take-offs). However, no methodology has currently been developed. The use of APUs is being severely restricted at some airports to maintain air quality, and therefore this source of fuel use and emissions may be declining. In total terms, the fuel consumption and emission contribution from this source is regarded as very small (Winther et al., 2006).

From time to time aircraft will have to dump fuel before landing so that they do not exceed a certain maximum landing weight. This is done at a location and altitude where there will be no local impact at ground level. Only large long-range aircraft will dump fuel. Non-methane volatile organic compounds (NMVOC) emissions might become significant at very large airports with frequent long distance flights (Winther et al., 2006). However, since the most probable altitude of these emissions will be above 1 000 m, these are currently not relevant for United Nations Economic Commission for Europe (UNECE) reporting (Winther et al., 2006). The airport authorities and airline companies might give information on the extent (frequency and amount) of dumping and the altitude at particular airports.

To calculate fuel consumption on a flight within the EU ETS an operator can follow any of the following formulas that will give the same result (EC, 2012: 26):

$$\mathbf{F_{N,A}=T_N-T_{N+1}+U_{N+1}}$$

Where:

$F_{N,A}$: The fuel consumed for the flight test (N = flight)

T_N: Amount of fuel contained in aircraft tanks after completion of fuel uplift for the flight

T_{N+1}: Amount of fuel contained in aircraft tanks after completion of fuel uplift for subsequent flight

U_{N+1}: Fuel uplift for subsequent flight

$$\mathbf{F_{N,B}=R_{N-1}-R_N+U_N}$$

Where:

$F_{N,B}$: The fuel consumed for the flight test (N = flight)

R_{N-1}: Amount of fuel remaining in aircraft tanks at the end of the previous flight

R_N: Amount of fuel remaining in aircraft tanks at the end of the flight concerned

U_N: Fuel uplift for the flight concerned

Airlines spend about $ 100 per minute / flight in the total operating costs (labour, fuel, maintenance, etc.). If the paths were reduced by one minute that could reduce the total industry operating cost over $ 1 billion per year and significantly reduce environmental emissions. Improvements in traffic flows on the ground, departure and arrival and rationalization of the existing Noise Abatement Departure Procedures (NADPs) can further reduce fuel consumption and cost of the industry over 530 million dollars per year. Finally, improving fuel efficiency by 1% across the industry can lower the fuel bill by around $2bn per year at current fuel prices and reduce fuel costs by 700 million dollars per year (IATA, 2015). Improvements in air traffic management (ATM) and other operational procedures could reduce the consumption of aviation fuel from 8 to 18%. The vast majority (6-12%) of these reductions comes from expected improvements in ATM (IPCC, 1999: 11).

2.5.1 Biofuels

While fossil fuels come from ancient biomass, are not considered as biomass as they contain carbon. As biomass is considered the biodegradable proportion of products, waste and residues of biological origin from agriculture (both plant and animal substances), forestry and related industries including fisheries and aquaculture, as well as the biodegradable fraction of industrial and municipal waste as well as biofuels and bioliquids (EC, 2012: 6). Biomass generally refers to any plant or material derived from a plant or biodegradable material that can be used as fuel. The biomass can be converted directly into liquid fuel or a biofuel for use as an alternative fuel. There are different types of biofuels. The best-known are:

- Ethanol, which is based on alcohol and is a high octane and clean burning renewable fuel
- Cellulosic ethanol, known as cellanol, is a complex carbohydrate, which is found in plant cell walls.
- Biodiesel is made through a chemical process called transesterification in which the glycerol is separated from the fat or vegetable oil.
- Synthetic fuel is any liquid fuel produced from coal, natural gas, or biomass. Sometimes refers to fuels derived from other solids such as oil shale, tar, or waste made of plastic.

The temperature, viscosity and opacity are a challenge for air quality biofuels. Such a fuel that has proven successful is ethanol. Ethanol (Aviation-Grade Ethanol, AGE-85) is a high performance, 85% ethanol content fuel mixture for use in any reciprocating aircraft engine. AGE-85 has begun to replace the 100 octane low lead content in gasoline, which was the standard leaded gasoline for aviation since World War II. The AGE-85 offers a substantial improvement in performance of the aircraft and produces at least 12 percent more horsepower and torque at typical cruising power. Lower operating temperatures are also achieved with engines tend to operate at 50 to 100 ° C lower than with the current fuel. Because the AGE-85 fuel causes significantly less accumulation of combustion products into the engine, the time between engine repairs is greater and maintenance costs are lower (Biedermann, 2015).

Fischer-Tropsch and Hydroprocessed Esters and Fatty Acids (HEFA) fuels were the first alternative fuels approved for use in aviation (ICAO, 2013a). In 2006, the Commercial Aviation Alternative Fuels Initiative (CAAFI), founded by U.S.-based aviation stakeholders, was the first worldwide initiative promoting the development of alternative fuels for aviation (ICAO, 2013a).

The CFM International has made a successful first test of the CFM56-7B engine using biofuel from ester. CFM56-7B is the exclusive engine for Boeing Next-Generation with airplanes 737-600 / -700 / -800 / -900. The thrust ranges from 18,500 to 27,300 Lb. The biofuel used for this test was 30% vegetable oil methyl ester blended with 70% conventional Jet A1-fuel. This test is designed to examine the operation of the jet engine using a fuel made from biomass, without making technical changes to the engine. With this type of biofuel, the target is a 20% reduction in CO_2 emissions compared with current fuels (NASA, 2009). In contrast to the oil price, the price of biomass is far from homogeneous (De Laporte et al, 2016), i.e. shows large variations in European countries and depends on the quality. The Commission expects a large increase in the use of biomass in the energy sector until 2020 (Directive 2009/28/EC).

Los Angeles (LAX) is the world's second airport that has incorporated biofuel into its regular refuelling process. In 2016, KLM has signed a three-year contract for the supply of sustainable biofuel for all its flights from there (KLM, 2016). South African Airways (SAA) and Mango have operated a flight with a Boeing 737-800 from Johannesburg to Cape Town powered with tobacco-based biofuels (SAA, 2016).

Environmental impact assessments show that the sustainability of alternative fuels depends on the precise feedstock and supply chain used and that, depending on the source, very low carbon fuels could be available as well as fuels that do not contribute to decarbonisation.

The outcomes of different surveys have shown that Gas-to-Liquids (GTL) does not provide a reduction in GHGs compared with conventional kerosene, even when carbon capture and sequestration (CCS) is used during the manufacturing process (EC DG ENER, 2014; Ecofys, 2014). There are studies in the literature that see the possibility of the equivalence of GTL emissions with kerosene, but only with very high carbon capture efficiency and this may also depend on the type of kerosene. From other studies, life-cycle Coal-to-liquids (CTL) emissions are even higher than for GTL.

Until recently, aircraft operators have been reluctant to integrate the energy dimension into their business models due to high costs of investment. Delta Airlines' investment in the energy sector by purchasing an oil refinery to produce its own conventional jet fuel was the first of its kind, and represents a move towards a new business model (Coady et al, 2010). This is not only a question of energy security, it could also be profitable when considering the integration of bio-jet fuels, providing that airlines take the specificity of such end products associated with the whole value chain into consideration, and that policy makers address the price gap in order to provide a catalyst for the deployment of bio-jet fuels for aviation. In another development, the Solena biofuels company had a long-term agreement with British Airways to build a waste-to-biofuel plant (GreenAir, 2012).

Economics, including the market context, are as important as environmental constraints in defining most promising alternative fuels for aviation. The cost of conventional jet fuel has followed a very uneven path over the last ten years or so and if the cost of carbon is factored in it could increase greatly over the next couple of decades.

Bio-jet fuels show a significant potential for emission reduction, depending on the process. Biomass-to-Liquid (BTL) generally shows better performance than HRJ and while all the BTLs considered meet the EU Renewable Energy Directive(RED) thresholds, this is not always the case for HRJ. This is because hydro-processing uses hydrogen which induces emissions in its production from natural gas. HRJ performance is also more dependent on the type of feedstock and on the way this feedstock is produced or cultivated (Han et al., 2013). Life-cycle emissions are very sensitive to the conditions considered for this cultivation (World Economic Forum, 2010).

The European Union has launched the “Initiative Towards Sustainable Kerosene for Aviation” (ITAKA) to produce sustainable bio-jet-fuel at a large enough scale to test its use in normal flight operations. The “Aviation Initiative for Renewable Energy” in Germany (AIREG) and “Bioqueroseno” in Spain, are also pursuing the development of a sustainable bio-jet fuel industry (ICAO, 2013a).

Alternative fuels could make one of the highest contributions to reducing the carbon footprint of aviation, and can reduce emissions of other pollutants such as particulate matter responsible for air quality issues around airports. Biofuels should not be seen as panacea though, since biofuels’ production can create a series of problems from land use issues until high food prices. Nevertheless, biofuels are a considerable option for mitigating CO_2 and PM emissions (Kousoulidou and Lonza, 2016).

2.6 Summary

This chapter aimed at the several external costs (negative externalities) of air transportation. The pollutants emitted noise and congestion costs both on the ground-around airports and in the airspace adversely affect social welfare. The activities related to aviation pollution on the air, produce GHG and contribute to climate change. Airplanes pollute and affect air quality while increasing their GHG at higher altitudes.

The emissions are directly related to the fuel burn. Therefore, the reduction of the fuel burn relates to the reduction of emissions. Airlines have an economic incentive to reduce the fuel burn. Another solution for the airlines that want to be more environmentally friendly is the use of alternative fuels. The alternative fuels and especially the biofuels can be a promising solution for the aviation industry when are sustainably developed and used. A number of schemes have been introduced in order to improve the sustainability of aviation growth. The next chapter will explore the EU ETS regulation of climate change caused by the aircraft operators in Europe.

3 EU Emissions Trading Scheme in aviation

Having discussed extensively about the negative externalities due to aviation in the previous chapter, the next question that this study aims to address is the environmental regulation through the Emissions Trading Scheme. Therefore, this chapter will examine its implementation. European Commission has adopted several regulations to 'save environment'. In the aviation industry, the most important is the regulation about Noise Pollution, i.e. Regulation (EU) No 598/2014 and Climate Change, i.e. EU ETS regulation.

3.1 Kyoto Protocol and European Union

According to Barrett (2009: 59), 'Climate change may or may not be the most important problem the world has ever faced, but it is certainly the greatest challenge for collective action'. Over the past 50 years, the air transport industry has experienced rapid expansion as technology has evolved and a steady decline in costs and prices was applied, which encouraged further traffic growth (IPCC, 1999: 296). Transport is one of the major factors for emissions in the planet. Emissions of carbon dioxide together with nitrogen oxide contribute to the creation of the greenhouse effect, which adversely affects the climate. Aviation has a severe contribution to global climate change. While total greenhouse gas emissions in the EU increased by 5.5% from 1990 to 2003, emissions of carbon dioxide caused only by international aviation in the 25 member states increased by 73% over the same period (CE, 2005; ESA, 2006). Air transport to destinations outside the EU-25 accounted for 60% of these emissions. In 2005, CO_2 emissions from all flights departing from the EU-25 amounted to 142 Mt CO_2 compared to the total weighted emission of greenhouse gases of 4 980 Mt CO_2 over the same period (EEA 2008, EC DG TREN, 2007).

The contribution of air transport in the EU-25 in the greenhouse emissions continue to rise, reaching 12% of total greenhouse gas emissions from transport as a whole in 2005 (EEA, 2008: 26). Even though there have been significant improvements in aircraft technology and operational efficiency, it was not enough to neutralize the effect of the growth in air traffic. The environmental economics and natural resources have sailed at a parallel course with the general economic theory at least since the 18th century, and all the great classical economists have expressed, directly or indirectly, aspects concerning the management of goods and environmental services. Environmental Economics is the discipline that has as its object the study of environmental problems, in light of the economics techniques (Field, 1994).

The International Air Transport Association (IATA) has requested the 10% of aircraft fuel to be from alternative sources by 2017 (Chuck, 2016), a rate that is difficult to be reached by 2017. Hydrogen has been proposed as a long-term alternative to fossil fuels with low emissions to power aircraft. Tests are done with unmanned airplanes using hydrogen-fuel (Bradley et al., 2007).

On February 4, 1991, the Council authorized the Commission to participate on behalf of the European Community in negotiations on the UN Framework Convention on Climate Change, adopted in New York on 9 May 1992. The Framework Convention has been ratified by the European Community by Council Decision 94/69 / EC of 15 December 1993. This Convention entered into force on March 21, 1994.The Framework Convention has contributed significantly to the establishment of basic principles for combating climate change globally. It defines the principle of "common but differentiated responsibilities." In addition, it helped to improve further the public awareness, worldwide, as well as to the problems associated with climate change. However, the contract does not include quantified and detailed commitments by country to reduce greenhouse gas emissions.

The Contracting States to the Convention decided at the first meeting of the parties, held in Berlin in March 1995, to negotiate a protocol regarding measure for the emissions reduction for the period beyond 2000, to the industrialized countries. This protocol was developed in Kyoto on December 11, 1997. The European Community signed the Protocol on 29 April 1998. It represents a significant step in combating global warming as it includes binding and quantified objectives for reducing greenhouse gases. The Kyoto Protocol tackles emissions of six greenhouse gases:

1. carbon dioxide (CO_2)
2. methane (CH_4)
3. nitrous oxyde (N_2O)
4. hydrofluorocarbons (HFC)
5. perfluorinated hydrocarbons (PFC)
6. sulfur hexafluoride (SF_6).

To achieve these objectives, the Kyoto Protocol suggests various means:

- stepping up or introducing national policies to reduce emissions (greater energy efficiency, promotion of sustainable forms of agriculture, development of renewable energy sources, etc.)
- cooperation with other Contracting Parties (exchanges of experience or information, coordination of national policies through emission permits, joint implementation, and appropriate development mechanism).

On May 31, 2002, the European Union ratified the Kyoto Protocol. The Protocol entered into force on February 16, 2005, following its ratification by Russia. Several industrialized countries have refused to ratify the Protocol, including the United States and Australia. The EU has reiterated its conditional offer to move to a 30% reduction by 2020 compared to 1990 level (UNFCCC, 2014b).

Table 3: The four phases of the Kyoto Protocol

Phase I: 2005-2007	Phase II: 2008-2012	Phase III: 2013-2020	Phase IV: 2021-2028
• Trial phase • No banking • NAPs • Free EUAs	• Kyoto period • Banking allowed • NAPs • Small amount of EUAs auctioned	• EU wide cap, no NAP • Auctioning of a portion of EUAs • Aviation and aluminum included • Reduce emissions by 20% (against 1990 levels) • Restriction on CDM and JI credits	• Not confirmed • Continued annual reduction of EUAs • Greater proportion auctioned • Most aspects not yet decided upon

The Kyoto Protocol has defined two mechanisms for carbon offset projects: The Clean Development Mechanism (CDM) and the Joint Implementation (JI). The main difference between the two mechanisms is that the first concerns investments in projects in developing countries, whereas the second concerns investments in projects in developed countries.

The **Clean Development Mechanism** (CDM) allows countries and companies to offset their GHG emissions, in order to meet their Kyoto obligations and targets and at the same time to assist developing countries in achieving sustainable development (UNFCCC, 2014a). The emissions reductions occurred by the CDM projects are reviewed and verified by the UN (The Gold Standard, 2012: 16). The CDM is the main source of income for the UNFCCC Adaptation Fund. This Fund was established to finance adaptation projects and programmes in developing country parties to the Kyoto Protocol that are particularly vulnerable to the adverse effects of climate change. In addition, since September 2007, the CDM has self-financed its regulatory functions through fees charged to projects and no longer relies on grants from the countries (Kollmuss, et al., 2010). The tradable unit under the CDM is a Certified Emissions Reduction (CER). Each CER is equal to 1 metric ton of CO_2 emissions abated (Kollmuss et al., 2010).

The **Joint Implementation** (JI) mechanism is the instrument for offset projects happening within countries with binding emission commitments under the Kyoto Protocol. The goal of the program according to Kollmuss et al (2010: 59) is "to increase market efficiency by allowing industrialized countries to meet a part of their obligation by investing in GHG abatement projects in another industrialized or economies in transition (EIT) country if the cost of abatement is lower in the other country" (Kollmuss, et al., 2010: 59). The tradable unit under the JI program is an Emission Reduction Unit (ERU). Each ERU is equal to one metric ton of carbon dioxide equivalent ($mtCO_2E$) (Kollmuss et al., 2010).

Helm (2009:18) states that 'Kyoto demonstrated how difficult it is to bring on board the major players; and that a better and more comprehensive agreement could be achieved without the Kyoto architecture getting in the way'. He also argues that the Kyoto and COP did not have a sufficient impact on climate change mitigation because they did not include aviation and shipping. The allocation of responsibility for the existing stock of carbon, the fact that some countries may benefit from climate change, the free-rider incentives and the difficult measuring of emissions make climate change intractable (Helm, 2009). According to Barrett (2009) what makes Montreal protocol work in comparison to Kyoto protocol is the permanent cuts in comparison to the five-year Kyoto target. Barrett (2009: 69) argues that 'An effective climate agreement must impose obligations that can be ratcheted up, and that are immune to backsliding.

The largest and most important emissions trading scheme is developed by European Union and is based on requirements of the Kyoto Protocol. The EU ETS concerns 25 countries. It is the largest emissions trading system and the first interstate system because it contains more than one country (Anger & Kohler, 2010). The success of the system lies in its ability to maintain a relatively stable carbon price, which gives an incentive for companies to take environmental protection measures (Anger & Kohler, 2010). The first phase, i.e. the period 2005-2007, was considered the trial period (Tietenberg, 2006).

The European emissions trading scheme differs from other Emissions Trading Schemes in terms of (Grubb & Neuhoff, 2006):

- The economic scale of the system, which exerts high pressure in the distribution and raises concerns about competitiveness, which paradoxically is the source of profit motivation unprecedented in the history of environmental policy
- The small size of the cuts relative to the «business-as-usual» and resulting instabilities in the system
- The corresponding high percentage of free allocation, which underlies legal pressures and the scope for distortions
- The multi-periodic nature of the distributions
- The responsibilities' allocation to Member States and how it affects the sustainable solutions.

3.2 EU Emissions Trading Scheme inclusion of Aviation

The EU ETS is one of the main instruments used by the EU to reach the statutory reduction of greenhouse gas targets. The EU ETS is a «cap and trade» scheme. Under the EU ETS, the European Union (EU), plus Iceland, Liechtenstein and Norway have set a ceiling or a maximum amount for annual emissions of carbon dioxide (CO_2) from large industrial sources (Kantareva et al, 2016).

Global carbon markets can be divided into two categories: the regulator (or compliance) and the voluntary market. The Emission Trading Scheme belongs to the first category, the regulatory market. Trade of pollutants is used by governments to reduce greenhouse gas emissions (GHG). The ETS uses various mechanisms of the economy to create a price on emissions. The carbon trading involves trading of rights (permits, allowances, credits) to emit a certain amount of emissions. Because of this commercial dimension, an economic incentive is created (Preston et al, 2012). For example, airlines reduce their emissions or acquire emission units from other projects under the auspices of the ETS and / or by investing in reduction strategies.

A quantity of "allowances" or permits to emit one metric ton of CO_2 is given or it needs to be bought by each individual. At the end of each year, each emission source must return the allowances at least equal to its emissions for the year. In case, that the source does not return with sufficient allowances it will have to pay a fine. As time passes by, the emission ceilings will be reduced and fewer allowances will be issued, causing CO_2 emissions to be reduced because of the level established by the ceiling (Leggett et al, 2012; Meleo et al, 2016).

The original European application of the Kyoto Protocol did not include emissions from aviation. In 2008, the European Parliament and the Council adopted a new law, Directive 2008/101 / EC, amending the EU ETS (Directive 2003/87 / EC) to include aviation activities. The EU ETS in aviation is only about CO_2 emissions from airplanes (Kantareva et al, 2016).

For every MT CO_2 emitted by a source, should be transformed to a right/allowance. For 2012, the 85% of emission allowances in aviation were offered free to aircraft users and the 15% were auctioned (EC, 2016). For the period 2013-2020, the 83% are offered free, the 15% are auctioned whereas the remaining 3% are banked for new entrants in the market or for fast growing airlines (EC, 2016). This intertemporal flexibility reduces the overall compliance costs (Kling and Rubin 1997; Tietenberg 2010; Ellerman et al. 2003; Ellerman 2002; Ellerman and Montero, 2002, Schleichl, Ehrhart, Hoppe, Seifert, 2006).

The initial allocation to the units is done through a benchmark system regarding the tone-kilometres that the aircraft flown from, to or within the EU during 2010. Every unit is receiving the 0.6797 free allowances (baseline) for every 1,000 tonkilometers of flight. For the period 2013-2020 the cap is reduced to 95% from the emissions from 2004-2006, the target is also further reduced (Leggett et al, 2012:12). In phase three, an airline receives 0.6422 allowances per 1,000 tonne-kilometres flown (EC, 2016). The cap on total allowances for phase three has been set at 210,349,264 per year. This is equivalent to 95% of 'historical' emissions (EC, 2016). As smaller the quantity of free allocated allowances is, the bigger the associated cost for the aircraft operators (IATA economics, 2013).

Airlines requiring more allowances can purchase them from EU auctions, other carriers and other sources of emissions in the EU ETS or other international emissions trading mechanisms. A small reserve of free allowances will be available for new or rapidly expanding airlines (Anger & Kohler, 2010; EC, 2016).The entry into force of the EU legislation covering emissions from international aviation is a significant move in the last two decades regarding whether and how the aviation CO_2 emissions can be mitigated. According to the rules of the UNFCCC (2014a), almost all the emissions are calculated in the country where they occur. Much of the emissions associated with international air transport, however, take place in international airspace.

Aviation emissions could be counted and regulated by the country where the aviation fuel is sold. However, small countries (such as Malta), for which the aviation and shipping fuel sales are an unusually large part of the economy, have objections to this choice. Partly it will have little influence on technologies used by carriers based somewhere else. They also argue that, if not all countries, that sell aviation fuel, regulate emissions, fuel sales will turn into uncontrollable point. This could result in financial transfers, losses and carbon leakage (Leggett et al, 2012).

To minimize compliance costs and to provide flexibility to sources, the EU ETS permits allowances to be negotiated. A source that has more allowances than necessary can sell the extra to another source that needs more, or to other entities, such as "allowances agent". The amount of the purchased allowances affects the price for the allowances. It is the aim to establish price of allowances, which are higher compared to the costs of reducing emissions by one ton. This aim gives economic incentives to reduce the amount of emission and to sell unused allowances to other polluters. It also gives businesses (e.g., technology companies) incentive to develop new, lower-cost means of reducing emissions (Kantareva et al, 2016).

Directive 2008/101/EC amended the EU ETS Directive 2003/87/EC and included aviation activities within the scope of the ETS as follows:

- All Member states from the European Economic Area (EEA) – including Iceland, Norway, and Liechtenstein – participate in the EU ETS.
- Total emissions are covered from flights that depart and arrive at EEA aerodromes (hereafter "intra-EEA flights"), from flights that depart from EEA aerodromes to destinations in third countries, and from flights that arrive at an EEA aerodrome from third countries (the flights to and from third countries are hereafter referred to as "extra-EEA flights").
- The emission cap from 2013 onwards has been set at 95 % of the average historic aviation emissions for the period from 2004 to 2006.
- Aircraft operators have been obliged to start emissions reporting in 2010 and full compliance – including surrendering of allowances – in 2012.

The EU ETS excludes certain types of flights from the cap-and-trade system, such as flights from airports that do not belong to EU Member State, flights transferring governors, military aircraft, search and rescue flights, circular flights, Public Service Obligation (PSO) and flights for training purposes (EC, 2016). Furthermore, flights under the de minimis criteria are excluded. These criteria include flights with airplanes with maximum certified take-off weight of less than 5,700 kg, flights from airlines with less than 243 flights for 3 continues 4-month periods or flights with annual emissions under 10,000 Mt per year (Kantareva et al, 2016)..

An airline that needs more allowances that the ones that allocated to it for free, can bit in the auctions that are frequently organised by the national governments or the market that holds allowances that wants to sell (EC, 2016). Because the high needs of airlines are part of an open system of emissions trading, the allowances can be purchased from entities from other sources (i.e. non-airlines) that are part of EU ETS or from credible/approved sources that have excess allowances coming from projects of developing countries. Moreover, airlines that have excess allowances can sell to other entities too (Anger & Kohler, 2010).

If an airline does not comply with the EU ETS there is a fine for excessing the permitted quantities. The fine is 100 € for every tome of CO_2 that is above the allowances allocated, a quantity many times higher than the expected prices in the carbon market. The air carrier is also responsible for the submission of allowances for the next year's emissions. The EC regulation took under consideration also the situation when an air carrier does not comply from for than a year to the regulation. The worst-case scenario is that the carrier will not be allowed to operate to the EU (Leggett et al, 2012).

The Member State is required to inform and consult the EC on how they will use the profit coming from EU ETS. There are concerns if the revenue will be used for the aviation industry and/or for the decrease of the Green House Gases (GHG) (Leggett et al, 2012). Within each Member State, a designated “competent authority” is responsible for administering the EU ETS with respect to airlines. To reduce administrative costs, each operator is administered by a single Member State, the one that issued its operating licence or by the state with the greatest estimated attributed aviation emissions from that operator in the base year (EC, 2016).

Airlines can be allocated to the Member State to and from which most of their flights operate. Given the role of London’s Heathrow Airport as a significant hub for flights into and out of Europe, a large number of airlines have been assigned to the UK. Germany, France, Spain and the Netherlands also act as administering States for a large number of carriers. Thus, there is high administration cost related to EU ETS for those countries.

Forsyth (2008) argues that an air transport specific ETS would be an inefficient means of achieving a country’s targets. He also argues that the emissions reductions in aviation may be quite small, because they do not have much scope to reduce. Nonetheless, if the ETS operates sufficiently overall, there is no problem if aviation does not achieve a great reduction in emissions. The regulation has different percentages for the different options for allowances in the area of aviation.

The EC is following a multisectorial/multidimensional approach in handling the GHGs from aviation taking measures in the Member States separately and all together. According to EC (2016) EU ETS is one of the many measures the EC is using to handle environmental problems in aviation (Cui et al, 2016). Other measures are for example research projects for technology and biofuels, like Clean Sky Joint Undertaking or changes in the airspace structure like SES.

New Zealand is using an emissions trading scheme for domestic flights. Under this scheme, biofuels with or without sustainability requirement are not included, whereas in the EU ETS the biofuel need to comply with sustainability criteria. This would make the possible link between EU ETS and New Zealand ETS more complicated. Australia introduced a single price for carbon as an additional charge for aviation in 2012. The airlines can choose if this extra charge is through the airlines or the fuel provider. Australia and EC agreed to connect their ETS from 2015 and both sides to acknowledge-accept the emission allowances until the 2018 the latest (IATA, 2012).

IATA (2013b) stated that 'if the European Parliament and Council agree on the decision of derogating from Directive 2003/87/EC is adopted by and made permanent; the cost of the EU ETS is estimated at 30 million Euros in 2012 and 130 million Euros in 2020. That is significantly lower than the cost incurred without derogation, which is estimated at 300 million Euros in 2012 and 1.5 billion Euros in 2020'.

EC suspended the application of the Emissions Trading Scheme to all the airlines overflying Europe pending new impetus that might be given by the ICAO Council to find a multilateral solution to combating climate change in the aviation sector. European Commission decided to 'stop the clock' (Decision No. 377/2013/EU). According to this Decision air carries that depart or land to an EEA airport are not obliged to surrender any allowances back and are exempted from the EU ETS. Carriers that depart and land to an EEA airport are obliged to submit the same amount of allowances they were given. For example, a flight from JFK to FRA is not subject to EU ETS, but a flight from HRW is subject to EU ETS. Emissions from flights between aerodromes in the European Economic Area (EEA) remain fully covered under the EU ETS. Flights from and to outermost regions are excluded, with the exception of Canary Islands, Melilla, Ceuta Aland Islands, French Guiana, Guadeloupe, Martinique, Reunion, Saint Martin, Azores, Madeira, Jan Mayen, Gibraltar (EC, 2013).

The emission factor from biofuels according to the EU ETS is zero. Therefore, there is no need to return allowances and possible future costs are avoided. If the materials or fuels containing both, and fossil and biomass percentage, the percentage of biomass is the 'calculation factor' (EC, 2012).

Sustainability criteria should be applied to biofuels and bio-liquids consumed in order to assure that they have a zero emissions of greenhouse gases in the activities of the aircraft operator covered by EU ETS. A biogenic material that does not comply with the sustainability criteria of the Directive on Renewable Energy, as applicable, is considered as a mineral, i.e. the emission factor is greater than zero (EC, 2012). Last year, nine additional ETS programs started in North America, Central Asia and East Asia. Three additional schemes are to follow in 2014 –2015, bringing the expected total up to 16 by 2015.

3.3 Principles of carbon offsetting

Carbon Offsetting projects are an attempt to internalise the externalities associated with anthropogenic climate change. According to Golden Standards' Carbon Offset Handbook, Carbon Offsetting is "the financing of emission reductions outside of your flight's emissions." (The Gold Standard, 2012: 8) There are several ways of offsetting carbon emissions, ranging from purchasing carbon allowances from a cap-and-trade scheme, to using carbon credits from unregulated or regulated carbon offset projects (The Gold Standard, 2012). Each airpassenger can pay to offset the emissions caused by their share of the flight's emissions. Passengers can offset their emissions by investing in carbon reduction projects that generate carbon credits. For example a passenger when booking the ticket has the choise of donating money for instance to the Envira Amazonia Project. Envira Amazonia is a payment for ecosystem services forest conservation project, otherwise known as a Reduced Emissions from Deforestation and Degradation (REDD+) project, protecting nearly 500,000 acres / 200,000 hectares of tropical rainforest.

In addition, IATA discribes market possibilities for Carbon Offsetting. There are two markets for carbon offsets in aviation and in the overall industry: the voluntary and the compliance market. Both of them are a way for individuals or organizations to “neutralize” the proportion of aircraft’s carbon emissions on a particular journey by investing in carbon reduction projects according to IATA (2016a). Furthermore, there is also the possibility that indivudal customers participate directly in Carbon Ofsetting programs. Each airpassenger can pay to offset the emissions caused by their share of the flight’s emissions. Passengers can offset their emissions by investing in carbon reduction projects that generate carbon credits.

The main goal of buying carbon offsets is that they should generate genuine emissions reductions. In order to ensure the quality of the offset programmes, the following principles should be respected (Ecosystem Marketplace, 2014) (IATA, 2008a):

- **Additionality.** Additionality is the principle that carbon credits can only be awarded to projects that would not have happened under a “business as usual” scenario.
- **Verification.** Verification is the process, through which an external independent party quantifies, verifies and confirms the accuracy of estimates. With respect to these guidelines, it applies in particular to emissions of CO_2 from airlines and also to CO_2 reductions achieved through offset programmes.
- **Traceability**. Traceability is reached through a receipt given to the customer indicating the type of the project or the quality standard that the offset meets. By this way, it can be ensured that the carbon offset has not been used before and will not be resold to other customers in the future.

- **Complementarity**. Carbon offsets purchased should be part of wider efforts to reduce emissions alongside technological and operational improvements in fuel efficiency.
- **Registration**. Registration is used to keep track of offsets and diminish the risk of double counting. Moreover, registries also clarify the ownership of the offsets by a serial number.
- **Guarantee**. When purchasing emissions reduction, it should be guaranteed that in case of failure, and alternative and equivalent offset will be made.

3.4 Trading Units and carbon prices

According to ICAO, (Doc 9885, 2008) one allowance is generally defined as a permit to emit one tonne of CO_2-equivalent. There are companies that have excess credits, meaning they stay under the cap and have spare allowances that they can sell to other companies that exceed their allowances. This practice is based on the financial incentive of the buying/selling process. Consequently, trading emissions allowances is a way to offset carbon (The Gold Standard, 2012: 16). The credits offered by the International Emissions Trading are called Assigned Amount Units (AAUs). Additionally, to AAUs tradable units and pricing information for offset credits under the EU ETS are based on those used for the CDM and JI project-based mechanisms respectively (Kollmuss, et al., 2010).

There are two principal types of carbon credits: certified emission reductions (CERs), which are backed by the UN, and voluntary emission reductions (VERs). VERs are backed by recognised quality standards such as the Voluntary Carbon Standard (VCS) and the Gold Standard. VERs play an important role in emission projects with high sustainable development benefits (IATA, 2008a).

Table 4: A comparison of CERs and VERs (IATA, 2008a)

	VERs	CERs
UN or government approved	No – voluntary, verified, and not regulated by government	Yes – certified through UN CDM process
Single standard	No – depends on verifier. Subject to same variation as CERs	In principle yes, but subject to variation e.g. in geographical location and nature of project
Gold Standard	Can apply but not a requirement	Can apply but not a requirement
Other standards	VCS, VER+, VOS, CCBS	CERs are tradeable with units in the EU ETS
Forestry	Can include a wide range of forestry projects	Limited - inclusion of afforestation and reforestation
Price (per tonne of CO_2)	Generally, but not necessarily exclusively, less expensive	Generally, but not necessarily exclusively, more expensive

The project type, its location, the market demand and the stringency of the offset program requirements influence and set the offset prices. Offset prices in the compliance market are driven primarily by the supply of and demand for offsets and allowances. Therefore, the prices for mandatory market are higher than those of the voluntary offsets (Kollmuss et al, 2010).

There is a close relationship between carbon prices and industrial production. When increasing industrial production, rising and associated carbon emissions, need higher allowances to cover their emissions. However, due to tighter restrictions on the demand side under ceteris paribus, the carbon prices rise (Chevallier, 2012).

As stated earlier, the airlines have also the option to bank the excess allowances for future use. Allowing carriers to bank allowances for future use reduces social costs by efficiently distributing abatement choices among different time periods (Fell et al, 2008). The literature focuses on price versus quantity regulation and little attention is paid to prices versus bankable quantities. Wietzman (1974) researched extensively the topic price versus quantity regulation. He argues that differences in the relative efficiency between price and quantity controls are a result of the difference in marginal benefit and cost slopes as well as the degree of the prevailing uncertainty in the markets. According to Laffont

(1977), uncertainty in the marginal costs function creates an information gap on the side of the regulator. The regulator faces uncertainty about the demand that will arise for the allowances. If the expected marginal benefit function from reducing emissions is flater relative to the marginal cost of abatement, then a price control is preferred. If, however, the marginal benefit function is steeper, then a quantity control is preferred (Weitzman, 1974).

According to Weitzman (2014), setting an internationally harmonized carbon price involves only one layer of negotiations as opposed to two on quantity side. The EU ETS includes many countries and a common decision needs to be reached. According to a quantity-based system, the EU members need to agree on the single aggregate level of emissions or allowances as well as the distribution of aggregate allowances/emissions among them. On the other hand, under the price-based system they need to agree on a uniform price, which is more complicated and difficult to reach agreement.

With cap-and-trade, the total carbon emissions are known but the price or (marginal) cost is uncertain, whereas in the carbon tax the opposite happens. According to Weitzman (2014) the political appeal of giving free allowance permits to carbon-intensive industry groups makes the ETS more favourable to politicians. Grodecka and Kuralbayeva (2015) argue that hybrid instruments, i.e. a combination of price and quantity mechanisms, are superior to the sole use of either policies considered. They conclude that a cap-and-trade mechanism with banking or borrowing possibilities when considered quantity based regulation, can make quantity policies more flexible.

One key feature of EU ETS is its role in international efficiency and collaboration (Hepburn and Stern, 2009). The Clean Development Mechanism (CDM) of the Kyoto Protocol offers units falling in EU ETS able to reduce costs through the acquisition of emission rights from developing countries (Chevallier, 2012). The CDM concerns Certified Emissions

Reductions (CERs). One CER is equal to one tonne of emission reduction CO_2, while one European Union Allowance (EUA) is equal to one tonne of CO_2 emission allowances in the atmosphere (Chevallier, 2012: 106). However, there is a limitation in the amount of CER s purchased to comply with EU ETS. CDM received criticism due to the fact that it reduces the incentives of developing-country governments to enact policies reducing emissions (Hepburn and Stern, 2009).

There is uncertainty in estimating the costs for aircraft operators. This is associated with the price of allowances. There are two types of allowances that can be used: The European Union Aviation Allowances (EUAAs) and the European Union Allowances (EUAs). Credits of carbon dioxide from the flexible mechanisms of the Kyoto Protocol can also be used, but the limits imposed by EU ETS for 2013-2020 are significantly restricting the use of these funds (IATA, 2013b).

Table 5 Cost of purchasing allowances in EU ETS (IATA, 2013b)

	Intra-EU EFTA ETS Flights			All Flights		
	2012	2013	2020	2012	2013	2020
CO2, mt						
Forecast emissions	51.7	48.3	52.3	229.8	224.5	264.6
Emissions cap	55.3	54.2	54.2	214.8	210.3	210.3
Free allocation	47.0	44.4	44.4	182.6	172.5	172.5
Auction (15%+3% special reserve when applicable)*	8.3	9.7	9.7	32.2	37.9	37.9
Allowances required for growth (purchased from other sectors)	-3.6	-5.8	-1.9	15.0	14.1	54.3
Total allowances purchased	4.7	3.9	7.9	47.3	52.0	92.1
EUA price, €/tCO_2 (Point carbon 17/12/2012)	6.5	9	16.5	6.5	9	16.5
Cost of allowance purchases, € billion**	0.03	0.04	0.13	0.3	0.5	1.5
€ cents/gallon of jet fuel	0.6	0.7	2.4	1.3	1.9	5.5

* Special reserve is assumed to be auctioned

** Cost estimates assume no use of carbon offsets from the flexible mechanisms of the Kyoto Protocol and treat Croatia as not falling within the EU ETS

Over the past years, the prices for EUAs have changed greatly, with the maximum value being 240% greater than the minimum by the examination of the same asset class. Policy makers are considering various proposals to support the prices of EUA either through delayed auction either by removing rights to create greater market tightness (IATA, 2013b).

According to ICAO (Doc 9951, 2011) most airlines provide a fair degree of transparency about the price of offsetting a flight. There is a huge variation between the prices per tonne of CO_2 that customers can pay to offset their aviation emissions.

Countries, including developing and emerging economies, have taken action on emissions from aviation through more efficient airspace design, consideration of appropriate market-based measures (MBMs), as well as initiatives relating to alternative fuels and the development of a comprehensive emissions inventory (WWF, 2012).

3.5 Auction of Allowances and airlines' decisions making

The largest emissions trading market is the European Union Emissions Trading Scheme (EU ETS), which uses a combination of free allowances from governments and auctions. Initially the aircraft operators were given free allowances based on their historical emissions. This method is known as grandfathering allocation. The initial allowances were calculated with the benchmarking method that was only relying on the tone-kilometre and the aircraft type. The allocation from with the two above methods cannot be altered. The last allocation method that is used in the aviation sector is the allocation through auctions.

Auctions compared with the allocation of free allowances offer the advantage of better distribution, as stakeholders who need more allowances can obtain those allowances (Cong & Wei, 2012). The Kyoto protocol in order to help countries to achieve an effective reduction of emissions, introduced three flexible mechanisms (Cong & Wei, 2012):

- Emissions Trade (ET),
- Joint Implementation (JI) and
- Clean Development Mechanism (CDM).

In auctions there is a seller or buyer of a particular product / service (or products / services) and a number of bidders or sellers competing by submitting bids. The auctioning is one of the «purer» market forms according to Vettas & Katsoulakos (2004). A Regulatory Authority may organize auctions where companies buy licenses (such as licenses spectrum uses) or auctions where companies compete for a specific offered service. The European Energy Exchange (EEX) is a secondary market and is the only exchange in Europe with experience in EUA auctions on a regular basis. During Phase II of the EU ETS, it has successfully carried out weekly EUA primary market auctions for Germany, The Netherlands (2011/12) and Lithuania (in 2011/2012) (EEX, 2012). Moreover, it has set a minimum amount of about 500 EUAAs (= 500 t CO_2eq) (Minimum lot size) per transaction (EEX, 2013).

A distinction of auctions is open type and sealed deals. The open type auctions may be with increasing bids (English style) or with decreasing bids (Dutch) (Vettas & Katsoulakos, 2004). The English auction (Ascending price auction) is the oldest and most famous auction type. The sale is conducted by the auctioneer starting from a low value, which is increased by small increments. Here are at least two bidders. The auction ends when only one biller remains at the end.

On the other hand, the Dutch auction (Descending price auction) is not widespread and rarely used. In this case, the auction with a price so high that probably no one is interested in buying and then the value decreases continuously until a bidder express an interest and purchases the product at the price proposed.

There are two types of auctions, static / sealed and dynamic / clock auctions (Cong & Wei, 2012). Static auction can be further divided into single price auction, discriminatory price auction and second price auction, according to the different settlement price of the market. Alsemgeest et al. (from (Cong & Wei, 2012)) based on an economic experiment compared the English clock auction with sealed uniform price auctions, and found that when communication between candidates were prohibited and the market clearing price was announced after each round of the auction the sealed unit price gathered more revenue for the auctioneer from the English clock auction, which means that the bidders were easier to conspire in the English clock auction.

According to Klemperer (2002) a well-designed auction is very important. The two issues that really matter are a) to attract entry and b) preventing collusion (Klemperer, 2002). He argued that a good auction mechanism should be able to prevent bidders from collusion between them. According to Vetta and Katsoulakos (2004) it should be given close attention to how precisely an auction is planned and executed. The auctions are more flexible than selling in a fixed price and less time consuming to negotiate a price (Menezes & Monteiro, 2008).

The German auctions on the EEX follow the process of a single price, which is the EU's usual practice according to the German Emissions Trading Authority (DEHSt, 2012). It is a bidding round with closed 'book of bids". This simple and robust procedure protects against market manipulation and continued to be used for the auctions in the third trading period (2013-2020) for aviation. The common procedure in prices means that all contractors pay the same price. The auction clearing price is determined by ranking all eligible bids, beginning with the highest bid, according to the bid price. In case of equal tenders, bids are sorted by a random process. The number of tenders is counted starting from the highest offer until the volume of offered allowances is reached. The bid price at which the total volume of bids reaches or exceeds the offered volume of auctioned allowances determines the auction clearing price.

Between October and December 2012, 23,531 million allowances of the third trading period (EUA), were auctioned weekly in EEX. In addition, 2.5 million EUAAs were auctioned in 2012 for air transport in the ETS yielding 17.525 million Euro (DEHSt, 2012). Around 15% of EUAAs, i.e. around 30 million euro per year will be auctioned from 2012 until 2020 (EEX, 2012).

Table 6 German early auctions of the third trading period (Early Auctions) and the EUAA auction of 2012 (DEHSt, 2012)

Auction segment	„Early auctions“
Auction product	EUA third trading period spot contracts
Period	26.10.2012 to 14.12.2012
Auction frequency	Weekly (Fridays, 09:00 to 11:00 hours)
Auction volume per auction	3 million EUAs (2.531 million EUAs on 14.12.2012)
Bid volume	500 EUA
Auction mode	Single-round, uniform-price procedure with a closed order book

Auction segment	Aviation emission allowances
Auction product	EUAA 2012 spot contracts
Auction date	31.10.2012 (09:00-11:00 hours)
Auction volume	2.5 million EUAAs on 31.10.2012
Bid volume	500 EUAA
Auction mode	Single-round, uniform-price procedure with a closed order book

Table 7: EUAA auction in 2012 (EEX, 2012)

Date	Contract	Volume	Cover ratio	Bidders	Bidders successful	Price	Revenue
31/10/2012	EUAA spot 2012	2,500,000	1.82	6	5	€7.01	€17,525,000

Source: EEX, DEHSt

The ‘Stop-the-clock’ Decision foresees auctioning of 15 % of 2012 aviation allowances in circulation. Returned 2012 aviation allowances were cancelled and thus were not considered as allowances in circulation. Allowances not auctioned before 1 May 2013, will be auctioned as 2013-2020 aviation allowances instead. Table 8 depicts slightly increasing prices on certain occasions. The increase is not considerable but it may be attributed to the flights number increase during the summer season.

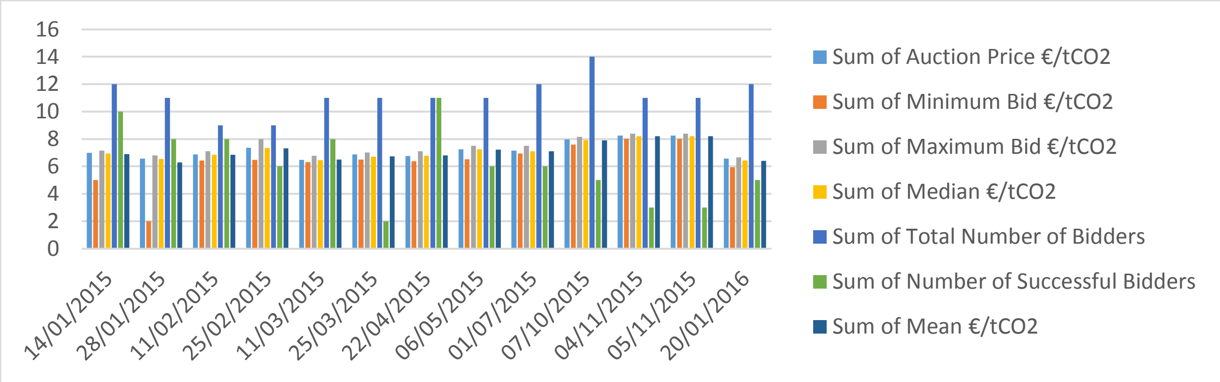

Table 8: EUAAs Spot Primary Market Auction Report 2015 (EEX, 2016)

Date	Auction Price €/tCO_2	Min Bid €/tCO_2	Maximum Bid €/tCO_2	Number of Bidders	Number of Successful Bidders	Auction Volume tCO_2	Total Revenue €
14/01/15	6.99	5	7.16	12	10	1,494,000	10,443,060
28/01/15	6.56	2	6.80	11	8	1,494,000	9,800,640
11/02/15	6.87	6.42	7.10	9	8	1,494,000	10,263,780
25/02/15	7.35	6.47	8	9	6	1,447,500	10,639,125
11/03/15	6.48	6.32	6.77	11	8	1,494,000	9,681,120
25/03/15	6.88	6.5	7.01	11	2	433,500	2,982,480
22/04/15	6.75	6.38	7.10	11	11	1,493,500	10,081,125
06/05/15	7.25	6.51	7.50	11	6	935,000	6,778,750
01/07/15	7.16	6.94	7.50	12	6	935,000	6,694,600
07/10/15	7.97	7.60	8.15	14	5	781,500	6,228,555
04/11/15	8.25	8.01	8.38	11	3	933,000	7,697,250
05/11/15	8.25	8.01	8.38	11	3	933,000	7,697,250
20/01/16	6.57	5.95	6.65	12	5	683,500	4,490,595

The seller seeks to maximize its income, which is through the price paid by the purchaser or, more precisely the expected utility of the price, as this is usually uncertain. The seller, however, can have also other purposes than profit maximization and can make another selection. For example, if a Greek carrier auctioning its extra allowances might be interested in the identity of those who acquire them (perhaps because they are competing carriers whose position is strengthened excessively with the sale of such allowances).

In the process of the auction, a bidder faces three types of uncertainty, a) uncertainty regarding the value of the item being auctioned, b) strategic uncertainty related to the strategies followed by the other players and c) uncertainty about the characteristics of his opponents (Laffont, 1997). It is like imperfect information games. Auctions according to Laffont (1997) are interesting since the rules of the game are well defined and many restrictions are available to define the structural models. In addition, the data are most public and accessible compared with the data of monopolies. Friedman presented a method to determine the best offer in a first-price of a sealed bid auction. Capen et al (in (Laffont, 1997) generalizing the model of Friedman, suggested that the bidders have to protect themselves from underbidding which should increase with the number of bidders.

Auctions of emissions trading have a special feature; the bidders can "save" their unused allowances for future use. Saving of rights entails makes intertemporal bidders' abatement costs verge to equal, fact that offers flexibility in reducing emissions and the corresponding costs (Cong & Wei, 2012). The bidders' attitude to risk (risk neutral, risk averse, risk loving) affects significantly their behaviour in auctions (Vettas & Katsoulakos, 2004). Finally, earnings from auctions can be invested in environmental protection programs and to limit distortions of this tax (Cong & Wei, 2012).

According to Vickrey (from Tietenberg 2006) there are several types of auctions but for emission trading the focus is concentrated in the following separation a) auctions producing a profit for the government and b) those that do not. A common auction platform facilitates the widest participation from across the European Union and, therefore, mitigates at greatest risk of having participants undermining the auctions by using them as a means for money laundering, the financing of terrorism, criminal activities or for market abuse (EU No 1031/2010).

To ensure that the operation of EEX is done without manipulation and influences, continuous surveillance is conducted by the independent Market Supervision Office (Handelsüberwachungsstelle, HÜSt), as required by the German law. HÜSt DEHSt refers to the results of monitoring activities through regular internal reporting. HÜST reported that the auction of allowances was held in EEX on behalf of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, in October, November and December 2012 in accordance with the procedure laid down without disturbance. For this period, the Market Supervision of EEX found no irregularities and especially no behaviour of bidders that sought to manipulate the price of the auction (German Emissions Trading Authority (DEHSt), 2012):

Two very important concepts in the theory of auctions are:

- Individual Rationality: The expected profit from the transactions for each participant of the mechanism should not be smaller than the gain for any other mechanism. The mechanism should give incentives from the beginning for the participation of agents at auction.
- Auctioneer's Utility maximization: the utility function of auctioneer in relation to all other mechanisms implementations must be maximized. Typical parameters of this function are money gain and the estimation of what goods are not traded.

Airlines are asked to take a decision if they will participate in an auction either for buying or selling allowances. Decision theory examines the processes of making rational decisions under uncertainty. However, when uncertainty provides an opportunity for some others to take advantage of this, then there is the theory of competitive sector decisions, i.e. game theory (Amadae, 2016). The game theory studies the strategic situations that are like games, i.e. how decisions are made by people who interact with each other (Nicholson & Snyder, 2016). The sectorial economics and particularly the dimensions of oligopolistic competition were areas where game theory has found fertile ground (Pacos, 1997).

This is a situation where (a) N (> 1) individuals, businesses, governments, trade unions, etc. (so-called players) make some choices in order to satisfy everyone's interest and (b) the result of each player does not depend only on its own choice, but by the choices of the other N-1 players (Amadae, 2016; Varoufakis, 2001). A game involves players, actions, information, strategies, benefits, results and balances (Waldman & Jensen, 2012). The games can be cooperative or non-cooperative (Nicholson & Snyder, 2016). The concept of Nash[6] equilibrium is part of a broader set of tools used to analyse strategic behaviour, known as non-cooperative game theory (Morgan et al, 2009). In cooperative games, players can make agreements, while in non-cooperative such agreements are not possible (Nicholson & Snyder, 2016).

In incomplete information games, players simply ignore the actions selected by other players. However, they know who the other players are, the possible strategies / actions. Therefore, the information on the other players in the incomplete information game is complete. In partly completed information games, players may know or not some information about other players, e.g. their type, their strategies.

Information serves as a very important role in game theory. When each player knows every move that the other player will make before he makes it then this is called a game with perfect information. In game theory, a non-player who makes random effects is called nature. If a game includes nature, but it does not move first, or if the first movement of nature is observed by all the players, then the game is characterized by comprehensive information. If nature never moves after the opening of one of the players, then the game is certain information.

However, if all players have the exact same information when each player is moving, the game is symmetric information, and if players have different information then the game is asymmetric information (Waldman & Jensen, 2012). A game called imperfect information

[6] Nash equilibrium is defined as the dominant solution in which both players do their best, given the opponent decision (Waldman & Jensen, 2006, p. 170)

game where a player must make a move but is unable to know the previous or simultaneous movement of another player, and when one or more players are unsure about any part of the tree then there is incomplete information game (Morgan et al, 2009).

The main models of the game theory are:

- The first model is the so-called Nash equilibrium. According to this model, the strategy of each agent is the best response to the strategies of the other agents, regardless of their types, given that they select also an equilibrium strategy (best response).
- A second, more powerful model is that of dominant strategies. In this model, the strategy of each agent is the best response to the strategies of the other agents, regardless of what those are.
- The third and weakest of the above models is that of Bayesian Nash equilibrium. According to this, each agent chooses its strategy to maximize the expected utility based on beliefs about the distribution of all types.

Harsanyri talked extensively about Bayesian Nash Equilibrium. His approach is to turn a game with imperfect information in a game with no perfect information (Menezes & Monteiro, 2008). Any buyer has imperfect information about the values of other buyers is considered as not sure of their type. It is like recommending one extra player (nature) which selects the type of each player. When there is nature it is referred to the randomness of with whom someone plays a game. A pair of strategies (a *, b *) is defined as a balance if the a * represents the optimal strategy of the player A when the player B selects the b *, and b * represents the optimal strategy of Player B when A chooses a *.

A strategy that works at least as well as any other, no matter what the other player is doing, is called dominant strategy. The set of dominant strategies and outcomes arising is called dominant strategy equilibrium (Morgan et al, 2009). Absolute strategy is a strategy that defines a particular action in each decision point, while the term mixed strategy is referred to the one that allows random arrangement between actions in some or all decision points (Morgan et al, 2009).

According to Stabler, Papatheodorou and Sinclair (2010) game theory is extremely useful for explaining the behaviour and predicting the results of strategies for pricing, product selection and differentiation, advertising, investment capital, mergers and acquisitions, and the barriers to entry. Game theory has greatly improved the understanding of interactions of firms in monopolistic market and its results in dynamic situations (Stabler et al, 2010).

An interesting phenomenon is the curse of the winner (winner's curse) suggesting that if someone wins an auction with common values, understands that submitted more "aggressive" offer from the others, who thus seem to have been less positive (for the value of the object / service) information, as a result, every buyer should be more conservative in the price tender (Vettas & Katsoulakos, 2004). Capen et al also studied extensively the "winner's curse" whereby the winner tends to be the one who exaggerates what is worth to him and one can win but has sacrificed too much evidence for this victory (Laffont, 1997).

For example, assume two competitive airlines, airline A and airline B. Both airlines are FSNCs and serve the same market, have the same characteristics and they is intense rivalry between them. Both airlines have the same availability of resources, the same access to R&D and should comply with EU ETS. Airline A decides to make only operational improvements on the engines by washing them more often. The cost of this action is very small as well as the benefit for fuel consumption and emissions. Airline A will need to buy allowances in order to comply with the EU ETS.

On the other hand, airline B decides to invest in fleet renewal. The total cost of its operations will increase due to the purchase cost of the new aircraft; it will reduce the fuel consumption and will have more allowances available to sell or bank. Airline B will have increased its cost per available seat resulting to an increase in the ticket price. Hence, many passengers will choose airline A instead of the more expensive airline B. Moreover, Airline B will have excess allowances that it could either bank or sell. Banking all the allowances is not a necessity for airline B since next year it will still have excess allowances. Therefore, the airline B will need to sell allowances in the auction. Since there will be a larger supply of allowances in the market thanks to airline B strategic decision to renew all the airplanes, airline A can buy 'cheap' allowances. Should the airline A or the airline B have known the strategic choices of each other the result could have been different.

According to Forsyth (2008) in the short run, competition in markets is not expected to decrease substantially: and prices will not rise to the level of the cost increase leading to reduced airline profitability. Reality proved that the EU ETS targets were not strict enough to create scarcity in the market. This would require an allowance price of € 20 to substantially increase the cost of operations.

3.6 Calculation of carbon dioxide emissions by ICAO

Technological improvements contribute to the reduction of fuel burn and emissions. According to International Council on Clean Transportation report (ICCT, 2016), the fuel consumption of new aircraft designs could be cut by 25% in 2024 and 40% in 2034. Although improvements in aircraft and engine technology and the efficiency of the ATM will bring environmental benefits, this will not fully offset the effects of pollutant emissions resulting from the projected growth in aviation (IPCC, 1999). The methodology followed by the ICAO (ICAO, 2014b) to measure the carbon dioxide emissions from aviation is based on distance travelled. The ICAO is using the best existing public display data on fuel consumption. It also seeks to improve the model, updating and searching data constantly to have a better estimate of emissions. As emissions of passenger aviation affected by changing variables, specific to each flight, it is necessary to establish general parameters.

The calculation of carbon dioxide emissions (Carbon Emissions Calculator, CEC) from ICAO requires the user to enter the departure and arrival airports for a direct flight, which is then compared to a published flight schedule to find the type of aircraft serving these airports and the number of departures for each aircraft. After fuel consumption is found for the aircraft, the load factor and passenger load index are introduced for finding the total fuel consumption. The system then calculates the average consumption for the trip weighted by the frequency of departures for each aircraft type. This is then divided by the total economy class passengers. The result is then multiplied by 3.157, which represents the number of tons of CO_2 produced by burning one ton of aviation fuel to calculate the footprint of carbon dioxide from every passenger travelling between the two airports.

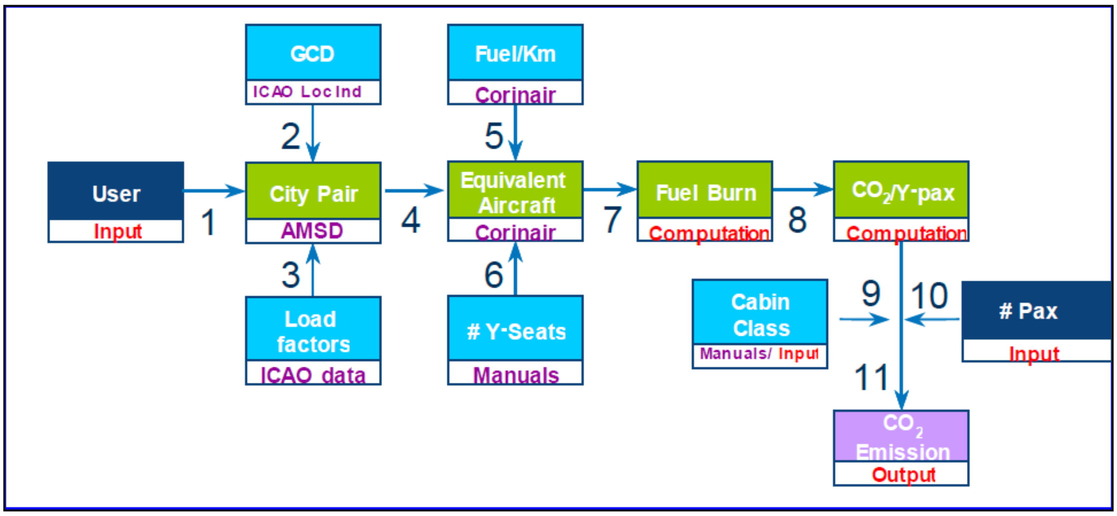

Figure 11: Emission calculation procedure of carbon dioxide from the ICAO (2014b)

Figure 11presents the process followed by the ICAO of calculating CO_2 emissions. The first step is the introduction of the airports of origin and destination. Code share flights are treated as one, while those with a different flight number must be calculated separately and then added by the user. The second step is the distance of travel, calculated from the coordinates of airports and the optimal path (Great Circle Distance). Then a passenger load factor is given in the defined by the user city pair, based on passenger load factor for the respective groups of path. Information about the load rate taken from the database, based on 17 groups of international routes and an additional 5 domestic areas. In the fourth phase, the aircraft from the database of scheduled flights is recognized and connected with the EMEP / CORINAIR base, which has a fuel consumption figure for aircraft. The relation of fuel consumption with the distance covered is shown by the Emissions Inventory Guidebook. The flight scheduling of passenger carriers is published on Official Airline Guide (OAG) and the ABC World Airways Guide (Wensveen, 2007).

According to Figure 11, the parameters taken under consideration are (ICAO, 2014b):

1. User input – The user enters the origin and destination airports. The database is searched for all flights, direct or non-direct, serving that city-pair. However, the tool does not compute total emissions for journeys with different flight numbers (connecting flights). To do this, the user can choose to build a total by calculating each of the journey legs separately and adding them up.

Code share flights are treated as a single flight. This avoids a possible double counting of flight departures that would otherwise affect the calculations.

The origin and destination database includes individual routings for single flight numbers with multiple stops. Hence, the passenger does not need to know, nor input the full itinerary of the flight.

2. Trip distance – The ICAO Location Indicators database contains the longitude and latitude coordinates for the airports. From these coordinates the Great Circle Distance (GCD) 1 is then calculated and corrected by a factor depending on the distance between the two airports concerned.

3. Traffic data – A passenger load factor is assigned to the user-defined city-pair, based on the passenger load factor for the corresponding route groups. Load factor information is obtained from the database, based on 17 international route groups plus 5 domestic areas.

4. Aircraft mapping – From the scheduled flights database, the scheduled aircraft is identified and linked to the aircraft fuel consumption database European Monitoring and Evaluation Programme/ Core Inventory of Air Emissions (EMEP/CORINAIR). When the scheduled aircraft is not in the database, the aircraft is mapped into one of the fifty equivalent aircraft types existing in the aircraft fuel consumption database. Appendix B provides details of how this mapping was done. This allows estimation of the total fuel use on each route serving the user-defined city-pair.

5. Fuel burn data – The fuel burn to flight distance relationship is extrapolated from the Emissions Inventory Guidebook (EIG) prepared by EMEP/CORINAIR. The factors considered include passenger load factor, flight distance, the proportion of the overall payload represented by passenger traffic, cabin class flown, and type of equivalent aircraft flown. The amount of fuel used on a route is the weighted average of total fuel burnt based on the frequencies of the scheduled aircraft types flown.

6. Economy Class (Y) seat capacity – From cabin floor plans obtained from the "Manual on Airplane Characteristics for Airport Planning", which is developed by manufacturers to provide necessary data to airport operators and airlines for airport facilities planning, the maximum number of Y-seats that can be fitted per equivalent aircraft is determined. This "virtual" all economy configuration later allows the computation of cabin class factors (steps 9 & 10).

7. / 8. **CO_2 per economy passenger** – Using the trip distance, equivalent aircraft fuel consumption, passenger to seat load factor and passenger to freight load factor for the

route group, and the number of Y-seats, the methodology calculates the CO_2 associated to each passenger, as follows:

$$\mathbf{CO_2\ per\ pax} = \frac{\mathbf{3,157 * total\ fuel * pax\text{–}to\text{–}freight\text{–}factor}}{\mathbf{number\ of\ Y\text{–}seats * pax\ load\ factor}}$$

The estimated annual emissions can be calculated from the fuel consumed, using the following formula for jet kerosene:

$$\mathbf{Estimated\ annual\ emissions\ [in\ tonnes\ CO_2] = annual\ fuel\ consumption\ [tonnes] * 3,15\ [\frac{tonnes\ CO_2}{tonnes\ of\ fuel}]}$$

Note: For aviation gasoline and jet gasoline the emission factor (EF) of 3.15 should replace with 3.10 (EC, 2016).

Aircraft operators determine the CO_2 emissions using a simplified version of the standard emission methodology using the following formula (EC, 2012):

$$\mathbf{Em = AD * EF}$$

Where:

Em: CO_2 emissions

AD: Activity data (= amount of fuel consumed in tonnes)

EF: emission factor (tonnes CO_2/tonnes fuel)

3.7 Monitoring, Reporting and Verification

Monitoring, reporting and verification (MRV) of emissions play an important role in the reliability of any emissions trading scheme. Without MRV, there would not be transparency in compliance and it would be much more difficult to enforce. Therefore, MRV applies to the EU Emissions Trading Scheme (EU ETS). It is the complete, consistent, transparent and accurate monitoring, reporting and controlling that creates trust in the emissions trading system. This is the only way to ensure that air carriers and aircraft operators comply with their obligation to surrender sufficient allowances (EC, 2012).

The EU ETS is an instrument based on the market. The market participants therefore want to know the monetary value of the options granted to them, trade and must hand back. At the same time, it is a means of ensuring and achieving environmental benefits in Europe level. This requires a significant level of fairness among participants, ensuring a stable MRV system to ensure that a ton CO_2 emitted "meets" the corresponding tonne mentioned (under the principle that: a tone must be a tone). The competent authorities monitor to ensure that the objectives set by the "cap" are achieved (EC, 2012).

In order to ensure efficient implementation of the directive for EU ETS, every aircraft user is assigned to only one member-state. In case the aircraft user holds a valid Air Operator Certificate (AOC) that is given by a member state according to the EU regulation 2407/92, the member state that gave the licence is the one that is responsible. In all the rest cases, the member state where most of the emissions take place is the responsible one.

Every aircraft user should monitor its annual emissions from activities that are involved in EU ETS (EC, 2012). The annual process of monitoring, submission of reports, compliance checks and acceptance of the reports about the emissions from the competent authority is usually referred as compliance cycle (EC, 2012).

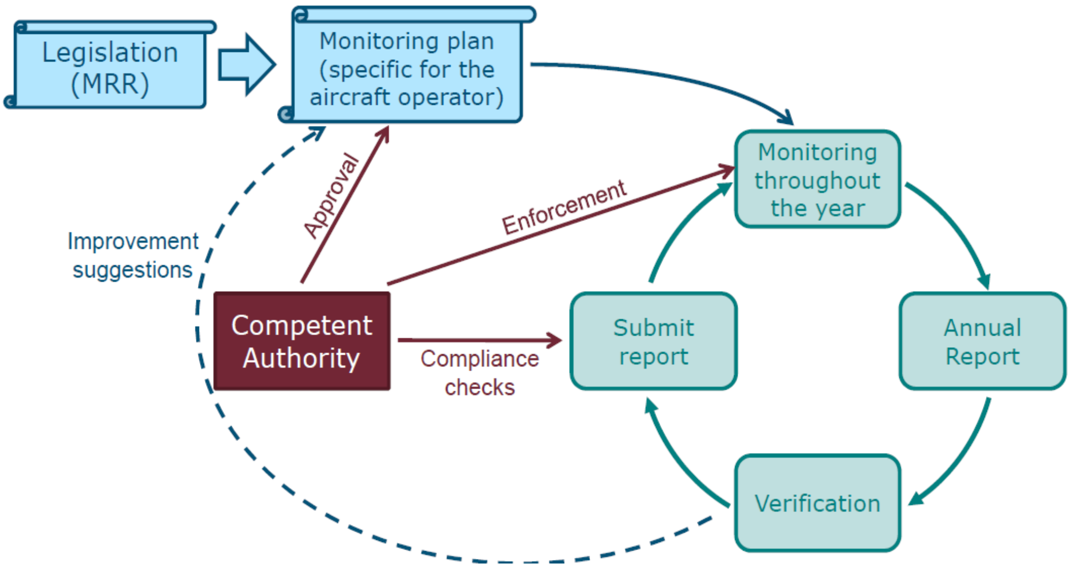

Figure 12 The compliance cycle of EU ETS

The cycle in the right side of Figure 12 is the main cycle. The airline is monitoring its emissions during all year. After the end of the calendar year (within 3 months), the airline should prepare its annual report about its emissions (AER), ask for verification and submit the verified report to the Competent Authority (CA) as indicated by Reg N0 100/2014. The last report should be associated with the surrender of the allowances to the system. Monitoring continues without any break until the end of the year. The process is very important for the trust towards the system and the credibility of EU ETS. The process should also be consistent during all the years thus the airline should ensure that the monitoring process is documented and cannot change without any notice. Regarding the EU ETS, the written process is called Monitoring Program (MP) (EC, 2012).

Figure 12 also depicts some very important responsibilities of the CA. CA should focus on the compliance of the aircraft users. The first step is to approve every monitoring plan before its implementation. Nevertheless, the compliance cycle has a wider perspective. Finally, there is a second cycle. This is the tactical re-examination of the monitoring plan, for which the verified form might offer important information. Moreover, the aircraft users are requested to continuously try to improve the methodology of monitoring (EC, 2012).

The common information for the monitoring plan involve the following actions from the aircraft user (the application depends from specific situations/cases):

- Gathering of information
- Description and explanation of calculations used
- Control activities (e.g. 4-eyes for the data collection)
- Archiving of data
- Frequent identification of areas of improvement

The compliance cycle of EU ETS replies on the fact that the monitoring process is following the year calendar. The MP should be approved by the CA before the start of the first year for the emissions, i.e. the first year for the allowances trading like 2013. Whereas for new aircraft operators, it is obligatory their MP to be submitted to the CA at least 4 months before they start operating flights that are controlled by the EU ETS (EC, 2012).

In practice, what is difficult to be achieved is that many times the aircraft operators do not really know in advance that they will operate in EU destinations. In addition, some aircraft operators do not know early enough with state is theirs CA. Thus, article 51 allows the following deviations (EC, 2012):

- An aircraft operator that flies a route that is under the EU ETS for the first time and it could not predict that it will fly this route 4 months in advance, should submit a MP to the CA without any delay but at least 6 weeks before is start flying this route.
- When the CA is not known in advance, the airline without unjustified delay should submit the MP when the information about the CA becomes available.

The EU ETS for MRV is a fundamental element for the success of the system. Every required parameter for the emissions monitoring has different levels of quality of data. Tier/Level means a set requirement used for determining activity data, calculation factors, annual emission and annual average hourly emission, as well as for payload (EC Reg No 601/2012, art 3).

Most of the airline companies do not have information about how the used carbon credits are tracked or registered (Interview with Airline representative, 2016). Without registration and tracking, the credits (or the reductions/removals from which they were created) may be sold more than once. In most cases, this information is only available at the website of the offset provider. All CERs are tracked through national registries under the Kyoto Protocol, and Gold Standard VERs are tracked using the Gold Standard Registry. Beyond these two cases, it is not always easy, or even possible, to find information about how credits are tracked.

3.8 Carbon Leakage

The EU ETS has been criticized as having failed to provide the necessary incentives to reduce emissions, it produces undesirable distributional effects and that distorts competition because of divergent rules between the different sections (Clo, 2010). Carbon leakage is one of the main issues in environmental policies for climate change. The carbon leakage is defined as the increase in CO_2 emissions outside of the countries with domestic policy mitigation[7] divided by the reduction of emissions of these countries. The increase in local prices of fossil fuels resulting, for instance, from mitigation policies can lead to a shift of production to areas with less stringent mitigation rules (or no rules at all), resulting in increase of emissions in these regions and therefore to carbon leakage. Moreover, the decline in global demand for fossil fuels and the consequent reduction in the prices of fossil fuels can lead to increased consumption of fossil fuels in countries that have not

[7] Climate Change Mitigation refers to efforts to reduce or prevent emission of greenhouse gases. Mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behaviour (UNEP, 2016).

taken steps to mitigate and, therefore, at risk of carbon leakage. However, the investment attitude in many developing countries may be such that they are not ready yet to benefit from such a leakage. The different emission limitations in different areas can also affect the choice of technology and the emissions profile in areas with fewer or no restrictions (Metz et al, 2007).

In short, carbon leakage is the prospect of rising GHG emissions when a company transfers production out of a country, because it cannot pass the cost increases caused by climate change policies to customers without significant loss of market share absence of a legally binding international climate agreement (Department of energy and climate change, 2013).

The leakage rate or index leakage reduction is the ratio between the increase in greenhouse gas emissions in countries that do not belong in Annex I because of climate policy and the reduction of greenhouse gas emissions in other countries of Annex I because of that policy. The estimated leakage reduction rates in applied models vary significantly, from 2% to 130% (Monjon & Quirion, 2011). The mathematical formulation of the rate of carbon leakage can be defined as the increase in CO_2 emissions in non-abating (NA) countries (who are not trying to reduce emissions) caused by domestic reduction measures in abating (A) countries as a percentage the absolute value of the volume reduction of CO_2 emissions derived from compliant countries, according to the following equation (Antimiani et al, 2013; Barker et al, 2007):

$$\boldsymbol{CL\,rate} = \frac{\boldsymbol{\Delta \mathrm{C}O_2^{NA}}}{\left|\boldsymbol{\Delta \mathrm{C}O_2^{A}}\right|} * \mathbf{100}$$

The Carbon leakage is a very important factor in the design of the 3rd phase of the EU ETS (De Bruyn, Nelissen, & Koopman, 2013). For the 3rd phase of the EU ETS auctioning is referred to be the basic mechanism for allocating emission allowances. However, an important exception is made for the areas "deemed to be exposed to a significant risk of carbon leakage". These areas receive free allocation to the statutory limits at Community level, at least until 2020 (De Bruyn et al, 2013: 11).

The two criteria presented in the revised Directive (2009/29/EC) to assess if an area is exposed to carbon leakage were related to the additional cost of carbon and the volume of trade. In short, areas with significantly high additional cost of carbon and / or highly exposed to the global market through international trade will take continued free allocation of emission allowances for 2013-2020 until the limits have been set at Community level (De Bruyn et al., 2013).

Areas were classified as "at risk of carbon leakage" through the comitology procedure will receive free allowances each year to a fixed reference point by 2020. Areas not classified so received a free 80% of allowances in 2013 and will be reduced each year by small increments until reaching 30% in 2020. The rest of the required allowances need to be bought at the ETS market or one of the regular auctions for new allowances. Therefore, the decision about whether an area could be classified as "exposed in carbon leakage" has important economic consequences for businesses participating in EU ETS (De Bruyn et al., 2013).

There are three distinct types of leakage. First, there is leakage through product markets, where competitors from the EU may face a competitive disadvantage because of the cost of carbon into the price of products. The products outside the EU will get a bigger share of the market, so the production that is not under an emissions cap is increased. Secondly, there is leakage through the capital markets, where investments are made in countries without climate policies, because these investments may have higher yields due to the absence of the cost of carbon. The third is the leakage through the energy market, where reduced energy demand in the EU leads to a lower price of fossil fuels worldwide, which stimulates consumption in other countries (De Bruyn et al., 2013:.14). One of the proposed measures to limit carbon leakage is free allowances and easy access to international units (De Bruyn et al., 2013).

3.9 Different Carbon offsetting programs

Carbon offsets play a role in both compliance and voluntary carbon markets. In compliance markets, such those created by the Kyoto Protocol or the EU ETS, governments and regulated facilities have mandatory, legal emission obligations, and can use offsets, such as CERs, as an alternative to reducing their own emissions. The CDM is currently the only program that can issue offsets from developing countries for use in compliance markets. In contrast, voluntary market offset programs such as the Gold Standard (GS), the American Carbon Registry (ACR), and the Verified Carbon Standard (VCS) issue offsets that can be used by businesses, governments, NGOs, and individuals electing to offset their emissions for other reasons, such as corporate or individual social responsibility.

Table 9: Some project types (IATA, 2008a)

Main supporters	Market share	Third-party verification required	Separation of verification and approval process	Registry	Project types	Excludes project types with high chance of adverse impacts	Price of offsets
Clean Development Mechanism Certified Emission Reductions (CERs)							
UNFCCC parties	large	yes	yes	yes	All less REDD, new HFC, nuclear	no	€14–30
Gold Standard							
Environmental NGOs (e.g. WWF)	small but growing	yes	yes	planned	EE, RE only	yes	VERs: €10–20 CERs: up to €10 higher
Voluntary Carbon Standard 2007 (VCS 2007)							
Carbon market actors (e.g. IETA)	new, likely to be large	yes	no	planned	All less new HFC	no	€5–15
VER+							
Carbon market actors (e.g. TÜV SÜD)	small but growing	yes	no	yes	CDM less large hydro	yes	€5–15
Voluntary Offset Standard (VOS)							
Financial industry and carbon market actors	N/A	yes	no	planned	CDM less large hydro	yes	N/A
Climate, Community and Biodiversity Standards (CCBS)							
Environmental NGOs (e.g. Nature Conservancy) and large corporations[15]	large for LULUCF	yes	no	N/A	LULUCF	yes	€5–10

Offsets can be sourced from various types of project activities (IATA, 2008a: 14):

- LULUCF (Land Use, Land Use Change and Forestry)
- Avoided deforestation
- Reforestation of former forest areas
- Afforestation of new areas
- Other types of land use projects
- Industrial greenhouse gas offsets
- Reduction of emissions and/or destruction of hydrofluorocarbon compounds (HFC_S)
- Reduction of emissions and/or destruction of nitrous oxide (N_2O)
- Methane (CH_4) capture and use in energy generation
- From landfills
- From mines

- From anaerobic digestion of, for example, livestock wastes
- Energy efficiency
- More efficient stoves
- More efficient power generation
- Light bulb replacement
- Use of “waste” energy in co-generation
- Renewable energy
- Wind turbines
- Hydroelectricity
- Solar, thermal and photovoltaic systems

The main points to consider when selecting a project include: Standard, i.e. what verification and auditing procedures are in place; Price, for instance, the VERs, from the voluntary carbon market, are generally cheaper than CERs from the regulated Kyoto market; Relevance to your business; Geographical location; and Resonance with customers, for instance, those projects with social and economic benefits to local communities may appeal more (IATA, 2008a).

3.9.1 ICAO and the environment

Under the 1992 UN Framework Convention on Climate Change (UNFCCC), the 1997 Kyoto Protocol (article 2(2)) tasks ICAO to secure the reduction of GHGs from aviation. In 2004, ICAO adopted three major environmental goals (ICAO Doc 9902, 2007), to:

1. limit or reduce the number of people affected by significant aircraft noise;
2. limit or reduce the impact of aviation emissions on local air quality and
3. limit or reduce the impact of aviation greenhouse gas emissions on the global climate.

In July 2012, the ICAO Council's Committee on Aviation Environmental Protection (CAEP) developed a range of Standards to address aircraft noise and local air quality. They adopted an Aircraft Carbon Dioxide (CO_2) Emissions Calculation System as the first building block towards a global CO_2 standard for new aircraft (ICAO, 2014b).

The ICAO Council formed a special High-level Group on International Aviation and Climate. Change (HGCC) to provide near-term recommendations on a series of policy issues related to the feasibility of a global MBM scheme appropriate to international aviation (ICAO, 2012). Its aim is to examine ICAO's development of a policy framework to guide the general application of any proposed MBM measures to international air transport activity (ICAO, 2012). These steps on November 2012 led the EU to propose the suspension (Stop the clock) of the application of its ETS to international flights (EC, 2014).

The International Civil Aviation Organization (ICAO) Assembly (191 members) meeting in 2013 agreed to develop a global scheme based on market-based measures (MBM) to limit CO_2 emissions from international aviation. The 39th ICAO Assembly in October 2016, reached a global agreement for environmental protection. The member states agreed that environment is of critical importance and 65 states including US, China and all EU countries signed up for voluntarily participation between 2021 and 2026 in the Carbon Offset and Reduction Scheme for International Aviation (CORSIA). CORSIA is a carbon-offsetting scheme and is the first global measure covering an entire industrial sector. CORSIA 'is expected to offset around 80% of global airline carbon dioxide (CO2) emissions above 2020 levels between 2021 and 2035' according to De Juniac, Director General of IATA (ATWonline.com, 2016).

MBMs provide financial incentives and disincentives to guide the behaviour of regulated entities towards lowering emissions (ICAO, 2013b). Under the policy framework adopted by the ICAO in 2010, MBMs are included in a "basket of measures" that Member States can use to address CO_2 emissions produced by international aviation and presented in their Action Plan (ICAO, 2013b). MBMs offer flexibility to participants to select between the implementation of emission reduction measures within their own sector, or offsetting those CO_2 emissions in other sectors. This is particularly important for the aviation industry, where in-sector emissions reductions are expensive and limited (ICAO, 2013b). Moreover, MBMs give financial incentives to guide behaviour towards environmentally responsible activity.

In June 2012, the ICAO Council narrowed the MBM options to three (ICAO, 2013b):

1. Global Mandatory Offsetting
2. Global Mandatory Offsetting with Revenue
3. Global Emissions Trading

Moreover, ICAO Assembly resolved that when states were designing new schemes and implementing existing schemes, they should:

- engage in bilateral or multilateral negotiations with other states to reach an agreement and
- grant exemptions to developing states whose total revenue tonne kilometres of international civil aviation is less than 1%.

ICAO and the European Commission (EC) signed in 2013 a Declaration of Intent, affirming their collaboration on assistance and capacity building activities to support actions to mitigate carbon emissions produced by international aviation (ICAO, 2013b). The Global Environment Facility (GEF) has approved the project concept, and has earmarked USD 2 million toward a new joint assistance initiative between the United Nations Development Programme (UNDP) and ICAO to reduce aviation emissions (ICAO, 2013b).

Furthermore, ICAO is requested to continue with the ICAO Global Framework for Aviation Alternative Fuels (GFAAF) and to gather information on the progress of alternative fuels in aviation, including through State action plans, in order to attain a global view of the future use of alternative jet fuels, and to account for changes in life-cycle Green House Gas emissions to evaluate the progress toward sustainability (ICAO, 2013).

In addition, the U.S. Federal Aviation Authority (FAA) is working on different programs to reduce emissions. In 2010, the FAA initiated the Continuous Lower Energy, Emissions and Noise (CLEEN) program to develop technologies to assist in reducing the environmental impact of commercial aviation (FAA, 2016). This Continuous Lower Energy, Emissions and Noise (CLEEN) program is a part of the FAA's aviation and airspace improvement program "NextGen" and focus on helping to accelerate the development and commercial deployment of environmentally promising aircraft technologies (FAA, 2016).

3.9.2 Voluntary carbon offsetting

The voluntary carbon offsetting refers to all voluntary actions to reduce carbon emissions. In this case, there is not a formal exchange, since this action is not part of a cap-and-trade system. It can also be referred to as the voluntary Over-the-Counter market. Continental Airlines, SAS AB, Delta Air Lines, Cathay Pacific Airways, Virgin Blue are only some of the airlines that have launched a voluntary carbon-offsetting program for passengers who want to offset their flights carbon dioxide emissions. Airlines offer individual carbon offset programs for marketing reasons in order to appear environmentally conscious.

IATA's program brings standardisation to the process and makes it possible for airlines, either smaller or bigger, to easily introduce a credible and independently validated offset program (IATA.org, 2016b). Around 32 IATA airlines have launched their own schemes using different carbon calculators and investing in emission reductions with variable quality (Schneider, 2012). Airlines are offering carbon credits stemming from renewable or other high quality projects that follow the stringent quality requirements of the Quality Assurance Standard for Carbon Offsetting (QAS) (IATA.org, 2016b). QAS-approved carbon offsets are audited against at least 40 criteria (Quality Assurance Standard, 2014).

IATA approved offsets must carry one of the following high quality certificates:

- CERs issued under the Clean Development Mechanism (CDM)
- VERs -Gold Standard or VCS version 2007 onwards
- Approved offsets based on land use employ sustainable REDD+ project[8] methodologies.

IATA in addition offers a Carbon Calculator that follows the ICAO methodology enhanced with real airline data.

3.9.3 Examples of other ETS outside of Europe

In 2008, Québec, a province in east-central Canada, joined the Western Climate Initiative (WCI) and actively contributed to the design of its regional carbon market. The Québec government launched its trading system in 2012. Its regulation was modelled on the architecture set up by the WCI. In its first two years, the Québec ETS covers electricity and industrial GHG emissions. However, from 2015, it also includes emissions from fossil fuels distribution (ICAP, 2016).

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[8] Reducing Emissions from Deforestation and Forest Degradation (REDD) is an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. "REDD+" goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks. The implementation of REDD+ must co-exist with significant emission reductions in both developed and developing countries to curb climate change (UN-REDD Programme, 2014).

The Québec Cap-and-Trade Regulation sets a minimum price for allowances sold at auction. At the first auction, which was held on Dec. 3, 2013, the minimum price, or “floor price”, was 10.75 CAD (about 7.25 EUR). The price will rise annually by five percent plus inflation until 2020. This guarantees a progressively stronger carbon price signal to the Québec economy (ICAP, 2014).

Covered entities in the Québec ETS must report their GHG emissions using specific and internationally recognized protocols. Furthermore, emissions data must be verified independently by an accredited verifier in accordance with ISO standards. The WCI stipulates that regulations and standards must be harmonized among its members. This ensures that one ton of GHG emitted and calculated is the same across the partnership (ICAP, 2016).

In October 2013, Québec and the California Air Resources Board signed an agreement to link their respective schemes from January 2014. A first joint auction of emission allowances is expected in 2014. As WCI members, Québec and California have cooperated closely for the past five years and have strengthened their partnership over this period. The signing of the agreement completed a year-long negotiation process, marked by excellent cooperation, to harmonize and integrate their respective ETS regulations. The link between the two systems creates the largest carbon market in North America, and the first transnational cap-and-trade system run by subnational governments in the world (ICAP, 2014).

The Emission Trading Scheme of Shenzhen city (SZ ETS) was launched on June 18, 2013, as the first carbon market in a developing country and in China (ICAP, 2014). The allocation to the power sector and the water supply sector was based on benchmarking. For manufacturing industries, given the large number of industry segments and the wide variety of products, processes and device facilities, the allocation team decided on a carbon intensity allocation method, based on carbon emissions per unit of industrial added value (ICAP, 2014).

3.10 Linking Emissions Trading Schemes

The term “linking” describes that the one system’s allowances or another system’s commercial units can be used directly or indirectly by one system joining another system for compliance (Crubb, 2009). The linking of systems creates larger emission reduction systems with better financial liquidity and harmonized prices without distortions due to competition, and thus less vulnerable (Tuerk, et al., 2009). The existing emission trading systems differ in size, cognitive characteristics, cost-containment and geographical scale, but also the type and volume of trading units (Tuerk, et al., 2009). Nevertheless, all the emissions trading systems wish to connect to the Clean Development Mechanism (CDM) (Tuerk, et al., 2009).

The direct connection allows transactions between different systems and can be distinguished by whether they allow trading in one or more directions. According to a unilateral connection, entities belonging to the system A can buy and use rights coming from the system B for compliance, but not vice versa (Tuerk, et al., 2009). If the system A establish a one-way connection recognizing rights from system B, and the rights price of system A is higher, trading between systems will occur until prices converge at an intermediate level. If the price of the system A is lower, there will be no incentive for trade between the two systems (Tuerk, et al., 2009). A critical factor in unilateral connections is the effect it will have the A system that will be connected to B system (Tuerk, et al., 2009). The connection of big cap and trade system with a smaller will increase the price of the small equalling to the value of the largest (Tuerk, et al., 2009).

In a complete linking, emission rights are traded freely between two or more systems and are equally valuable for compliance (Tuerk, et al., 2009). There is the option of using as intermediate link the Clean Development Mechanism (Tuerk, et al., 2009). In addition, areas with rising carbon prices due to linking systems will experience more leakages. The opposite will occur in areas with declining prices (Tuerk, et al., 2009). There is also the possibility the caps be relaxed to the countries in order to benefit from the additional sales (Tuerk, et al., 2009). The economic impact of linking emissions trading systems can be of three types (Flachsland et al., 2009): a) quasi-static, short-term gains efficiency; b) dynamic efficiency gains; and c) the distribution results.

To link two or more emissions trading systems among themselves, the following parameters should be considered (Tuerk, et al., 2009):

- Monitoring, Reporting and Verification (MRV) rules for allowances
- Banking provisions
- Registries
- Rules governing new entrants and closures
- Compliance periods
- Allocation methods
- Relative stringency of targets
- Stringency of enforcement
- Eligibility of offset credits
- Intensity targets
- Cost-containment measures.

EU ETS involving aviation could be associated with a bilateral agreement with one or more of the following programs (Haites, 2009):

- A domestic trading scheme in a country with an emission reduction commitment under the Kyoto Protocol or a future agreement, such as EU ETS or Swiss ETS

- A trading system that is not linked to the UNFCCC, such as RGGI or the Chicago Climate Exchange.

The CDM does not require returning units or rights and thus a bilateral agreement with the CDM is not an option (Haites, 2009).

3.11 Summary

Carbon offsets should be part of a climate strategy by a company/organization. Aviation for instance, cannot be carbon neutral, since it operates in an energy mix based in fossil fuels. A climate strategy is not enough in order the company to eliminate internally the emissions. According to Gössling and Upham (2009) two developments have substantially affected aviation, EU ETS and the continuous rise in fuel prices. This trading scheme shall provide economic incentives to reduce CO2 emissions based on market principles as well as set fix limits of the mount of emitted emissions. The Kyoto Protocol and the EU ETS are based on the principle that the emission of pollutants is a commodity and a measure is required to calculate the degree of equivalence between the different gases.

Emissions trading is a market-based policy tool that can be used to promote economic efficiency in achieving environmental goals. By harnessing market forces, emissions trading regimes can create incentives for economic agents to discover and implement cost-effective approaches to complying with environmental targets. The aircraft operators are obliged to monitor and report their annual emissions to their Competent Authority (CA). The CA should make compliance checks on the surrendering of allowances, inspect the monitoring throughout the year and approve (or not) the GHG permit and monitoring plan pf the aircraft operators. It is evident that the aircraft operators and the CA have many responsibilities and a lot of documentation to fill in as well as well as management procedure.

4 Single European Sky

As discussed in previous chapters the traffic in Europe is increasing and the Air Traffic Management (ATM) system is deemed insufficient to accommodate the traffic in a sustainable way. A proof of this insufficiency is the comparison between Europe and USA. EUROCONTROL and US Air Traffic Organization (FAA-ATO) identified the differences of ATM performance. As shown in Table 10, Europe is similar to USA in terms of total surface of continental airspace, but USA controls approximately 59% more flights operating under Instrument Flight Rules (IFR) with less Air Traffic Controllers (ATCOs) and fewer facilities.

Table 10: US/EUROPE Key ATM System Figures (EUROCONTROL and FAA, 2013)

Calendar Year 2012	Europe	USA	US vs. Europe
Geographic Area (million km^2)	11.5	10.4	≈ -10%
Nr. of civil en route Air Navigation Service Providers	37	1	
Number of Air Traffic Controllers (ATCOs in Ops.)	≈17 200	≈13 300	≈ -23%
Total staff	≈58 000	≈35 500	≈ -39%
Controlled flights (IFR) (million)	9.5	15.2	≈ +59%
Flight hours controlled (million)	14.2	22.4	≈ +59%
Relative density (flight hours per km^2)	1.2	2.2	≈ x1.8
Share of flights to or from top 34 airports	67%	66%	
Share of General Aviation	3.9%	21%	
Average length of flight (within respective airspace)	559 NM	511 NM	≈ -11%
Number of en route centres	63	20	-42
Nr. of APP units (Europe) and terminal facilities (US)	260	162	-98
Number of airports with ATC services	≈ 433	≈ 514	+81
Of which are slot controlled	> 90	4	
ATM/CNS provision costs (in billion €2011)	8.4	7.8	-12%
Source	EUROCONTROL	FAA/ATO	

Moreover, Europe has 37 ANSPs, 63 Area Control Centres (ACCs), 260 Approach control units (APPs). The European states have individual military needs and requirements thus there is a difference in the number and locations of Special Use Airspace (SUA).

According to the study (EUROCONTROL and FAA, 2013), the number of restricted and segregated areas in Europe is higher and they are more scattered which potentially affects the level of flight inefficiency and capacity from the system point of view. Flight and cabin crew, aircraft ownership, fuel, maintenance, handling and catering infrastructure, passenger services and distribution and other costs are the main costs for all airlines and an airline is managing the costs according to its business model. For instance, the Low Cost Carriers (LCCs) have a different unit cost than the Full Service Network Carriers (FSNCs) and follow different cost reduction strategies. ANS costs are the only costs that are the same for every carrier and the way the carriers operate does not affect the ANS cost significantly. All carriers are charged the same unit rate when they fly above a European Civil Aviation Conference (ECAC) country.

The European sky is one of the busiest skies in the world with as many as 33,000 flights a day (EC, 2015). The increased traffic, problems in capacity, climate change and the necessity of developing a more cost efficient system led to an ambitious initiative to reform the architecture of the Air Traffic Management (ATM). This initiative was first launched by the European Commission in 1999 and is called Single European Sky (SES).

4.1 The Single European Sky concept

European sky according to EUROCONTROL is fragmented in small insufficient blocks that use a wide variety of Air Traffic Control (ATC) technology. The fragmentation resulted in safety risks, delays in flights and increased cost. Thus, better coordination for transferring the responsibility of an airplane between two ATC sectors in Europe is needed.

The European ANS system covers 37 ANSPs, 60 control centres, is 10.8 million km^2 and the estimated costs of fragmentation of airspace amounts to 4 billion EUR a year according to EC (2015).

SES is based on the four following main regulations:

- the Framework Regulation establishes the European Commission as the regulator for the civil sector and the Single Sky Committee to assist it in its regulatory activities;
- the Airspace Regulation which will establish a single European Upper Information Region and within it organize airspace into functional airspace blocks (FABs);
- the Service Provision Regulation establishes a common licensing system for civil ATM providers; and
- the Interoperability Regulation which aims to ensure that systems, equipment and procedures operate seamlessly.

The main target of the Scheme is to restructure the European ATC in accordance with the traffic flows, to create additional capacity and to increase the efficiency of the system preserving and increasing the safety standards. Finally, the delays due to inefficiency will be reduced. Functional Airspace blocks (FABs) are one of the tools that where implemented by SES to overcome these problems (EUROCONTROL, 2008:1).

The stakeholders of the SES are the following:

- European Commission as regulator
- The EU Member States in their capacity as Civil Aviation Authorities and National Supervisory Authorities
- Airline associations like the International Air Transport Association (IATA), the Association of European Airlines (AEA), and the European Regions Airlines Associations (ERA)
- Trade Unions such as the European Transport Workers Federation (EFT) and Air Traffic Controllers European Union's Coordination (ATCEUC)
- EUROCONTROL as Network Manager
- SESAR JU, EASA, ICAO

The SES program aims at separating the regulatory role of the competent services and service providers to provide an improved governmental control of the increasing number of privatized service provider and to establish common rules and standards. Thus, the ANSP was separated by the CAAs. Furthermore, the program intends to reorganize the European airspace so as not to longer be limited by national borders. This allows the complete unification of European airspace between 29,000 ft and 46,000 ft and to establish more direct flight paths between origin and destination. With this unification of European airspace, each airline would be free to determine the route to be followed by the aircraft, saving time, fuel and money.

4.2 Functional Airspace Blocks

One of the core elements of the SES initiative are the FABs, which aim to reduce the inefficiencies – in terms of safety, capacity, and cost – that result from the European airspace fragmentation. A Functional Airspace Block (FAB) is an airspace block based on operational requirements, reflecting the need for integrated management of the airspace regardless the existing boundaries of Flight Information Regions (FIR's), where the provision of air navigation services and related functions are oriented to performance and are optimized looking forward to implementing of cooperative relationship between the ANSPs in each FAB. Because FIRs are often limited by national boundaries, FABs also provide the potential to overcome bilateral restrictions and to provide a more efficient overflight from one territory to the next.

The functional airspace blocks follow the bottom up approach and are one of the tools introduced by the "Single European Sky (SES)”, in order to enhance the security, the overall system efficiency of air traffic management in Europe, to create additional capacity to meet the needs of airspace users and reduce delays. The FAB's can improve the planning and organization of airspace.

The Single European Sky (SES) is a flagship European initiative to overhaul the control of European air traffic, to meet future capacity and safety needs. Based on the steps taken in the late 90s, the Single Sky package I was adopted (SES I) in 2004 and the Single Sky II package (SES II) in 2009 (EC, 2012).

According to the European Commission (2012), it is anticipated that with the implementation of the SES:

- the safety will improve by ten times;
- the capacity of airspace will triple;
- the cost of air traffic management will reduce by 50%;
- the impact on the environment will reduce by 10%.

The weakness caused by the fragmented European airspace result in additional costs of nearly 5 billion annually. In any average flight added to the mileage of 42 km, resulting in the aircraft consumes more fuel, creating more emissions, increasing the burden on users and there are longer delays. U.S.A. controls the same volume of airspace with more traffic with almost half of the cost. With the consolidation of the European sky and the consolidation of related services, FABs will reduce the impact of aviation on the environment and reduce the cost of flights that today represent billion every year (EC, 2012).

The categorisation of FABs was done using geographical criteria according to European Commission. Nine FAB initiatives have been taken (as seen in Figure 13); two of these have already been implemented, namely the UK-Ireland and Denmark-Sweden FABs from 2014:

1. NEFAB (North European FAB): Estonia, Finland, Latvia, Norway.
2. Denmark-Sweden: Denmark, Sweden

3. BALTIC FAB Poland, Lithuania
4. FABEC (FAB Europe Central): France, Germany, Belgium, Netherlands, Luxembourg, and Switzerland
5. FABCE (FAB Central Europe): Czech Republic, Slovak Republic, Austria, Hungary, Croatia, Slovenia, Bosnia and Herzegovina
6. DANUBE Bulgaria, Romania
7. BLUE MED Italy, Malta, Greece, Cyprus, (and Egypt, Tunisia, Albania, Jordan as observers)
8. UK- IRELAND FAB United Kingdom, Ireland
9. SW FAB (South West FAB) Portugal, Spain

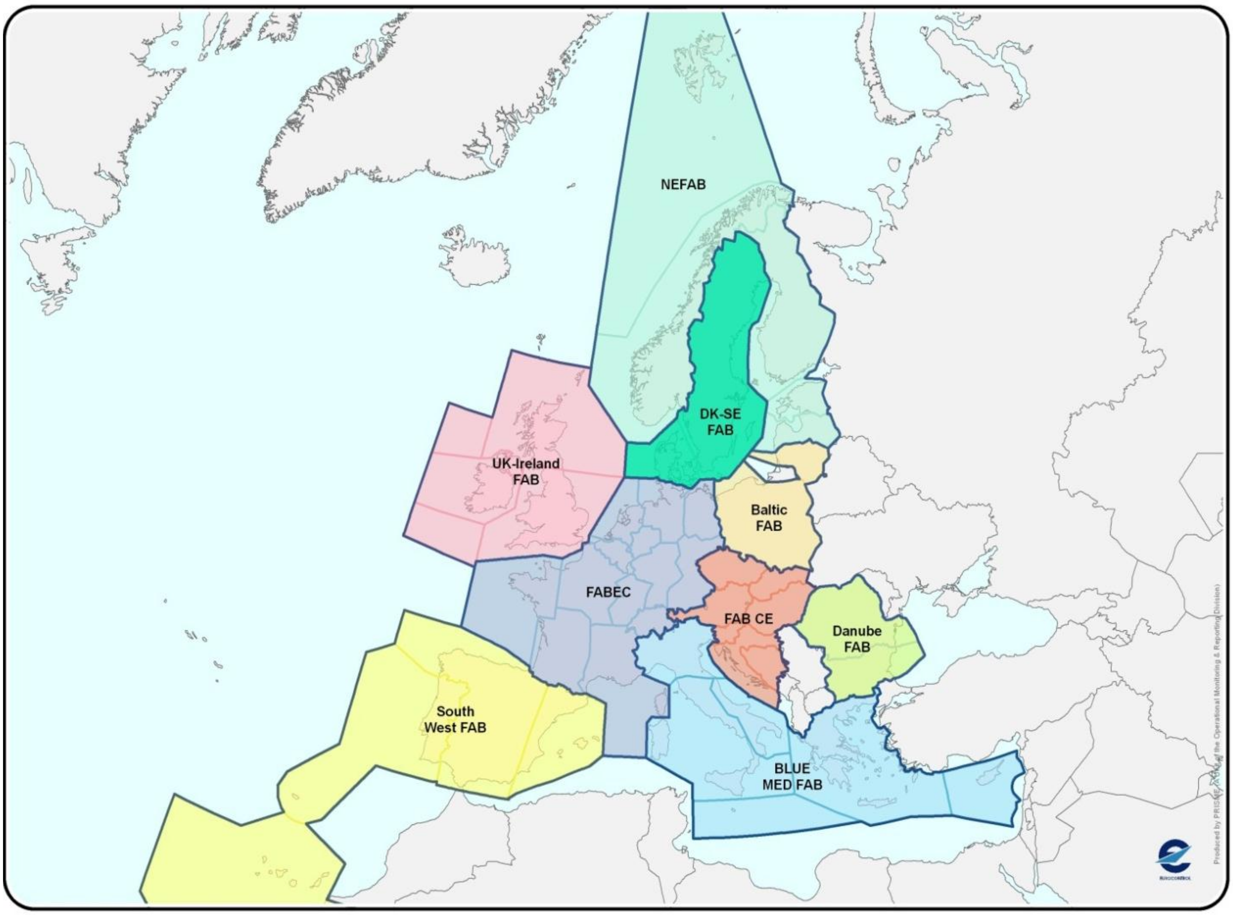

Figure 13: The geographical scope of FABs (EUROCONTROL, 2016a)

These initiatives extend beyond the borders of the EU. This proves the openness of approach for functional airspace blocks.

Table 11: Functional Airspace Blocks

NEFAB (North European FAB)	
Member States - ANSPs	1. Estonia -Estonian Air Navigation Services (EANS) 2. Finland -Finavia 3. Latvia -Latvijas Gaisa Satiksme (LGS) 4. Norway – Avinor
Area (million km2)	0.7
Denmark-Sweden	
Member States-ANSPs	1. Denmark - Naviair 2. Sweden - LFV (Luftfartsverket)
Area (million km2)	0.8
BALTIC FAB	
Member States-ANSPs	1. Poland - Polish Air Navigation Services Agency (PANSA) 2. Lithuania- Oro Navigacija
Area (million km2)	0.4
FABEC (FAB Europe Central)	
Member States-ANSPs	1. France - Direction des Services de la navigation aérienne (DSNA) 2. Germany - Deutsche Flugsicherung (DFS) 3. Belgium - Belgocontrol 4. Netherlands- Luchtverkeersleiding Nederland (LVNL) 5. Luxembourg 6. Switzerland- Skyguide
Area (million km2)	1.8
FABCE (FAB Central Europe)	
Member States-ANSPs	1. Czech Republic - Air Navigation Services of the Czech Republic (ANS CR) 2. Slovak Republic - Letové prevádzkové služby (LPS) 3. Austria - Austro Control 4. Hungary - HungaroControl 5. Croatia - Croatia Control - Croatian Air Navigation Services 6. Slovenia- Slovenia Control 7. Bosnia and Herzegovina

Area (million km2)	0.5
DANUBE	
Member States-ANSPs	1. Bulgaria - Bulgarian Air Traffic Services Authority (BULATSA) 2. Romania- Romanian Air Traffic Services Administration (ROMATSA)
Area (million km2)	0.4
BLUE MED	
Member States-ANSPs	1. Italy - ENAV (Ente Nazionale di Assistenza al Volo) 2. Malta- Malta Air Traffic Services (MATS) 3. Greece 4. Cyprus (plus Egypt, Tunisia, Albania, Jordan as observers)
Area (million km2)	1.7
UK- IRELAND	
Member States-ANSPs	1. United Kingdom 2. Ireland - Irish Aviation Authority (IAA)
Area (million km2)	1.3
SW FAB (South West FAB)	
Member States-ANSPs	1. Portugal - NAV Portugal (pt) (Navegação Aérea de Portugal) 2. Spain -ENAIRE (ENAIRE)
Area (million km2)	2.9

It is evident from the map that the criteria were not only geographical. For example, NEFAB and Denmark-Sweden FAB prove that the criteria are also political and/or operational. In addition, in terms of geographical coverage the FABs are not equally categorised. For instance, Baltic FAB or Danube cover an area of 0.4 million Km2 whereas South West FAB covers an area of 2.9 million Km2. Another important element is the traffic. The annual total en-route service units in 2015 for SW FAB were 18.2 million whereas Danube had 7.8 million terminal service units (TSUs) (EUROCONTROL, 2016a). Another important element is the complexity of the airspace. Where there are special use airspace (SUA) areas, the complexity of navigation can be an issue and the workload of the pilots and ATCOs is increasing. Thus, the categories are not equally balanced in terms of traffic, covered area, number of states, ANSPs and traffic complexity.

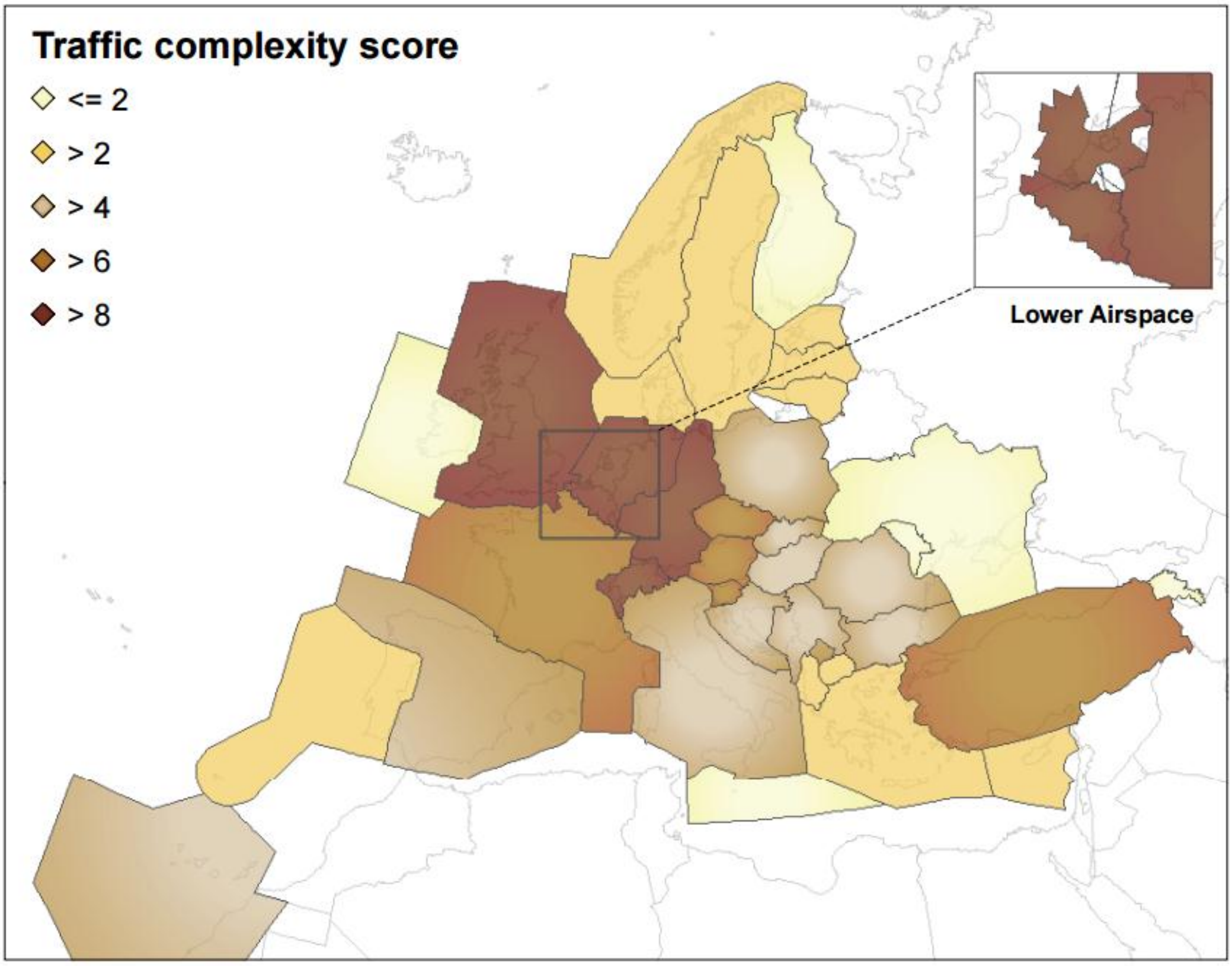

Figure 14: Traffic complexity scores (EUROCONTROL, 2016a: 13)

Maastricht Upper Area Control Centre (MUAC) is a successful example for the harmonised European sky. MUAC is an international non-profit air navigation service provider, operated by EUROCONTROL on behalf of four States – Belgium, Germany, Luxembourg and the Netherlands. Someone could argue that MUAC should be extended to other countries, but this depends on the political willingness of the states in question to transfer control of their national airspace. MUAC airspace size is 260,000km2, has around 4,470 flights per day, 1.6 million flights per annum and the 98.9% of the flights are on time with an average delay per flight of 0.17minutes.

To manage this busy and complex airspace, MUAC is organised on a multinational, cross-border basis. The area of responsibility of MUAC in Belgium, Germany, Luxembourg and the Netherlands consists of the Brussels UIR (Upper Information Region), the Amsterdam FIR and the Hannover UIR from flight level 245 to flight level 660. It has to be noted that over 17% of all European flights use MUAC's airspace (EUROCONTROL, 2016b). It is part of FABEC that covers the 55% of the European traffic (FABEC.eu, 2016).

For the 11th consecutive year, the ATM Cost-Effectiveness (ACE) 2012 Benchmarking Report confirms MUAC as one of Europe's best-performing Air Navigation Service Providers with the highest controller productivity. The Free Route Airspace Maastricht and Karlsruhe (FRAMaK) project delivers a total of 466 direct routes in the upper airspace controlled by MUAC and the Karlsruhe UAC, creating a large-scale, cross-border direct route network over Belgium, most of Germany, Luxembourg and the Netherlands.

Traffic is one of the main issues that affect the productivity and the profitability of the ANSPs. Traffic flows are related to the number of passengers and the origin-destination airport. The gentle flow of traffic can explain schedules, which seem excessive in relation to traffic origin-destination (Wensveen, 2007). By nature, traffic flows differ from case to case, depending on the geography, route structure and alternative services available. Some cities because of favourable conditions to their geography derive more benefit from the traffic flow, unlike some other cities. A company cannot change that, and a carrier may not assume that a city A can support a specific type of service because a city B receives such services. The traffic can therefore vary from city to city depending on the geography and route structure, but even in the same city varies from year to year depending on the type and intensity of nonstop services that can bypass this city (Wensveen, 2007). The main aim of Air Traffic Flow Management is to balance air traffic demand with system capacity to ensure a safe, efficient utilization of the Airspace System.

In 2021 according to EUROCONTROL (2015a) forecasts there will be 11.4 million IFR movements (±1 million) in Europe figure that is 19% more than in 2014. In 2014, the number of flights increased by 1.7% compared to 2013. As for the flights, this forecast is partly driven by a weak economic growth in some parts of Europe. Sport events, like EURO and Olympics, swifts to traffic flows due to airspace unavailability, like parts of Eastern Ukraine, Syria, Iraq and Libya, or GDP changes are aspects that influence traffic and are taken into consideration on the forecasts.

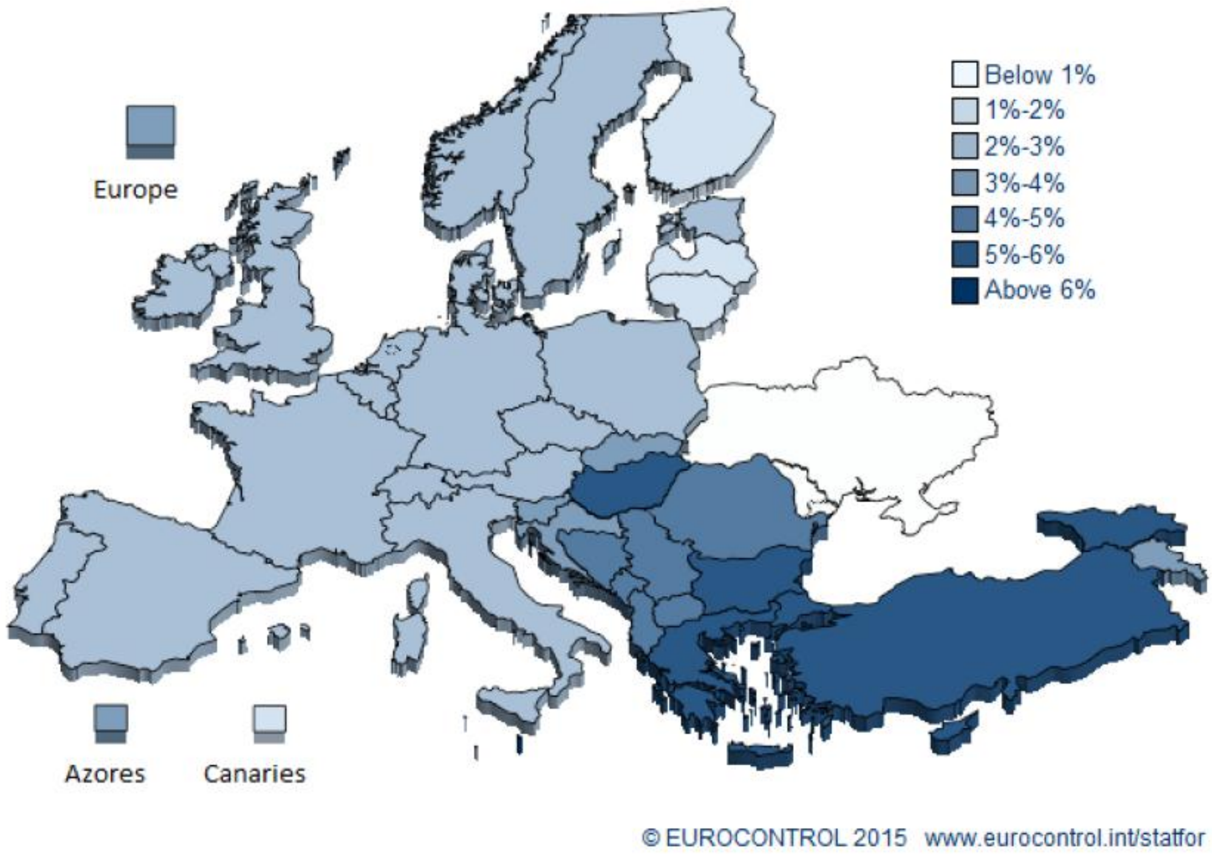

Figure 15: Average annual flight growth 2014-2021 per state (EUROCONTROL, 2015a)

France, Germany, Spain followed by UK, Italy and Belgium/Luxembourg are still the busiest states in terms of number of extra flights per day, but Turkey has the fastest growth rates (6.0% as average annual growth rate over the 7 years) and the highest number of extra flights per day (2,330 additional flights per day in 2021) and is the biggest contributor to the growth in Europe (EUROCONTROL, 2015a: 38).

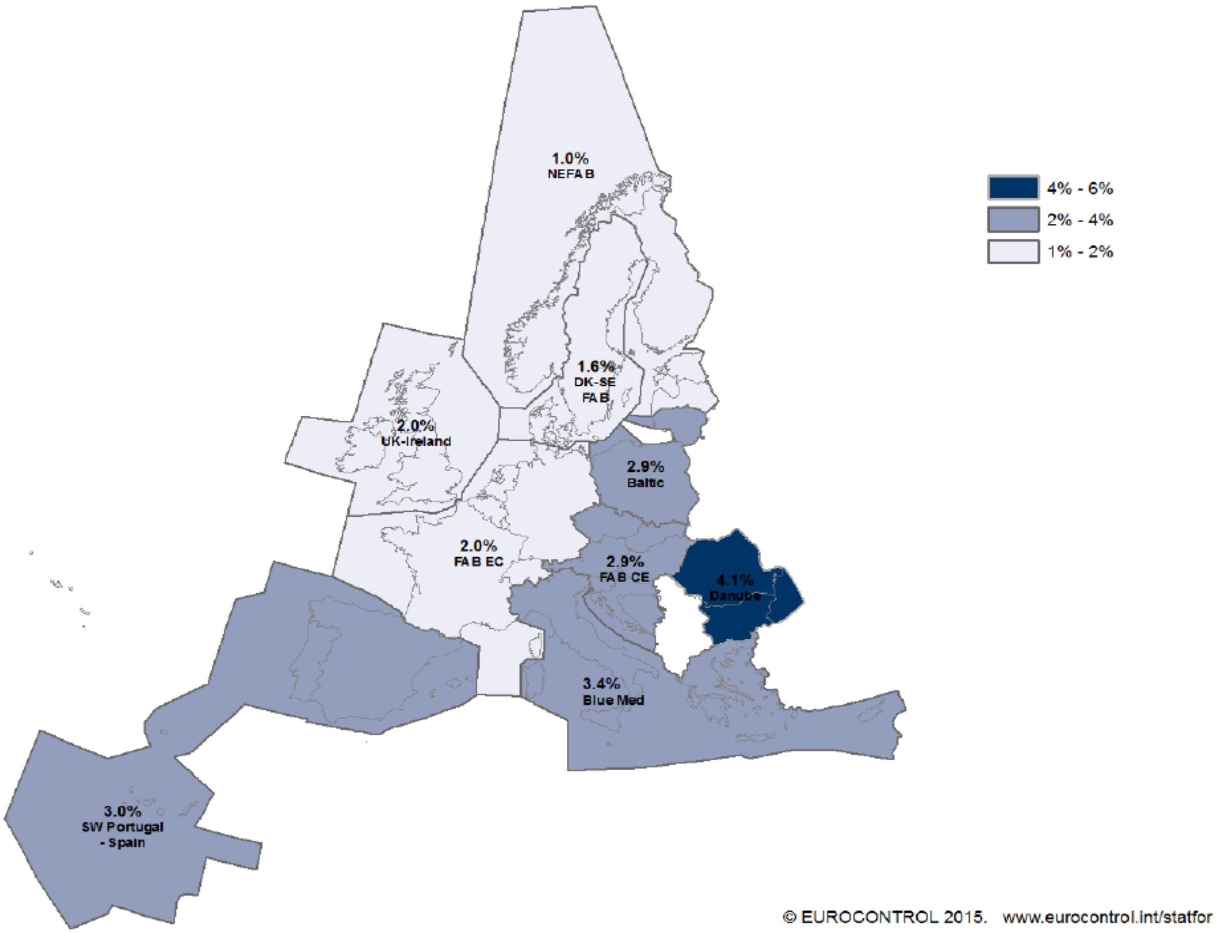

Figure 16 Average Annual Growth per FAB, 2021 v 2014 (EUROCONTROL, 2015a)

Danube FAB is expected to have the highest average annual growth rate (4.1%, ±1.7 pp) over the next seven years. Blue Med FAB and South West FAB are the busiest European FABs with respectively 3.4% and 3% average annual growth rate. NEFAB and DK-SE FAB will experience more limited average annual growth rates of respectively 1% and 1.6% by 2021 (EUROCONTROL, 2015a: 38).

The income of the ANSP is under the use pays principle and is coming from en-route charges and from terminal charges. There are different sorts of air navigation charges; route charges, terminal navigation charges, and communication charges (EUROCONTROL, 2016a). The charging is defined according to the zone the airspace user is flying at. The zones are of two kinds: en route charging zones and terminal charging zone. The 'en route charging zone means a volume of airspace for which a single cost base and a single unit rate are established and the ‘‘terminal charging zone means an airport or a group of airports for which a single cost base and a single unit rate are established according to the Commission Regulation (EC) No 1794/2006 of 6 December 2006 laying down a common charging scheme for air navigation services. Charges are directly cost-related. If the traffic is very low in one airspace, the charges could be increased in order for the ANSP to recover the cost of the offered service. Thus, the traffic forecasts affect the charges of the services by the ANSPs

4.3 Charges for the ANS provision

The Chicago Convention established the ICAO (International Civil Aviation Organization) and introduced the charges for airports and air navigation services (Huet, 2011). In 1958, 5 types of charges were examined: a. a weight factor only, b) weight and distance factors, c) a parameter depending on the kind of flight and nature of facilities required, d) a parameter depending to the route flown, or e) general levies on fuel and oil provided at international airports. After 9 years, at 1967, ICAO Conference on Charges for Airports and Route Air Navigation Facilities (CARF) decided that it should be only one charging price per flight that will cover all the air navigation services and be based on the achieved distance and the weight of the aircraft (Huet, 2011).

At 1970, a multicriterial charging system was established that exists until today. From the 1st January 1986 there is a simple charging system according to which there is only one charging price per flight that is paid in one currency, euro (since 1991) and is collected by one body, EUROCONTROL, on behalf of its Member States (41 states) (EUROCONTROL, 2010). The CRCO operates the EUROCONTROL Route Charges System on behalf of the EUROCONTROL Member States under the provisions of the Multilateral Agreement relating to Route Charges. In addition, the CRCO bills and collects terminal charges and communication charges for Member States as well as air navigation charges for non-Member States, on the basis of bilateral agreements.

At 2011, EUROCONTROL collected the charges for 38 Member States and the forecasts were that it would collect 6.5 million euro with a recovery rate of more than 99%and has an administrative cost of some 0.3% of the amount collected (Huet, 2011:150). At this collecting system, there is not any difference between the upper and the lower airspace.

In 1998, the charging system of the Most Frequent Used Route (MFUR) to a Route per State Overflown (RSO) charging system, allowing a more accurate billing, closer to where the costs and services are generated. The first exemption to the full recovery mechanism was UK. UK requested an alternative charging system that is based on independent economic regulation as precondition to the partial privatization of its air navigation service provider, NATS, to allow private investors to drive cost-efficiency, decrease charges and generate profit (Huet, 2011:151). There are two different methods for the calculation of unit rate, full cost recovery method and determined costs method.

SES aimed to implement a common single charging system for the provision of the Air Navigation Services for the whole duration of the flight (EUROCONTROL.int, 2016b). According to EC (2012) the so called ‘common charging scheme’ is of vital importance for the implementation of a harmonised system of ATC in Europe. The common charging scheme enhances a) the transparency of charging and collecting of the charges for the airspace users, b) the efficient provision of ANS for the airspaces users that are funding the system and c) the provision of harmonised services that is a fundamental step for the implementation of Single European Sky.

The Route Charges System ensures the interoperability of SES rules and the fundamental principles of EUROCONTROL regarding the application and collection of aeronautical charges. The total charge (R) per flight that is collected by EUROCONTROL equals to the sum of charges (ri) that are produced in the zone of charges that are established by the states (EUROCONTROL.int, 2016c):

$R=\sum_{n} \mathbf{ri}$

The single charge (ri) is calculated by multiplying the distance factor (di) to weight factor and to the unit rate (ti)

$r_i= d_i \times p \times t_i$

di x p) is defined as the number of service units in charging zone (i) for this flight.

The current charging system for ANS offered transparency among the European ANSPs since the calculation is done with a common system and with the same formula (Huet, 2011). A very important step for the charging system is that it implemented the charging zones without splitting it to upper and lower airspace.

Search and rescue flights authorised by the appropriate competent body, flights performed by aircraft of which the maximum take-off weight authorised is less than two (2) metric tonnes, flights performed exclusively for the transport, on official mission, humanitarian flights authorised by the appropriate competent body, customs and police flights, circular flights and flights performed exclusively under Visual Flight Rules (VFR) within this charging zone are exempted from the payment of route charges (EUROCONTROL.int, 2016c).

Route charges are a type of reimbursement for the costs occurring for the States and the ANSPs as well as the cost of EUROCONTROL. The costs of ANSPs are mainly costs for the provision of ATC, COM, NAV, MET, AIS, overheads, training, research and development. The costs for the States are mainly regulatory services and oversight services (EUROCONTROL.int, 2016c).

The tariffs are calculated based on the forecast of the traffic. There is an adjustment mechanism that balances the losses and gains on a year n+2 scale. Additionally, the mechanism is calculated on a full costs recovery and it provides the application of economic regulation (SES Performance Regulation). The states are taking under consideration the depreciation cost, operating costs, costs of capital and EUROCONTROL cost and establish a forecast cost-base for each charging zone. Thus, a unit rate is established for each charging zone. The unit rate for Greece in 2013 was 33.89 euro and 34.53 in 2014 whereas for UK was 83.98 in 2013 and 83.73 in 2014 (EUROCONTROL, 2014; EUROCONTROL; 2015b). The unit rate is reducing year by year. The average weighted unit rate for 2011 was 58.09 euro, whereas the average unit rate for 2016 was 56.72 euro (EUROCONTROL, 2012; EUROCONTROL, 2016c).

Table 12: Cost-bases and national unit rates for 2016 (EUROCONTROL, 2016c)

Charging Zone	National For./Det. Costs 2016	Carryovers - Bonus or penalty	Other revenues 2016	Grand Total 2016	Service Units 2016	National Unit Rates
	1	2	3	4	5	6
Austria	192,111	12,362	0	204,473	2,777	**73.63**
Belg.-Luxembourg	172,792	-7,944	676	164,172	2,510	**65.41**
Bulgaria	88,383	-28,042	108	60,233	2,667	**22.59**
Croatia	90,626	1,603	7,834	84,395	1,783	**47.33**
Cyprus	53,598	-5,736	0	47,862	1,426	**33.57**
Czech Republic	114,052	-996	0	113,056	2,637	**42.87**
Denmark	97,125	-235	0	96,890	1,571	**61.67**
Finland	45,596	1,102	1,039	45,659	812	**56.23**
France	1,296,577	10,579	12,000	1,295,156	19,177	**67.54**
Germany	1,039,589	38,822	0	1,078,410	13,057	**82.59**
Greece	151,227	4,326	0	155,553	4,318	**36.02**
Hungary	93,068	-7,840	3,062	82,166	2,364	**34.75**
Ireland	121,387	-1,251	0	120,136	4,050	**29.67**
Italy	693,557	16,445	0	710,002	8,866	**80.08**
Latvia	23,118	-594	22	22,502	824	**27.31**
Lithuania	23,342	-346	160	22,836	509	**44.90**
Malta	19,082	-3,065	0	16,017	621	**25.79**
Netherlands	184,104	5,546	327	189,322	2,826	**67.00**
Norway	110,993	-13,917	0	97,077	2,368	**41.00**
Poland	163,010	-4,893	1,361	156,756	4,544	**34.50**
Portugal Lisboa	117,113	7,145	375	123,884	3,105	**39.90**
Portugal Santa Maria	44,536	2,335	54	46,817	4,337	**10.80**
Romania	159,457	-7,705	249	151,503	4,117	**36.80**
Slovakia	61,912	-2,750	0	59,162	1,126	**52.54**
Slovenia	33,169	-504		32,665	500	**65.38**
Spain Can.	98,751	0	9,577	89,174	1,528	**58.36**
Spain Con.	622,073	28,229	9,680	640,622	8,936	**71.69**
Sweden	210,172	-5,915	540	203,716	3,303	**61.68**
Switzerland	143,111	9,988	0	153,099	1,470	**104.15**
United Kingdom	937,954	100,423	123	1,038,254	10,435	**99.50**
Albania *	23,526	-29	0	23,497	520	**45.17**
Armenia *	5,041	214	0	5,255	135	**38.95**
Serbia/Montenegro/KFOR *	78,290	-1,398	712	76,181	2,016	**37.79**
Bosnia Herzegovina *	38,469	31	0	38,501	917	**41.97**
FYROM *	14,713	41	0	14,754	282	**52.36**
Moldova *	4,177	159	0	4,336	77	**56.32**
Turkey *	407,153	-47,124	0	360,030	14,846	**24.25**
Georgia	18,933	37	0	18,971	837	**22.66**
Determined Costs	7,201,582 100.0%	147,171 2.0%	47,186 0.7%	7,301,568 101.4%	118,562	**61.59**
Full Costs *	590,304 100.0%	-48,068 8.1%	712 0.1%	541,524 91.7%	19,630	**27.56**
All charging zones	7,791,886 100.0%	99,103 1.3%	47,898 0.6%	7,843,091 100.7%	138,193	**56.72**

* *Full Cost Method : reduced forecast costs (excluding exemptions) - chargeable service units*
Any differences are due to roundings

EUROCONTROL has bilateral agreements for aeronautical charges with 4 no-member states, Belarus, Uzbekistan, Morocco and Egypt, but also with the Ukraine (until its full technological incorporation to the multilateral route charging system). The terminal charges for Ukraine, Belarus and Egypt for 2011 are around 35.3 million euros. The total route charges for 2011 were 390.1 million euro and correspond to 1.25 million flights (EUROCONTROL, 2012).

According to Crespo and Mendes De Leon (2011) it would be a utopia to say that in the long-term FABs could establish one charging zone with strict common rules. The article 4 of the charging regulation says that FABs should have harmonisation and consequently the implantation of this regulation to the maximum extent. European Commission admits that it would be more beneficial for the European Network to have big charging zones according to the business needs, but with slightly differentiated rules than to continue with the same tradition charging zones following national borders.

The charging regulation utilised the economic sides of the performance system and introduces economic incentives with a cost risk sharing system. FABs are tools for the restructuring of the ANS service provision and enhancement of cost efficiency. FABs are encouraged to define a charging zone or a common cooperation net by which it will be easier to reach economies of scale (Huet, 2011). The full cost-recovery system offers financial stability to ANSPs and allows users to get back any over-recoveries, but it does not act as economic incentive for the ANSP to be cost-efficient since they face low financial risk.

4.4 The economics of Air Transport Management

Single European Sky is a quite ambitious initiative. The implementation of SES is proven hectic. In order to understand SES’s importance for the aviation sustainability as well as the possible reasons why it is not fully implemented, it is of critical importance to explain the business environment. Industrial economics theory will be applied to better understand the aviation environment of SES.

Industrial economics deal with economic problems of the industries, as well as their relationship with the society (Stigler, 1968). Industrial economics will be used to understand the economic aspects of ATM seeking to analyse their behaviour and draw normative implications for the aviation system. This part will concentrate on the constraints which impede the achievement of the SES goals and will try to remove them emphasising on empiricism.

One of the key issues in industrial economics is assessing whether a market is competitive. The elements of market structure and market concentration are critical for modelling firm behaviour. It deals with the information about the competitors, natural resources and factors of production and government rules and regulations related to the aviation industry. Furthermore, it deals with the business policy and decision-making. Those two elements are interdependent, since without adequate information no one can take proper decision about any aspect of business.

Industrial economics are closely related to the concept of efficiency or performance. 'The appropriate decision making and efficient implementation of the decisions are the vital determinants for the efficiency conditions in business' (Barthwal, 2004:31). The market structure and market power in ATM is affecting the performance of SES and the implementation of the regulations.

The main players in SES are the Air Navigation Service Providers, European Commission and CAAs/NSAs. To determine the degree of competition in an industry, an initial indication is the number of enterprises, which is not the most appropriate. Another way to measure the degree of competition is the production concentration level. The simplest indicator of the concentration of an industry is the sum of the market share for the industry (index CRκ) (Pacos, 1997: 52).

$CR_k = \sum_{i=1}^{k} s_i$

Where:

$CR_{k:}$ concentration ratio

S: share of the firm i

K: number of the 3, 4, 8 ... larger firms in the industry

Another way of measuring is the index Herfindahl -Hirschman (index HHI). The H index has the advantage over the CRk that it takes into account, in addition to 3.4... larger companies in the industry, all other businesses (Pacos, 1997: 54)

$H = \sum_{i=1}^{n} s_i^2 = \frac{l + cv^2}{n}$

Where:

Cv: represents the variation coefficient of the size of the companies in the industry

Cv2 / n: measures the contribution of inequality in the degree of concentration

1 / n: the inverse of the number of enterprises

The more firms there are in an industry, the lower the value of HHI, ceteris paribus (Waldman & Jensen, 2012). This index takes account of all firms in the industry. Their market shares are weighted by the market share itself. The larger the firm, the more will be its weight in the index. The maximum value for the index is one where only one firm occupies the whole market. This is the case of a monopoly. When the scope is national, then the ANSPs are natural monopolies. When the scope is ECAC then the ANSPs are considered Oligopolies. When considering though the services, the market structure becomes more complicated.

According to the European Commission (2016) the five biggest ANSPs, i.e. DFS for Germany, DSNA for France, ENAIRE for Spain, ENAV for Italy and NATS for the UK bear 60 % of total European gate-to-gate service provision costs and operate 54 % of European traffic. Only 40 % of remaining gate-to-gate costs are borne by 32 other smaller ANSPs that operate the 46% of European traffic. Consequently, the traffic is concentrated to the 5 big ANSPs.

When the scope of the services provided is not a country and the ANS are provided to more than one country or a country has more than one ANSP then the market is considered oligopolistic. An oligopolistic market is created when a small number of producers dominate the industry (Stabler, et al., 2010). In the market, there are often a number of competitors, but so that everyone has a negligible influence on the price (Varian, 1992).

If firms of an oligopolistic industry manage to communicate with each other (in terms of pricing, market shares, etc.) they achieve a restriction to competition and reduce uncertainty, all of which reduce the total profits of the industry. A formal or informal agreement / partnership between businesses for market exploitation is called cartel. Conditions for the creation of a cartel are the production of homogeneous product, the strong interdependence and knowledge of the demand conditions. Where a cartel operates in accordance with the intentions of its members, it acts as individual practical monopolist, which maximizes the total profit of the industry (Besanko & Braeutigam, 2011). The cartel achieves maximization of profits when it is acting as a monopoly (Varian, 1992).

Air Navigation Service Providers after 2010 started forming alliances. The ATM reforms were first mention in 1999 and they were implemented in 2012 through the Sky harmonisation. ANSPs may cooperate for different reason, the most important are a) a good cost benefit business case; b) synergies in technologies and expertise; c) optimisation in the production and achievement of economies of scale or scope; and d) forced by government regulation or legislation (Singh, 2011).

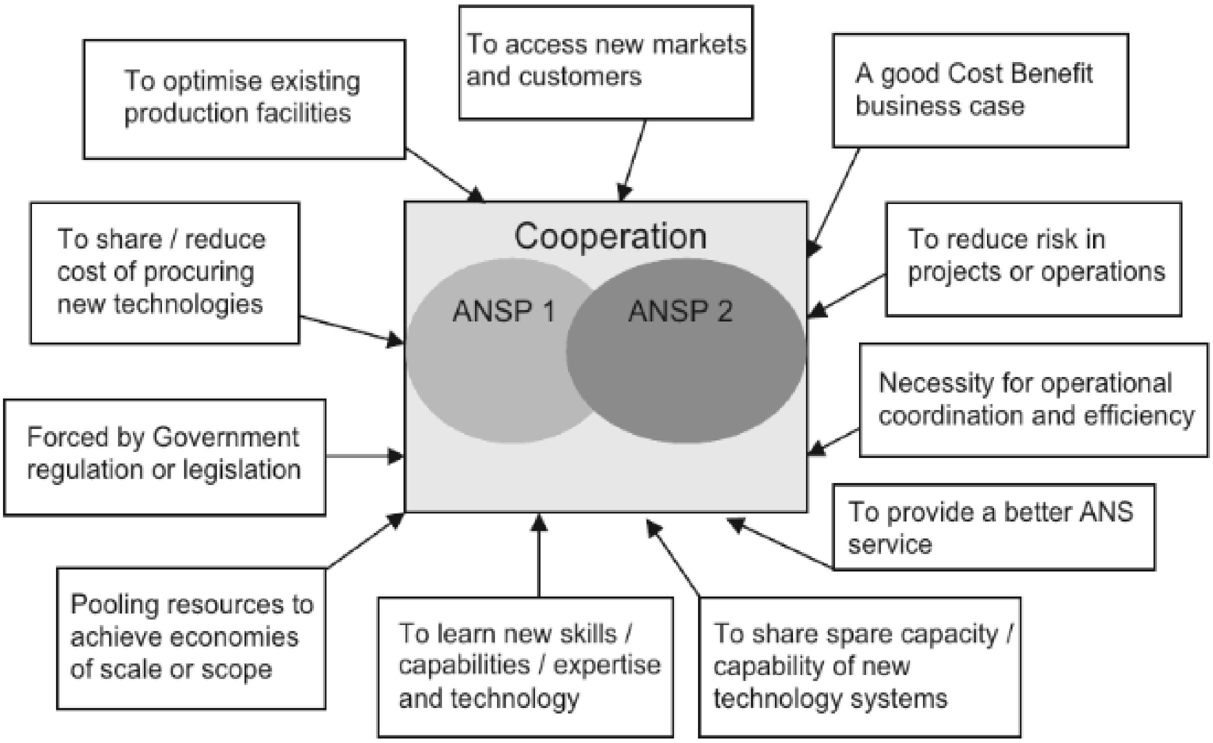

Figure 17: Drivers for ANSP cooperation (Singh, 2011: 343)

Air Navigation Service Providers are taking advantage of economies of scale. The main point on the economies of scale lies in cost conditions, namely the way in which unit cost varies as the amount of product produced by a production unit (Pacos, 1997). If production increases and the long-term average cost decreases, then the cost exhibits economies of scale (Vettas & Rector, 2004). In addition, economies of scale in cost function are interrelated with the returns to scale production function and so 'when the input product exhibits constant returns to scale, the long-run average cost remains constant when changing the level of production' (Morgan et al, 2009). Economies of scale simply are factors that cause the average cost of producing something to fall as the volume of its output increases. When economies of scale are strong, which means that the market has very few companies, the average cost curve falls abruptly to a large range of production levels (Morgan et al, 2009).

Unlike the traditional microeconomic approach under real conditions, competition is not perfect. Perfect competitive or monopolistic markets are simply the opposite ends within which there are several gradations of organization of the market. Business's attitude affects their performance, i.e. prices, profits, etc. In many cases, it even affects the performance of other companies in the sector. The behaviour of all firms in an industry affects the performance of the entire sector. Thus, the performance of airlines or the performance of airports, or the performance of ANSPs is affecting the performance of aviation as a sector.

ANSPs within a country are considered natural monopolies. Monopoly is a situation in which only a producer of a commodity exists for which there is no substitute (Stabler et al, 2010; Waldman & Jensen, 2012). The fact that a company does not face competition from other operators does not mean that it can set the highest price of all feasible (Vettas & Rector, 2004).

The cases of monopoly according to Katz & Rosen, (2007: 581) are a) the sellers are price modulators, i.e. the demand curve for a price modulator now has a downward slope as the price falls as the quantity of product sold increases; b) the sellers do not behave strategically because the supplier does not encounter resistance from the other suppliers in the selection of its own actions; c) entering the industry is impossible; and d) buyers are price-receivers. The ANSPs are charging according to the cost of the service taking under consideration the traffic volume. Thus, the airspace users are price receivers. The airspace management belongs to the ANSP and the government either as Ministry of Transport or as CAA has given the company the exclusive right to serve an airport and the cost of service provision makes the provider more productive than many (natural monopoly).

If for any level of production in the sector the overall cost of production of that level in a company is less than the total cost to be borne by two or more companies if they share this production together, then a market is characterised as natural monopoly (Besanko & Braeutigam, 2011; Morgan et al, 2009; Scotter, 2008). This happens when there are several strong economies of scale or economies of scope (Vettas & Katsoulakos, 2004). In the long-run equilibrium, each firm in monopolistic competition has a normal economic profit and produce on the downward part of the curve of average cost (Waldman & Jensen, 2012, p.366). According to Schumpeter, the ideal way for market structure is not perfect competition, but large firms with monopoly power (Waldman & Jensen, 2012).

Moreover, Viscusi, Harrington and Vernon (2005), distinguish between permanent and temporary natural monopoly. The Long-Run Average Cost (LRAC) of permanent natural monopoly continuously decreases as output increases. In temporary natural monopoly, the LRAC decreases but after a certain point it becomes constant.

Natural monopolies in most cases are regulated or operated by state (Varian, 1992). In cases where the regulated monopoly does not take subsidy, it should operate on the average cost curve or above in order not to have negative earnings. If a natural monopolist operates in conditions of equal price and marginal cost, it will produce an effective amount of product MC, but without covering its costs (Varian, 1992).

The existence of natural monopoly does not guarantee that a company will be able to prevent competitors from entering the market. The natural monopoly can put other barriers to entry in the market called monopoly viable (sustainable monopoly) (Scotter, 2008). So it (Scotter, 2008: 330) has cost function C (q) and demand function D (p) if

1. The 1st condition is applied, under which the company meets the market demand at any price [q = D (p)].
2. The 2nd condition is applied, under which the company covers the cost of [p * q = C (q)].
3. The 3rd condition is applied, whereby the company sets a price p such that any competitive company trying to enter the market by selling a smaller quantity at a lower price, would suffer [p´*q´<C(q´) for all p´<p and all q´≤D(p´)].

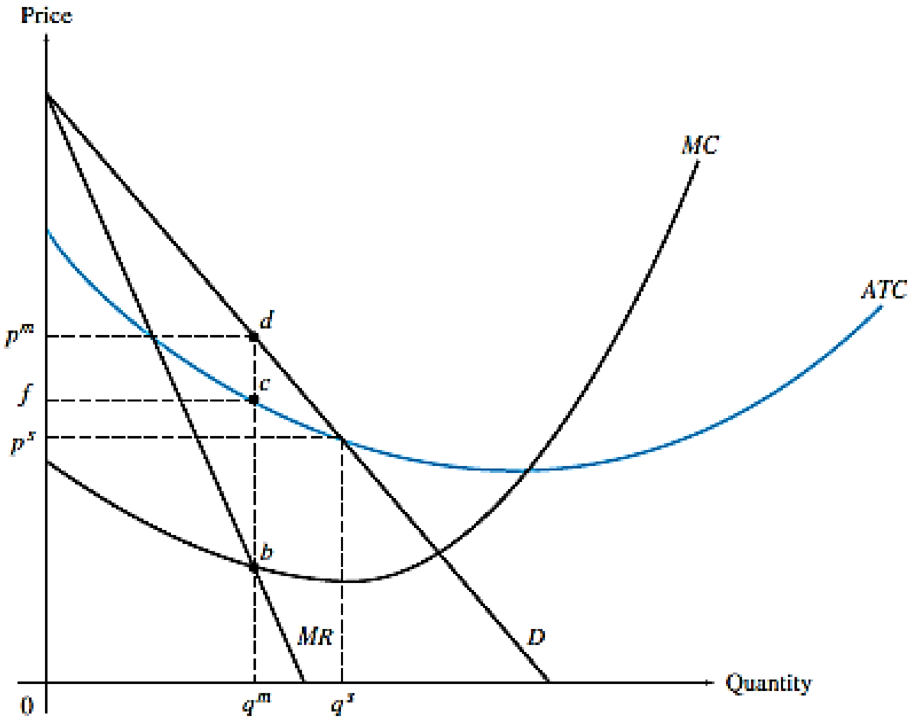

Figure 18: Price and Quantity in monopoly market

In Figure 18, it can be seen that the profit-maximizing price is p^m and q^m quantity as at this point the MC = MR. The supernormal profits of the company equal to the size of p^mdcf. The supernormal profits are probably attracting competitive companies. If a competitor enters the market, then the company will lower the price to p^s, which is sustainable and market price, where ATC = D. The company assumes that consumers will stay inactive and will not move the demand to the competitor immediately and the company will have time to amend the price properly and thus preventing the competitor from taking the market share (Scotter, 2008).

One key characteristic of natural monopoly is subadditivity. This means that it is cheaper to produce the same production level when only one company produces, and that the same production level becomes more expensive when a second company joins the market. On the other hand, economies of scale exist when additional units of production are associated with a lower average cost, but costs per unit begin to rise after a certain level.

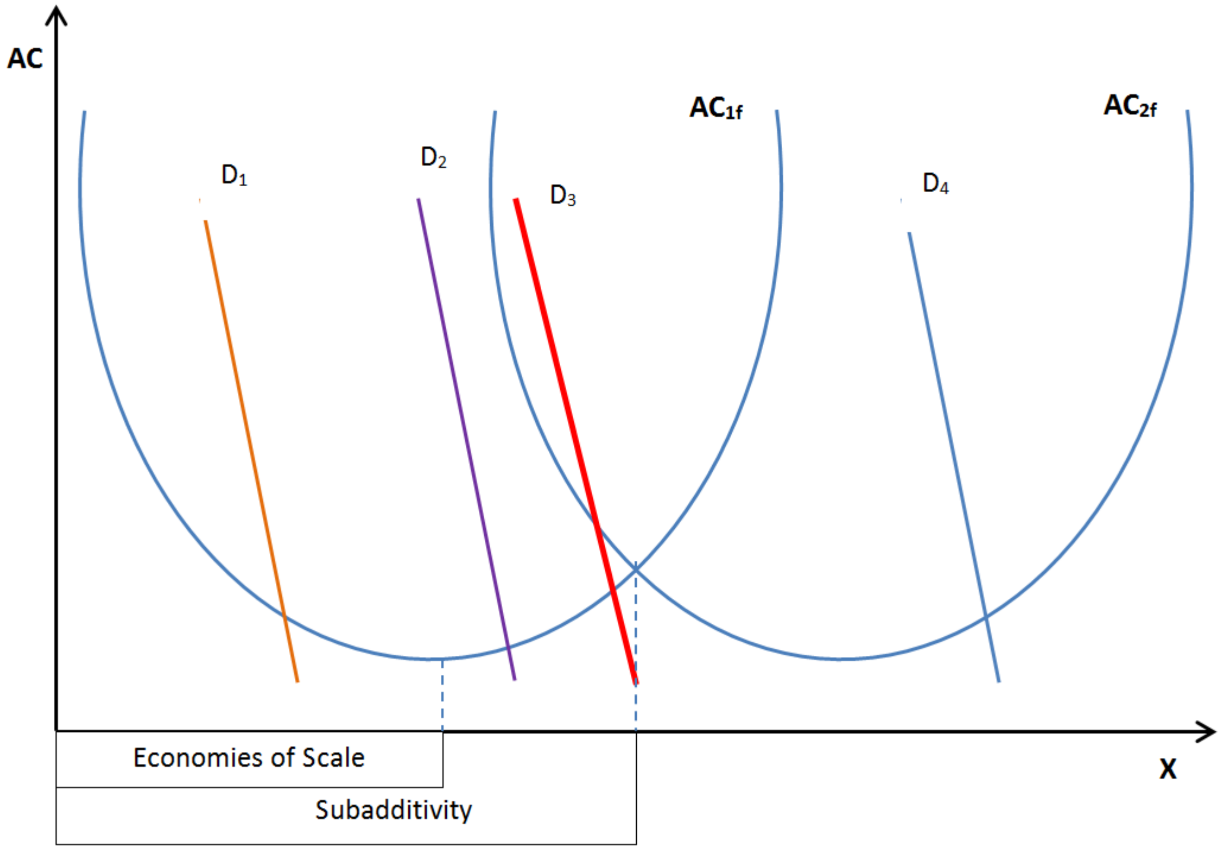

Figure 19: Economies of scale versus subadditivity

Figure 19 depicts the case of economics of scale versus subadditivity. The orange demand curve, within the economies of scale region, is a viable natural monopoly. The purple line indicates a non-sustainable natural monopoly. The red line indicates the border case of a profit generating monopoly (which would attract competitors) and the blue line indicates a viable duopoly. Subadditivity is considered a necessary but insufficient condition for a natural monopoly to be considered optimal, whereas if economies of scale exist, this is a sufficient but not necessary condition for a natural monopoly to be sustainable. In multiple-output case where the interdependence among outputs becomes important, economies of scale are neither necessary nor sufficient for costs to be subadditive according to Viscusi et al (2005).

4.5 Economic regulation of Air Navigation Services

Air Navigation Service Providers (ANSPs) as explained above operate as natural monopolists. There are different organisational forms. There are a) governmental agencies (e.g. FAA-Federal Aviation Administration in USA), b) state owned or government business enterprise (e.g. DFS Deutsche Flugsicherung GmbH in Germany), c) private-public-partnership (PPP[9]) (e.g. NATS in UK) and d) private entity (e.g. Nav Canada). All the different ownership and organisational forms exist and all have the potential according to ICAO (Doc 9161, 2013) to deliver excellent service under the condition of an appropriate government structure.

Most of the ANSPs are not private entities or PPPs. The idea behind privatization is to increase the role of market forces, thus to improve industry performance. Apart from that freeing of entry to an industry, encouraging competition and permitting joint ventures can contribute to improvements on industry performance. Market forces can also be increased by restructuring the nationalized industry, to create several successor companies that may be publicly owned.

Privatisation can bring benefit to consumers, since private companies tend to produce the quantities and varieties the customers want, thus by covering customers' need, private companies generate earnings. The companies though are becoming profit-orientated and

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[9] Public-private partnership (PPP) provides private financing for infrastructure investment without immediately adding to government borrowing and debt, and can be a source of government revenue (ICAO-9980, 2012).

are unwilling to offer uneconomic services, are orientated towards eliminating inefficient production and restrictive labour practices.

Nav Canada is the first fully private ANSP. It was created in 1996 and is the world's second largest ANSP by traffic volume. Nav Canada is following self-regulation, which means that it has an unlimited ability to set fees to airlines at a level sufficient to cover all of its costs, including reasonable reserves. Nav Canada is monitored by airline customers through membership on the board of directors (ICAO Doc 9980, 2012). On the other hand, AEROTHAI, Aeronautical Radio of Thailand Limited, is a State enterprise in which 89 airlines had minority equity stakes in 2008, but the government controls the charges (ICAO Doc 9980, 2012). Charges for ANS is an important cost for airlines and thus for passengers' fairs.

Within Europe, UK is by far the most liberalised market. NATS was proposed as PPP in 1998 and was finally formed as PPP in 2001. In 2001, Airline Group acquired 46% of NATS, the NATS staff took 5% and the remaining 49% was held by government. In 2009 joined the A6 alliance. In 2011, NATS crated a partnership with Ferrovial Servicios, called FerroNATS. FerroNATS provides air traffic control services in the airports of Alicante, Valencia, Ibiza, Sevilla, Jerez, Sabadell, Cuatro Vientos, Vigo, La Coruña and Melilla (NATS 2015). Prices of NATS are regulated in accordance with the price-capping formula (RPI-X) to create incentives for efficiency and are revised every 5 years taking into account, inter alia, major investment projects.

Both airports and ANSPs are characterised by sunk costs. The central economic rationale for airport regulation is the maximisation of conventional economic welfare or, equivalently, the minimisation of deadweight loss according to Biggar (2012). Czerny, Guiomard and Zhang (2016) identify airport market power per se; airport market power in combination with potential airline market power (which relates to vertical governance and/or integration in air transport markets); airport congestion; distributional issues; investment in airport infrastructure; and the supply of airport concession services, as the main issues of concern in price regulation of airport monopolies from an theoretical viewpoint. Large airports with substantial market power are usually subject to detailed and strict regulation (Biggar, 2012; Bel and Fageda, 2010).

According to Viscusi, Harrington and Vernon (2005) when an industry is regulated, market forces and administrative processes codetermine industry performance in terms of allocative and productive efficiency. It is very difficult for the government to perfectly monitor firms and market forces play a predominant role regardless of the degree of government intervention.

Moreover, Viscusi, Harrington and Vernon (2005) point three key decision variables for the economic regulation of an industry, a) price, b) quantity and c) number of firms. The regulator may control the entry and/or exit of firms. Control over entering the marker usually applies in public utilities areas. The control of exit aims to have services provided to a wider area. This regulatory principle is applied in the railway sector. Restrictions on the quantity of production can be used with or without price regulation.

In price regulation, the regulator sets a particular price (or price structure) that firms must charge or restricts firms to setting price within some range. One of the main issues the regulator faces when regulating a monopolist is related to Ramsey pricing. This means that the price margins should be inversely proportional to the demand elasticity for the various products/services. Ramsey pricing is economically efficient in the sense that can maximize welfare under certain circumstances. Ramsey pricing is effective only if all markets are equally monopolistic or equally competitive. The services/products with more elastic demands are charged less, likewise, the more inelastic the demand, the higher the price ceteris paribus.

Under the rate of return regulation (also called cost of service or cost plus regulation) ANSPs are required to obtain approval for the level of charges and investment. This regulation aims to limit the provider's rate of return on capital at the level prevailing in a competitive market. According to ICAO Doc 9161 (2013) it allows cost pass-through for both operating and capital expenditures, but it may provide the ANSP with a strong incentive for over-investment in order to increase the volume of its profit. The solution to this could be price cap regulation, under which the regulator sets a maximum chargeable rate. Under performance regulation, ANSPs can charge up to a specific amount following a traffic risk sharing mechanism.

ANSPS transition phase began in the 1980's rather slower in comparison to the airports and airlines, and traditionally have been operated directly by governments. Each structural situation, strategy or legal regulation that limits the chances or entry speed is a factor of protection for established business like air carriers or ANSPs, and it affects the potential competition (Pacos, 1997). Thus, the entry barriers are considered very important. Equally important are considered the exit barriers. The exit barriers raise the issue of non-recoverability of an investment cost (Pacos, 1997)

Bain defined barriers to entry as market conditions that allow a dominant firm to raise prices above the level of competition, without attracting new entry. A barrier to entry exists when there is a new business entering the market is not able to achieve the same profit levels with those of the dominant firm before the new entrant (Waldman & Jensen, 2012). Bain found economies of scale, absolute cost advantages, the necessary capital expenditure and product differentiation advantages as four elements of the market structure that act as barriers to entry (Waldman & Jensen, 2012). Economies of scale act as a barrier to entry, in the sense that the new entrant is unable to ensure that the size of the sector demand, which would allow it to benefit from economies of scale without simultaneously increasing the overall supply resulting in compression of the selling price in below the minimum unit cost (Pacos, 1997).

Hence, the entry of a new ANSP is considered much more difficult than the entry of a new airline due to the high sunk costs as well as the authorisation dependence from the government authorities. All the European Common Aviation Area (ECAA) states and the organisational and corporate arrangements for the ANS provider are gathered in the Table 13.

Table 13: Organisation and Corporate arrangements of the ECAA states (Efthymiou et al, 2016)

ANSP	Country	Organisational & Corporate Arrangements
Aena	Spain	State enterprise
ANS CR	Czech Republic	State enterprise
ARMATS	Armenia	Joint-stock company (State-owned)
Austro Control	Austria	Joint-stock company (State-owned)
Avinor	Norway	Joint-stock company (State-owned)
Belgocontrol	Belgium	State enterprise
BULATSA	Bulgaria	State enterprise
Croatia Control	Croatia	Joint-stock company (State-owned)
DCAC Cyprus	Cyprus	State body
DFS	Germany	Limited liability company (State-owned)
DSNA	France	State body (autonomous budget)
EANS	Estonia	Joint-stock company (State-owned)

ANSP	Country	Organisational & Corporate Arrangements
ENAV	Italy	Joint-stock company (State-owned)
Finavia	Finland	State enterprise
HCAA	Greece	State body
HungaroControl	Hungary	State enterprise
IAA	Ireland	Joint-stock company (State-owned)
LFV	Sweden	State enterprise
LGS	Latvia	Joint-stock company (State-owned)
LPS	Slovak Republic	State enterprise
LVNL	Netherlands	Independent administrative body
MATS	Malta	Joint-stock company (State-owned)
M-NAV	F.Y.R.O.M.	Joint-stock company (State-owned)
MUAC	-	International organisation
NATA Albania	Albania	Joint-stock company (State-owned)
NATS	United Kingdom	Joint-stock company (part-private)
NAV Portugal	Portugal	State enterprise
NAVIAIR	Denmark	State enterprise
Oro Navigacija	Lithuania	State enterprise
PANSA	Poland	State body (acting as a legal entity with an autonomous budget)
ROMATSA	Romania	State enterprise

ANSP	Country	Organisational & Corporate Arrangements
Skyguide	Switzerland	Joint-stock company (part-private)
Slovenia Control	Slovenia	State Enterprise
SMATSA	Serbia	Limited liability company
	Montenegro	

Cyprus ANSP before was Government department and in 2015 started to be reformed again. DFS in Germany in 2002 was Limited Liability Company. LVNL (The Netherlands) in 2002 was State enterprise and Slovenia Control was a government department. State enterprise is a government-owned corporate entity operating under a special statute, not normal commercial law (PRU, 2004). Commercialization in ANSPS is deemed as a possible answer to financing and budgets constraints, as ANSPs were generally dependent on government budget for their capital and operational expenses. One important factor is reinvesting in the operational systems and enhancing performance and efficiency.

According to ICAO Doc 9587 (2008) the objective of ongoing regulatory evolution is to create an environment in which international air transport may develop and flourish in a stable, efficient and economical manner without compromising safety and security and while respecting social and labour standards. One also very important aspect in aviation industry is cost. As far as the cost of infrastructure is concerned according to IATA (2013a) airlines and passengers are estimated to have paid at least US$92.3 billion for the use of airport and air navigation infrastructure globally in 2011, equivalent to 14.4% of the cost of transport. Cost efficiency is quite critical for an airline to compete and survive in such a competitive market. Cockpit and cabin crew, aircraft ownership, fuel, maintenance, handling and catering infrastructure, passenger services and distribution and other costs are the main costs for all airlines. ANS costs are the only costs that are the same for every carrier and the way the carriers operate does not affect the ANS cost significantly. All carriers are charged the same unit rate when they fly above a country.

The Cost Effectiveness of ANSPs is measured by the annual ATM Cost-Effectiveness (ACE) Benchmarking Report conducted by Performance Review Unit of EUROCONTROL. The main indicators that are taken under consideration are the ATCO-hour productivity, i.e. the number of flight hours handled by each ATCO hour. This is can be influenced by sector productivity (reflecting whether the number of sectors is optimal for the volume and pattern of traffic), staffing per sector and ATCO productivity (reflecting, for example, the efficiency and flexibility of ATCO rostering) (PRU, 2004). On the other hand, it is important to recognise that a single flight hour can make different demands on ATCOs, depending on the nature of the flight and the extent to which it interacts with other traffic. Thus, the productivity is related to the complexity of the airspace.

The second main indicator is ATCO employment costs, which is closely related to the wages and working practices (the trade unions power plays an important role in the negotiations of the salaries) but will also reflect local economic conditions that are outside of management's control. The last main indicator for the cost effectiveness of ANS is the support costs, and in particular, the ratio of total ATM/CNS provision costs to ATCO employment costs.

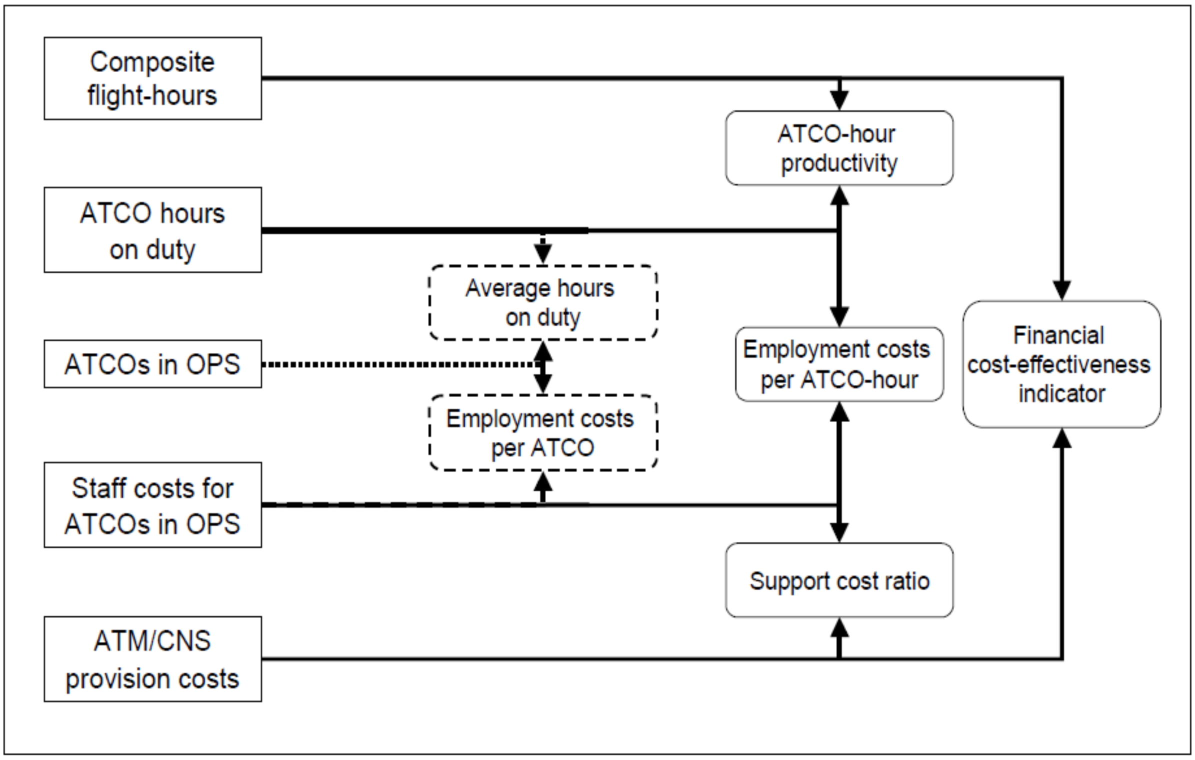


Figure 20: PRU Framework for Cost Effectiveness Analysis (PRU, 2004: vii)

One of the main cost drivers for ANSPs costs is the complexity of the controlled airspace. The complexity of the airspace is closely related with the ATCO's workload. Complexity covers anything that increases the possibility of airplanes interacting with each other and therefore ATCOs may need to take action to ensure that safe distances are maintained (NERA, 2006). Apart from the volume of airplanes handled, the complexity is affected by whether certain routes cross each other and therefore give rise to potential conflict situations, i.e. in the horizontal routes level. Moreover, whether there is a mix of traffic that may be either climbing, descending or cruising within a particular area of airspace, i.e. the vertical evolution of airplanes is affecting the complexity of the airspace. Finally yet importantly, the mix of traffic speeds is influencing the complexity. Even if all planes are following the same route and flying in the same direction, if some are faster than others are, then ATCOs will need to ensure that faster planes do not catch up with preceding slower planes. Thus when the airspace is more complex, more ATCOs will be needed to ensure the safe separation between planes and in general safe operations.

The risks related to the revenues of ANSPs are the demand, the exchange rate and the debt. The politic/economic climate, the changes in air traveller preferences and climate events like volcanic eruptions can affect the revenues of ANSPs since the traffic is affected. The traffic risk sharing arrangement from SES Charging Regulation can mitigate the risk and will be explained in a later chapter. Unlike in other industries, demand is not affected by competition, as ANSPs are monopoly service providers. One other risk for those ANSPs that are not in Eurozone is the exchange rate. ANSP charges are initially fixed in terms of the domestic currency and converted to Euros using estimates of monthly average exchange rates thus there can be a positive or negative effect on revenues of the ANSP. Finally, ANSPs face a small risk of non-payment from airlines with hectic economic situation.

On the other hand, the risk associated with cost are related to the cost variations, exchange rations and policy and regulation. There is a possibility that increases in charges do not keep pace with increases in the cost base due to for instance inflation. The difference in the exchange rate between euro and other currencies has an impact on the costs of the ANSPs too. Finally risk in cost associated with possible changes to the regulatory framework and relatively frequent changes to regulated charges can increase the uncertainty of ANSP. Nevertheless, ICAO requires that states offer support to an ANSP by providing distress finance or direct grants (Steer Davies Gleave, 2014).

The liberalization in the Air Navigation Service Provision was preceded by the liberalization of airline activities. ANS in Europe started being liberalised through Single European Sky and Functional Airspace Blocks. First proposed in 2004 and established in 2009, the FABs were implemented 4 December 2012. Although on the air carrier side the private participation, privatization and commercialization was faster than for airports and Air Navigation Service Providers (ICAO, 2003), it is deemed necessary to liberalise the ANS provision in order to improve the efficiency of aviation system and deliver a better value for money and time for the passenger. Small ANSPs face difficulties in fully taking advantage of economies of scale and dealing with the high cost of investments. ATC services like meteorology and data communication services could be unbundled and outsourced, thus leading to reduced costs and overall efficiency gains (Efthymiou et al, 2016).

The ANSPs and the airports have some similarities in terms of the sunk costs and the natural monopoly forms. Niemeier (2002) researched the German airports regulatory system in the first stages of liberalisation and concluded that the inefficient cost-plus regulation does not increase the economic welfare and it is necessary to install an independent regulator (to price cap airports) and to intensify competition by privatization, cross-ownership restrictions, competition from near airport sites, slot auctioning and open skies.

Since transport infrastructure is characterised by very high asset-specificity due to the sunk costs on durable and immobile investments, it is important to prevent market abuse, opportunistic behaviour and provide adequate levels and quality of service at reasonable process according to ITF/OECD (2011). Moreover, an independent regulator ‘shields market interventions from interference from ‘captured’ politicians and bureaucrats’ (OECD 2002). The regulator should be independent of government and operate in a transparent fixed framework set by legislative act maintaining their independence.

Within the last years, the examples of changes in the ownership forms, pricing and investment regulation and the liberation on service provision are quite impressive. The Performance Regulation 550/2004 brought a relative liberalisation by stating that the issue of certificates shall confer on ANSPs the possibility of offering their services to other ANSPs, airspace users and airports within the Community. By this way, there is no obligation on choice and the management of performance of the service provider is done through an arm's length commercial contract. For instance, NATS, the ANSP of UK, has no monopoly on terminal ATM service provision and it provides such services at 15 of the 90 or so UK airports where terminal ATC services is required.

Furthermore, according to the EC Regulation 2015/340 laying down technical requirements and administrative procedures relating to air traffic controllers' licences and certificates pursuant, a mutual recognition of the certificates issued by ATCO training organisations across the European Union and harmonises the medical requirements for pilots and controllers facilitating the mobility of Air Traffic Controllers in Europe.

The system before SES was deemed insufficient and costly. For instance, the estimated costs of fragmentation of airspace amounts to 4 billion EUR a year and the five biggest ANSPs (AENA-Spain, DSNA-France, NATS-UK, DFS-Germany and ENAV-Italy) bear 60.3% of total European gate-to-gate ATM/CNS provision costs and they operate 54% of European traffic according to EC (2015). SES separated the NSA/CAAs from the ANSPs to ensure safety and efficient supervision on the targets achievement.

A random example of the situation is the traffic in April 2015. That month traffic increased by 1.7% compared to April 2014 and despite crisis traffic is increasing. En-route ATFM delays increased by 117% compared to April 2014 and airport ATFM delays increased by 74%. Based on airline data, the average departure delay per flight from "All-Causes" was 9.7 min per flight; this was an increase of 4% in comparison to the record low of 9.3 min per flight in 2013 according to EUROCONTROL (2015c).

Bessley (1997) noted that the benefits of privatization derive partly from the ability to diversify and redeploy assets, unconstrained by nationalization statutes. Bessley (1997) also highlighted that privatisation is not just selling share, but it should be part of a whole scheme tailored to the particular conditions of each industry. Privatization schemes should be designed to maximize net consumer benefits, in terms of lower prices and improved quality of service. It should be noted that competition in privatisation is the moving power for effective means of maximizing consumer benefits and curbing monopoly power. Moreover, Stricter competition policy is preferable to rate-of-return regulation, efficiency audits and related forms of government 'nannying'" (Bessley, 1997) as well as it is essential to deal with social negative outcomes, such as transitional unemployment.

The adjustment results depend on a variety of factors, which are a) motivation for regulation, b) the types of methods of regulation, c) the structure of the setup process, d) the characteristics of the industry/sector and e) the economic and legal environment in which the regulation takes place (Joskow & Rose, 1989, p. 1451).

In natural monopoly, the producer can minimize the cost, but an unregulated market may lead to prices or costs to quite high level (Joskow & Rose, 1989, p. 1454). Price regulation and absence of market entry may be a good practice in regulatory perspective if a) the production of a single company of one or more goods minimizes costs, b) a company with a statutory/legal monopoly chooses average prices and earnings, which are too high and individual prices can be either too high or too low, c) the fear of entry of new competitors in the market cannot teach a 'lesson' to the monopolist and e) the insufficient market entry may result from the absence of a legal monopolist even if the prices are under regulation (Joskow & Rose, 1989, p. 1454). The regulation aims to regulate the entry of potential competitors in the market to achieve economies of a business, to set the price so that there are insufficient or supernormal profits and to regulate the structure of values so as the individual values to be profitable (Joskow & Rose, 1989, p. 1454).

Measuring the effects of economic regulation is achieved through some indicators considering the behaviour and performance of the company and/or the market. The most important indicators are (Joskow & Rose, 1989, p. 1457):

- The average price level and structure of prices (e.g. non-unified and non-linear tariff, pricing for natural monopolies of many products)
- Static costs of production, including:
    - Distortion of input
    - Ineffectiveness under imperfect competition
    - Direct costs of regulation
    - Paid input prices
- Dynamic efficiency, including the degree and direction of innovation and productivity
- The quality and type of the product
- The distribution of income and leases including
    - Profitability of regulated firms
    - Sharing leases with production factors
    - Income transfers between customer groups
    - Income transfers between producers group

According to Salvatore Sciacchitano, executive secretary of ECAC 'liberalization of market entry and fair competition go together and are keywords that have characterized the development of aviation in the last decades in Europe' (Sciacchitano, 2013). According to O'Connell and Warnock-Smith (2013) yield decreased due to continued liberalization of air services, high levels of competition, rising fuel bills and volatile operating environments.

According to Matthew Baldwin, Director for Aviation and International Transport Affairs, European Commission (Baldwin, 2013) Europe is the most liberalized market for aviation in the world. Airfares can be set freely, routes can be free in single aviation market (including cabotage), there is no limit to the number of carriers and frequency, as well as the ownership and control of European airlines. Moreover, the last ten (10) years have been at the forefront agreements with Morocco, the Western Balkans, Jordan, Georgia, Moldova, Ukraine, Lebanon, Azerbaijan and Tunisia. Agreements with Morocco and the Western Balkans signed in 2006, reduced tariffs by 40% and benefits from 2006 to 2011 is estimated at 6 billion euros (Baldwin, 2013).

The central issue of regulatory economics according to Train (1991) is the design of mechanisms that regulators can apply to induce firms to achieve optimal outcomes. It should be noticed that uncertainty has important implications for the behaviour of the firm and consequently for the design of appropriate regulation. According to Armstrong and Sappington (2007: 1607) ‘the policies are sorted on four dimensions: (1) the extent of pricing flexibility granted to the regulated firm; (2) the manner in which regulatory policy is implemented and revised over time; (3) the degree to which regulated prices are linked to realized costs; and (4) the discretion that regulators themselves have when they formulate policy’.

There are different forms of regulation. For instance, there is the rate of return regulation and the RPI-X regulation. Apart from those, tree other alternative types of regulation are market-based instruments, self-regulation and co-regulation approaches, and information and education schemes.

Rate of Return (ROR) regulation follows the process described below (Bessley, 2005: 57):

“The regulated company files a tariff when it wishes to revise its prices. For an agreed test period (‘frequently the latest 12-month period for which complete data are available’ (Phillips 1969)), the company calculates operating costs, capital employed and cost of capital. The regulator audits these calculations and determines a fair rate of return on capital employed. These data plus assumptions about demand are used to calculate the total revenue requirement. This determines the level of the tariff. The structure of the tariff has to avoid unfairness and unjust or unreasonable discrimination. The tariff therefore has to be approved on a line-by-line or service-by-service basis, which typically requires the allocation of common costs on the basis of, for example, output, direct costs, revenues,

etc. An approved tariff generally stands until the company files to change it, usually on the grounds that the achieved rate of return has become inadequate."

According to Adler et al (2015) the RoR regulation has few incentives for the regulated firm to control costs and could lead to over-capitalization. The rate of return on capital is defined (Train, 1991:33-34) as (PQ-wL)/K, where L is the only one noncapital input and K the level of capital investment and wL the cost for noncapital inputs. Based on ROR regulation an ANSP can choose any K, L, Q and P as long as the fair rate of return f is:

$f \geq (PQ-wL)\ K$

Thus, the maximum economic profit an ANSP is allowed to earn is (f-r) K since economic profits are the difference between the ANSP's revenue and its costs for all inputs, including capital, meaning

$\pi = PQ-wL-rK$

Under the ROR regulation (Train, 1991) the hypothesis that an ANSP faces two scenarios, bad and good luck, exists. Good luck means that the ANSP is able to earn greater profits at each input combination than under bad luck. In addition, each ANSP does not know its exact profits at each level of capital and it calculates the expected. It is assumed that there are equal chances for the two scenarios to occur. The ANSP 's expected profit then is the average of its sliced-off good luck and bad luck hills.

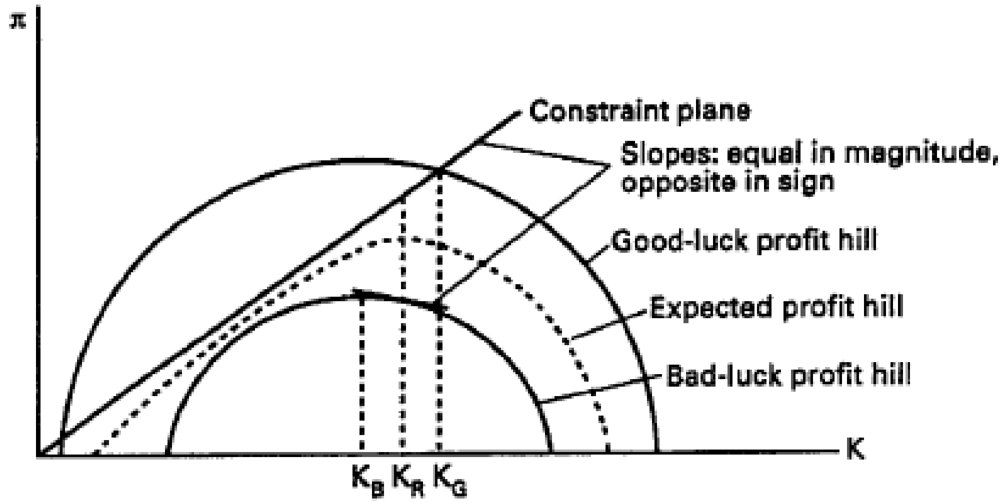


Figure 21: Example of regulated ANSP under uncertainty (Train, 1991: 102)

According to Figure 21, the ANSP in the good luck scenario would earn excessive profit over a range of capital levels. The constraint plane slices off this part. In the case of the bad luck scenario, the ANSP earns less than the cap. The maximum expected profits occur at capital K_R. If the ANSP knew that the good (bad) luck scenario would prevail, it would choose K_G (K_B). Because of uncertainty, the ANSP chooses K_R as a weighted average solution. The constraint plane depends on the shapes of the good and bad luck scenario hills and the maximum allowed rate of return (cap).

This regulatory system aims to control prices. For a period of 4-5 years, the ANSP should not make any increase in the average price of a pre-specified basket of its goods and services larger than RPI-X, where RPI is the retail price index (i.e. the rate of inflation) and X is a performance related figure specified by the regulator. At the end of the specified period, the level of X is reset by the regulator, and the process is repeated.

According to Bessley (2005) RPI—X is less vulnerable to 'cost-plus' inefficiency and overcapitalization (the 'Averch-Johnson effect') than the rate of return (RoR) regulation. Furthermore, RPI—X system offers more scope for bargaining, especially on productivity and offers the company more flexibility in pricing.

The ‘cost of capital’ to a company and the required rate of return to the prospective provider of finance are not identical. Divergences will occur under respective transactions costs and tax positions. The regulators in order to control prices and assure competition needs to be fully informed concerning the scope for cost reductions and the extent and effects of new entry. Bessley (2005: 371) stated “the aim of an RPI/CPI—X regime is to set up a total allowed revenue stream for a period of years ahead, with the intention to create an incentive to beat the productivity gains built into that allowed revenue”.

Table 14: Price cap versus rate of return regulation (Armstrong and Sappington, 2007:1608)

	Price Cap	Rate of return
Firm’s flexibility over relative prices	Yes	No
Regulatory lag	Long	Short
Sensitivity of prices to realized costs	Low	High
Regulatory discretion	Substantial	Limited
Incentives for cost reduction	Strong	Limited
Incentives for durable sunk investment	Limited	Strong

According to Train (1991) the aspects of monopoly control that regulation is intended to address such as high prices are not necessarily mitigated and could made worse, by the regulation. Averch and Johnson created a model, known as A-J model that shows that the regulatory procedure does not induce the firm to choose the socially optimal outcome, but can be used to identify other types of regulation that do.

Under rate of return regulation, the firm can earn only up to the “fair rate” of return on its capital investment. The firm is free to choose the price, output level and inputs under the condition that its profits do not exceed the fair rate. This regulation can sometimes lead to the opposite outcome, since firms face perverse incentives that operate against optimality.

ICAO Doc 9161 (2013) states that the rate of return regulation (also called cost of service or cost plus regulation) may provide the ANSP with a strong incentive for over-investment in order to increase the volume of its profit. Where there are no other incentives on efficiency (for example, through governance) rate of return regulation may provide limited incentive to cost-effectiveness and may also encourage overinvestment beyond the requirement of users.

On the other hand, under the price cap regulation if the ANSP exceeds the target, it may keep any over-recoveries according to ICAO Doc 9161 (2013). Where the target is not met, the ANSP would not be allowed to increase charges to compensate for the under-recovery and would have to find the means to balance its accounts during the regulated period. Under this scenario, the ANSP has a strong incentive to improve its efficiency and reduce its costs. On the other hand, an ANSP may have an incentive to overstate capital expenditure prior to the price cap being set and, subsequently, not to undertake the full programme (the price cap can give the ANSP a short-term return on the assets without actually having to invest in them). It can be proven quite complex and hence expensive for a regulator to monitor and evaluate the efficiency of such a regulation.

Output-based price caps may mitigate this problem. Prices set instead in relation to output performance may provide better incentives to invest efficiently. The price can be varied up or down based on meeting performance specifications. If price caps can be linked closely to outputs over time, the ANSP will have fewer incentives to delay or not undertake productive investments. The barriers to this form of regulation are the long lead times to investment such that the benefits in terms of outputs are often achieved only many years later and the challenge of defining outputs in such a way that they cover service quality as well as capacity (ICAO Doc 9161, 2013).

Market based regulatory instruments according to OECD act to change or modify behaviour through the economic incentives facing businesses. Trading schemes are a common form of market-based instrument. MBI change relative prices and/or create trading opportunities. Fiscal measures like taxes and subsidies, are also commonly used MBI. Taxes are often imposed on harmful activities, such as tobacco products to make them relatively more expensive and discourage their consumption. Subsides on the contrary are used to encourage consumption or production of activities or products which are considered desirable. OECD stated “the key advantage of market-based instruments is that they reflect decisions made by citizens and businesses in response to the incentives they face, therefore Market-based instruments are generally very flexible instruments”. MBI are extensively used in environment and natural resource management issues.

Another type of regulation is Return on Output (ROO) regulation. The firm under this regulation can earn a certain amount of profit up to the allowed amount per unit of output it sells, being free to choose its output and input level as well as the price (Train, 1991). Under the Return on Sales (ROS) regulation, the firm is allowed to earn a specific amount of profit on each euro (Train, 1991). If marginal revenue is positive up to the second best output then the firm behaves like under the ROO regulation, approaching arbitrarily closely. On the other hand, Return on Cost (ROC) regulation allows to the firm a certain amount of profit on each euro it expends. The firm increases its allowed profit by increasing its costs. However, if marginal revenue is negative, then the firm obtains more revenues by not increasing output. Self-regulation and co-regulation is another type of alternative regulation. Industry self-regulation, broadly defined, can be seen as taking place when a group of firms exerts control over its own membership and their behaviour (Baldwin et al, 2013).

According to Coglianese, Nash and Olmstead (2002) the regulatory system is performance based when performance is used as:

- the basis for the legal commands found in regulatory standards,
- a criterion for allocating enforcement and compliance resources,
- a trigger for the application of differentiated (or tiered) regulatory standards, and
- a basis for evaluating regulatory programs and agencies.

The performance based standards rely on the ability of the regulator to specify, measure and monitor the performance. The information may be extremely difficult to be obtained. When the implementation is hectic, the effect will be poor and the target of the regulation will not be reached (Coglianese et al, 2002)

According to ICAO Doc 9980 (2012) the characteristics of ANS provision are much different from those of the airports. ANS rely on facilities and services provided by other states, since they extend over all the territory of the State concerned and sometimes beyond. ANS provision has an international dimension based on necessary multistate cooperation especially for route facilities and services.

4.6 Performance

The performance in Single European Sky is focusing on four Key Performance Areas (KPAs) a) Safety, b) Capacity, c) Cost-Efficiency and d) Environment. The 4 KPAs are part of the wider set of 11 ICAO KPAs, which also include efficiency, flexibility, predictability, security, access & equity, interoperability and participation. The implementation as from 1 January 2012 of the performance scheme aims at setting and implementing binding targets for EU Member States through the adoption of European-Union wide performance targets and approval of consistent National or Functional Airspace Blocks (FAB) performance plans.

Commercial aircraft operate at cruise altitudes of 8 to 13 km, where they release gases and particulates that alter the atmospheric composition and contribute to climate change. The effects of non-CO_2 emissions (which have no Kyoto Protocol equivalent values) are still scientifically less well understood although there are indications that certain non-CO_2 emissions could have effects in some cases. In the case of contrails, the impact could be significant, but scientific understanding of the direction and magnitude of the impact is not currently well consolidated. To control the beyond CO_2 emissions, environment is included in the Key Performance Areas.

The Performance Scheme is developed in different periods, which are called Reference Periods (RP). The first RP is covering the years 2012-2014. The second RP starts at 2015 and finishes at 2019. A critical point in Performance Regulation is the Monitoring, including data collection and dissemination. If there is an evidence that the targets will not be reached, then the introduction of corrective measures is necessary.

The estimated Total Economic Cost (TEC) for 2012 is around €10.5 bn for the SES area (Grififths, 2014). The user charges are estimated to 7.5 bn euro. In another presentation in 2011 (Grififths, 2013), the ANS total economic cost was €14 bn p.a., where the user charges were estimated to €9 Bn p.a. The cost of ATFM delays in 2011 was estimated at €1.4B and the flight efficiency €3.8 B (en-route for €2B and TMA, taxi for €1.8B) whereas the ATFM delays cost in 2012 was estimated to be €0.8B and the flight efficiency €2.2B (en route for €1B and TMA, taxi for €1.2B). There are no available data after 2012. Nevertheless, it is evident that the efficiency is improving. The ATFM delay and flight-efficiency cost estimates are not included in the user charges. Airborne ANS cost, SESAR and NEXTGEN cost is not included.

4.6.1 KPA: Safety

Safety is the first priority in air transportation. The role of ATM is vital in ensuring overall aviation safety for example by providing separation between aircraft. Uniform safety standards and risk and safety management practices should be applied systematically to the Air Navigation System. To ensure safety to the maximum extent, criteria and standardised safety management processes and practices should be implemented to the global aviation system.

4.6.2 KPA: Capacity

The area of Capacity is another important area for the European Airspace. The system should find a way to meet airspace user demand at peak times and locations and to keep up with the demand of the traffic flows. To respond to future growth, capacity must increase, along with corresponding increases in efficiency, flexibility, and predictability while ensuring that there are no adverse impacts to safety giving due consideration to the environment.

For the first Reference Period (RP1) a Union-Wide target has been set for en-route ATFM delays per flight. Furthermore, the performance regulation stipulates that the three PIs related to airport capacity (i.e. a. Arrival ATFM delay, b. additional Arrival sequencing and metering area (ASMA) time and c. Additional Taxi Out time) be monitored on. No targets have been set for ANS capacity at airports in RP1. Arrival ATFM delay and additional taxi-out time is monitored for 77 airports that are subject to the Performance Regulation. As far as the ASMA is concerned, only airports accommodating more than 100,000 movements per annum, i.e. 39 airports, are subject to monitoring of additional ASMA time (PRB, 2013).

The Union-wide target for en-route ATFM delays in 2014 is 0.5 minutes per flight, with intermediate targets of 0.7 min/flight in 2012 and 0.6 min/flight in 2013 (PRB, 2013). The

Union-wide capacity performance is the aggregation of both national and FAB capacity performance. As far as the ASMA is concerned, additional taxi-out times are higher in winter than in summer due to remote de-icing and snow removal operations. In addition, it is recognised at several airports that Airport Collaborative Decision Making (A-CDM) can significantly reduce taxi-out time (PRB, 2013).

4.6.3 KPA: Cost-Efficiency

The third area that the Single European Sky is regulating is the cost-efficiency. Any proposals for changes in the ATM (e.g. investments in infrastructure) should always take under consideration the cost of service to airspace users for improving ATM service quality or performance. In addition, the ICAO guidelines regarding user charge policies and principles should be followed.

Under the cost efficiency KPA, Union-wide targets have been set for the average determined unit rate (DUR) for en-route ANS in 2012 (€57.88), 2013 (€55.87) and 2014 (€53.92). The aggregation of the individual national cost-efficiency targets for RP1 provides for a slightly lower figure for 2012 (€57.75) and higher figures for 2013 (€56.69) and 2014 (€54.84) (EUROCONTROL, 2015b).

The results of the second year of RP1, under the Deducted Costs (DCs) method with specific risk-sharing arrangements according to the PRB Annual Monitoring Report 2013 (PRB, 2013) were as expected. The ANSPs took action and complied with the new calculation method. In a 2014 report one of the recommendations of PRB to EC is the provision of more detailed information on the computation of the cost of capital (CAPEX) in Annual Monitoring Reports and in the Performance Plans for RP2 (PRB, 2014b). This is related to the lack of clarity for the calculation of the cost of the service and therefore the determination of the charge. The en-route cost-efficiency performance is improving since 2012. The en-route unit costs decreased 5% compared to 2013 mainly due to the notable traffic growth (5.9%) according to EUROCONTROL/Performance Review Commission report for 2015 (2016).

4.6.4 KPA: Environment

The Air Navigation System should contribute to the protection of the environment by considering noise, gaseous emissions, and other environmental issues in the implementation and operation of the global Air Navigation System. According to Regulation 691/2010 “the Performance Scheme” the main objective is to reduce ANS related CO_2 emissions and Local Air Quality (LAQ) through flight efficiency improvements, both in the air and on the ground.

The **first Reference Period (RP1)** focused on improvements on average horizontal en route flight efficiency of last filed flight plan (KEP) in European Network level (reduction of -0.75% of the route extension in 2014 compared to the 2009 baseline equal to 5.42%) only and not mandatory to national/FAB level and monitoring on Effective use of Civil/Military airspace structures (PRB, 2013). The other objectives of RP1 are:

1. Develop and support the deployment of 500 airspace changes in 2012 – 2014.
2. Support the implementation of Free Route Airspace (FRA) in 25 ACCs by 2014.
3. Increase annually the number of Conditional Routes (CDR) by 5% annually according to the Flexible Use of Airspace Concept (FUAC).
4. Increase annually the CDR1/2 availability and usage by an average of 5% annually (FUA).
5. Reduce the route unavailability (in time and quantity) by 10% in 2013 and 2014 (FUA).
6. Reduction of vertical flight inefficiency by 5% in 2014.

The FUA indicators (bullet 3-5) are reported on quarterly. Flight efficiency (bullet 6) is reported on only twice per year.

Whereas the main objective for the **second Reference Period (RP2)** is in EU wide level and in national/FAB level (PRB, 2014a). The focus of RP2 is on:

1. Average horizontal en route flight efficiency of last filed flight plan (target is set in European Network level (KEP=4.1%);
2. Horizontal flight efficiency of actual trajectory (KEA) (target is set in EU wide level (KEA=2.6%) and in FAB level-different for every FAB);
3. Effectiveness of booking procedures for Free Use of Airspace (only monitoring in EU wide level and in national/FAB level);
4. Rate of planning of CDRs (only monitoring in EU wide level and in national/FAB level);
5. Effective use of CDRs (only monitoring in EU wide level and in national/FAB level);
6. Additional time in taxi-out phase (only monitoring in National/FAB level and in airport level);
7. Additional time in terminal airspace (ASMA) (only monitoring in National / FAB level and in airport level).

Monitoring of the ASMA and Additional taxi-out time indicators has started during RP1, under the Capacity KPA. The rationale for monitoring is to gain experience with the indicator, and to ensure an acceptable level of quality, both from a data and algorithmic perspective.

Table 15: Estimated ANS-related impact on fuel burn and CO_2 emissions savings (EUROCONTROL/Performance Review Commission, 2015)

	Estimated ANS-related impact on fuel burn and CO_2 emissions		Fuel burn estimations		Estimated CO_2 emissions	
			2012	% change	2012	% of total
	Total within EUROCONTROL airspace		**46Mt**	**-0.9%**	**144Mt**	**100%**
	per flight (within ECTL airspace)		**4.8t**	**+1.6%**		
ANS related inefficiencies	At stand	Airport ATFM	-	-	-	-
		En-route ATFM	-	-	-	-
	Gate-to-gate	Taxi-out phase	0.29 Mt	-4.5%	0.9 Mt	0.7%
		Horizontal en-route extension	1.36 Mt	-3.3%	4.3 Mt	3.1%
		Vertical profile (see footnote[18])	0.24Mt	-2.5%	0.8 Mt	0.5%
		Arrival Sequencing and Metering area (ASMA)	0.59 Mt	-0.8%	1.9 Mt	1.3%
	Total estimated ANS-related impact on fuel burn		**2.5Mt**	**-2.8%**	**7.8 Mt**	**5.7%**

Environmental impact assessment studies were conducted by EUROCONTROL in order to evaluate the impact of the FABs creation the environmental performance of SES. For instance, the DANUBE FAB Environmental Impact Assessment Study was carried out using the System for traffic Assignment and Analysis at a Macroscopic level (SAAM) fast-time simulation tool to calculate the changes in fuel use and CO2 emissions n the Danube FAB airspace above FL09 (Kantareva et al, 2016). The study concluded that the annual fuel saving due to the FAB implementation will be 45,000 tonnes by 2020 and 80,000 tonnes by 2030. The annual CO2 savings are expected to be 143,000 tonnes by 2020 and 255,000 by 2030 (Kantareva et al, 2016).

4.6.4.1 Flight efficiency improvements

During the last decade, a higher increase in capacity than the traffic growth was achieved, while maintaining safety standards. At the same time, more efficient routes were implemented. Currently, the European ATS route network distances are only 3.6% longer than the Great Circle distances (for intra-European flights) (IATA, EUROCONTROL, CANSO, 2008). An initial assessment of the European ATS route network design, availability and utilisation indicates that flight efficiency could further improve by enhancing both route availability and utilisation. The restrictions imposed on the utilisation of the European ATS route network contribute with approximately 0.4% to the airspace utilisation inefficiency.

EUROCONTROL developed a Flight Efficiency Plan (FEP) containing 5 Action Points that required immediate attention (EUROCONTROL.int, 2016d):

1. Enhancing European en-route airspace design
2. Improving airspace utilization and route network availability
3. Efficient TMA design and utilization
4. Optimizing airport operations
5. Improving awareness of performance

These action points could save the airlines 470,000 tons of fuel each year – the equivalent of 390 million euros and 1.5 million tons of CO_2 emissions (EUROCONTROL.int, 2016d). In Figure 22, the comparison of US and Europe in terms of en route flight efficiency is shown. The data of Europe (i.e. the 41 member states of EUROCONTROL) appear from 2011 and afterwards. Data were not gathered prior to SES. An "inefficiency" of 5% means for instance that the extra distance over 1 000NM was 50NM. One interesting element to note is the difference between the actual and filed plan. Airlines fly more direct routes (i.e. closer to the great distance cycle).

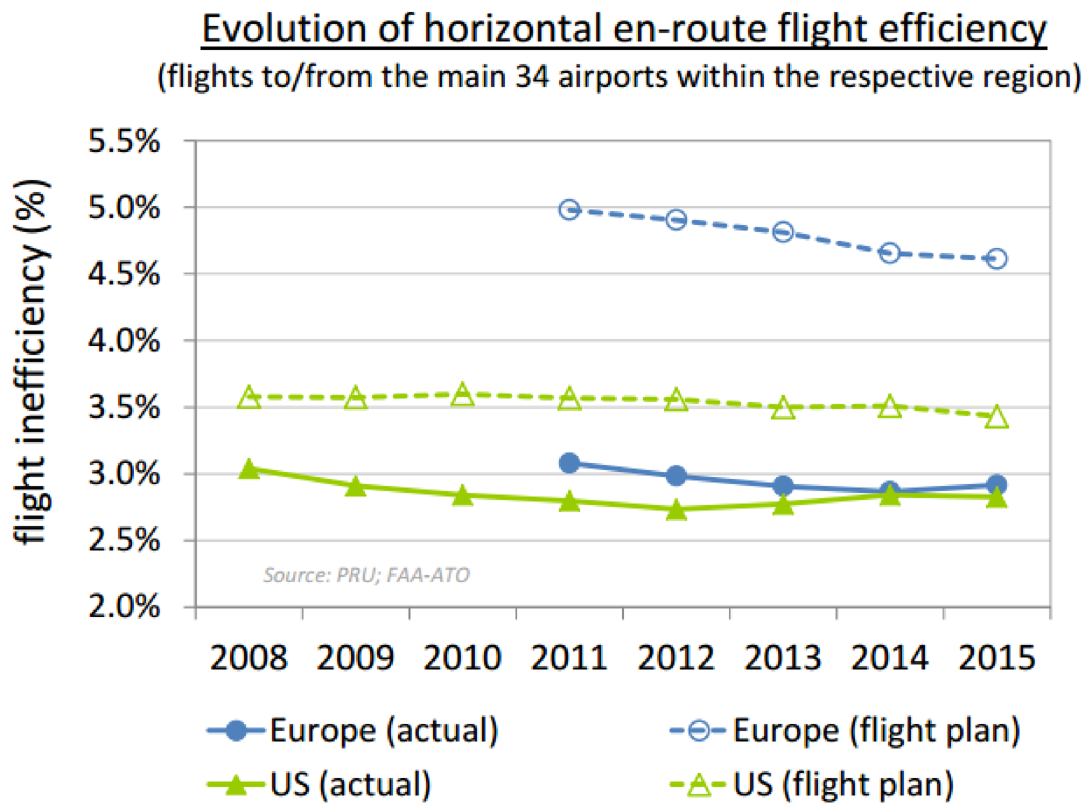


Figure 22: Evolution of horizontal flight efficiency (actual and flight plan) (2008-2015) (FAA and EUROCONTROL, 2016)

Airframe design, weight, weather conditions and the airspace they are flying in influences the optimum cruise conditions. Flight Management Systems on board of aircraft can determine the most efficient cruise altitude and speed to optimise fuel burn. ATM can assist in this process by enabling capacity in the en-route phase of flight to offer aircraft the cruise levels and speeds they request to burn less fuel. Furthermore, taking advantage of the wind can offer efficiency gains.

Flight efficiency can be measured horizontally or vertically. The factors influencing horizontal flight efficiency are illustrated in Figure 23 created by ICAO (Doc 030, 2013). The figure also describes the planning process of an optimized Flight Plan Routing. States that do not have a central archive of surveillance data use indicator option A based on the last filed flight plan trajectory. If surveillance data are available (radar data, ADS-B data or other), States use the actual trajectory (indicator option B).

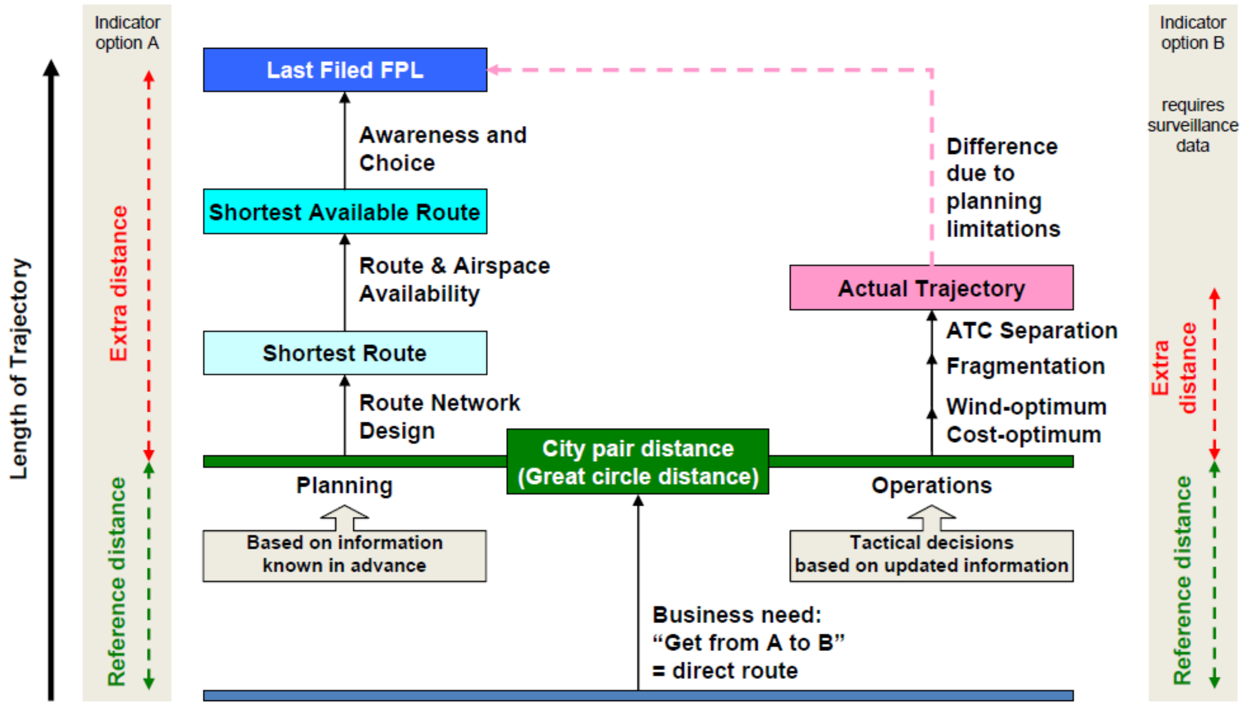


Figure 23: The planning process of an optimized Flight Plan Routing (ICAO Doc 030, 2013)

Furthermore, according to ICAO (Doc 030, 2013) the desired outcome is not to achieve zero extra distance, since that would create operational and economic problems. The user-preferred trajectory rarely corresponds to the direct route. Computing the indicator for wind-optimum trajectories (assuming such data are available), for example, can produce an extra distance compared to the direct route. This is because more favourable wind situations (e.g. high wind speed bands over the Northern Atlantic Ocean) can increase the groundspeed of an airplane and so reduce flight time based costs (e.g. aircraft or fuel). Hence, it is not advised to attempt a reduction of the horizontal en route flight efficiency indicator towards its theoretical limit (zero).

4.6.4.1.1 The NATS's 3Di inefficiency scoring model

NATS has developed a flight efficiency metric, called 3Di inefficiency score 3Di (NATS, 2014). The 3Di is an average efficiency rating for vertical and horizontal trajectories. It applies to domestic airspace, for the airborne portion of flight only. It needs to be highlighted that because aircraft performance and in particular fuel flow rates vary across the different phases of flight the metric applies different weightings for level flight occurring in climb, cruise, and descent phases of flight. The combination of those two factors (i.e. deviation from the optimal trajectory and flight phase related rating) gives the inefficiency score for each flight in the considered airspace. Scores run from 0, which represents zero inefficiency to over 100, with most flights typically having a score in the range between 15 and 35. The score can be improved by better airspace design, controllers' tools, flow management techniques, changes to procedures, awareness training, flexible use of airspace and optimised co-ordination across sectors. The score is also affected by the number of flights, the traffic demand on sectors, the weather, any unusual events (e.g. runway closure) and changes in the runway capacity.

In the horizontal plane, it compares the actual radar ground-track against the (most direct) great circle track – between first and last radar point. Inefficiency in the horizontal plane is defined by the difference between these two distances, which describes the 'additional miles flown'. In the vertical plane, it compares the actual vertical profile from radar data against a modelled ideal flight, defined as a continuous climb to the aircraft's Requested Flight Level (for cruise), and followed by a continuous descent approach. Inefficiency is the difference between the 'actual' and 'ideal' flight profile. The vertical inefficiency is defined by the amount of flight time spent in level flight and the deviation from its requested cruise level. Level portions of flight at low altitude are more fuel penalising than at higher levels.

By providing the most direct possible routes, smooth continuous climbs and descents and optimum flight levels during cruise, air traffic controllers aim to help reduce aircraft fuel burn and carbon emissions, earning a low 3Di score. The combination of 3Di airspace efficiency metric with the Flight Optimisation System, or 'FLOSYS' enables the Air traffic controllers to analyse the environmental efficiency of flights in near real-time.

By having access to this granularity of data for the first time, controllers and airspace managers will be able to better identify the opportunities for operational improvements that will save airlines fuel and cut carbon emissions.

4.6.4.2 Continuous Descent Operation and Continuous Climb Operations

During normal approaches, aircraft are often required by Air Traffic Control to descend early and to level off at intermediate altitudes. The flight phases at these lower altitudes are more fuel inefficient compared to flights in higher altitudes. Nowadays, it is the aim to keep aircraft as long as possible in the cruising level and to perform the succeeding descent with idle engine power to increase the fuel and noise efficiency. Therefore. Continuous Descent Operations (CDO) describes a descent technique whereby engines are as far as possible operated at idle thrust to reduce engine noise, fuel burn and exhaust gas emission during descent (Shresta, Neskovic and Williams, 2009).

In ICAO Document 9931 (Doc 9931, 2010), the ‘Continuous Descent Operations Manual’, CDO is defined as “an aircraft operating technique aided by appropriate airspace and procedure design and appropriate ATC clearances enabling the execution of a flight profile optimized to the operating capability of the aircraft, with low engine thrust settings and, where possible, a low drag configuration, thereby reducing fuel burn and emissions during descent. The optimum vertical profile takes the form of a continuously descending path, with a minimum of level flight segments only as needed to decelerate and configure the aircraft or to establish on a landing guidance system (e.g. ILS).”

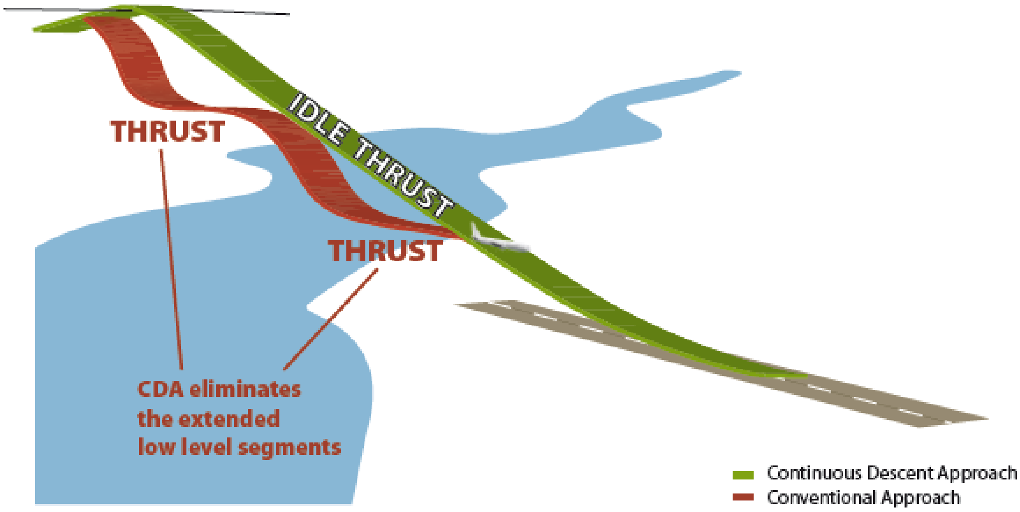


Figure 24 General CDO concept (EUROCONTROL, 2011a: 2)

To achieve the maximum possible benefits of CDO in terms of fuel savings and noise reduction, the descent should be flown from the Top-of-Descent (TOD) to the Final Approach Fix (FAF) closed to the airport (ICAO Doc 9931, 2010). CDOs create measurable benefits concerning fuel burn and emission reductions even though if they are not introduced or flown to the full extend starting at the TOD. The establishment of some parts of continuous descents and the removal of only some level offs during a descent can also create measurable benefits (Shresta, Neskovic and Williams, 2009). Resulting of such optimised descents according to the ICAO CDO manual can provide the following advantages (ICAO Doc 9931, 2010):

- more efficient use of airspace and arrival route placement
- more consistent flight paths and stabilised approach paths
- reduction in both, pilot and controller workload
- reduction in the number of required radio transmissions
- cost savings and environmental benefits caused by reduced fuel burn
- reduction in the incidence of controlled flight into terrain (CFIT)

- authorisation of operations where noise limitations would otherwise result in operations being curtailed or restricted.

Also if the actual focus is on the descent phase of a flight, the principle of avoiding level offs at lower altitudes can be applied conversely to the climb phase of a flight. This method is called Continuous Climb Operations (CCO). ICAO Document 9993 (Doc 9993, 2013) defines CCO as “An operation, enabled by airspace design, procedure design and ATC, in which a departing aircraft climbs without interruption, to the greatest possible extent, by employing optimum climb engine thrust, at climb speeds until reaching the cruise flight level”.

4.6.4.3 KPI: Average horizontal en-route flight efficiency:

As described in section 4.6.4.1, the average horizontal en-route flight efficiency (indicator) is the difference between the distance of the en-route part of the trajectory and the optimum trajectory which is, on average, the great circle distance. Thereby, “en-route” is defined as the distance flown outside a circle of 40 NM around the airport. The flights considered for the purpose of this indicator are:

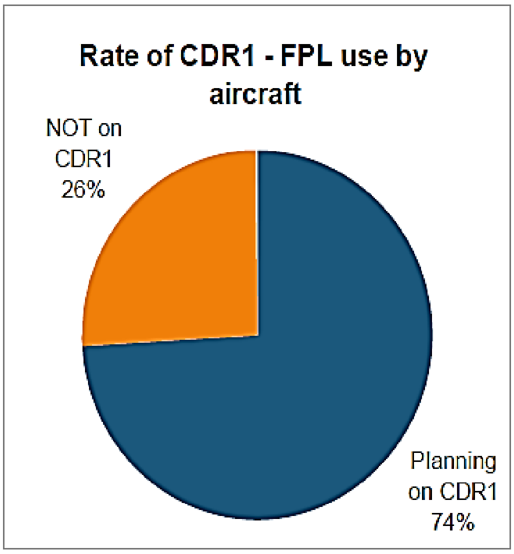
- all commercial IFR flights within European airspace;
- where a flight departs or arrives outside the European airspace, only that part inside the European airspace is considered;
- circular flights and flights with a great circle distance shorter than 80NM between terminal areas are excluded.

4.6.4.4 Conditional Routes

One other aspect that contributes to the improvement on the environment area are Conditional Routes (CDRs). A Conditional Route (CDR) is an ATS route that is only available for flight planning and is used under specified conditions. A Conditional Route may have more than one category, and those categories may change at specified times (EUROCONTROL.int 2016e):

- Category One - Permanently Plannable CDR: CDR1 routes are in general available for flight planning during times published in the relevant national Aeronautical Information Publication (AIP). Updated information on the availability in accordance with conditions published daily in EAUP/EUUPs. CDRs1 can either be established on an H 24 basis or for fixed time periods or at fixed flight level bands.
- Category Two - Non-Permanently Plannable CDR: CDR2 routes may be available for flight planning. Flights may only be planned on a CDR2 in accordance with conditions published daily in the EAUP/EUUPs, and
- Category Three - Not Plannable CDR: CDR3 routes are not available for flight planning; however, ATC Units may issue tactical clearances on such route segments. CDR3 are not subject to allocation the day before by Airspace Management Cell (AMCs).

Figure 25 depicts the percentage of filed plans that used CDRs. The left shide shows that 74% of airplanes that could have used CDR1s (that are permanently plannable) have planned to use CDR1. The right side though shows the CDR2 (that are not permanently plannable). The 64% of the airplanes planned on CDR2 (EUROCONTROL, 2013). The use of CDRs should be increased since the occurring benefits both for the environment and the economy are high.



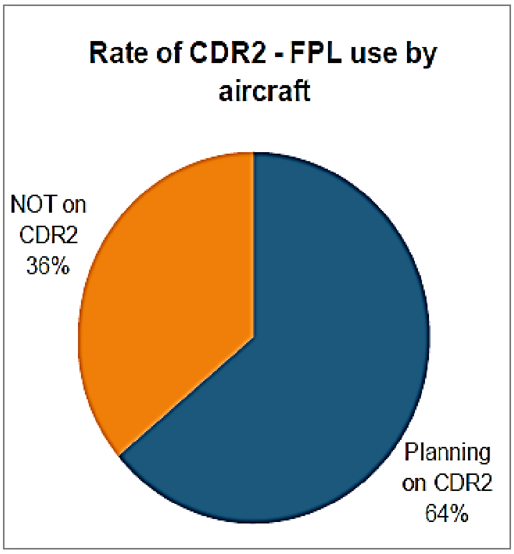


Figure 25: Use of CDRs (EUROCONTROL, 2013: 22)

For instance, improving flight plan quality and utilisation of civil/military airspace structures can lead to reduction on emissions. Figure 26 depicts Conditional Routes (CDR) that could have been used during one peak day by the aircraft operators. The green routes are the available, but not used routes and the red routes are the used ones. In case all the available routes would be used at their full potential, annual savings of 30.000 tons of fuel/year or reduced emissions of 100.000 tons of CO_2/year could be achieved.

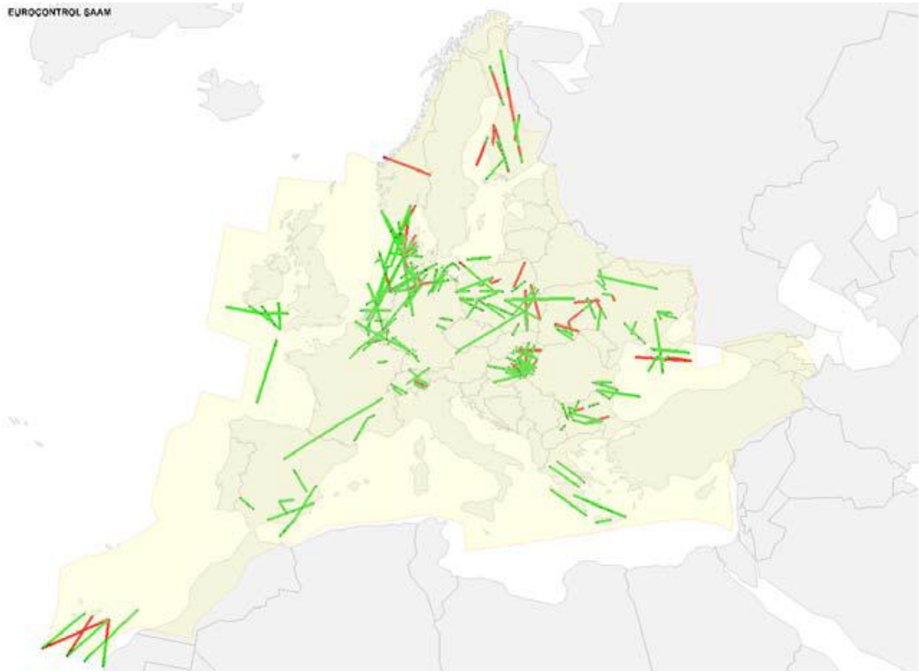


Figure 26: Conditional Routes (CDR) during one peak day

Apart from improving airspace utilisation and route network availability, enhancing European airspace design and introducing a more efficient Terminal Airspace, by improving Terminal Airspace design and implementing Continuous Descent Approaches (CDAs), or optimising airport operations, by Implementing Airport Collaborative Decision Making (A-CDM) can lead to carbon offsetting.

Through Collaborative Decision Making (CDM) procedures airport and aircraft operators, ground handlers and air traffic control share information, creating a common situational awareness for all actors. CDM is a concept to be implemented in an airport environment through the introduction of a set of operational procedures and automated processes.

4.6.4.5 Free Route Airspace

Free Route Airspace (FRA) is a specific airspace within which users shall freely plan their routes between an entry point and an exit point without reference to the ATS route network. In this airspace, flights will remain subject to air traffic control (SkyBrary, 2016). Despite FRA aims to its permanent implementation it is used during specific time periods. In complicated airspaces like MUAC, FRA plays an important role in its capacity.

The main benefit from the implementation of FRA are straighter routes and the consequent reductions in the total flown distance, carried and burned fuel and emissions. This will reduce the weight of the aircraft during flight and hence will give a further benefit of reduced fuel burn and CO_2 emissions during the whole flight. Additionally, FRA will significantly reduce complexity of the route structure and flight planning. Therefore, there are also opportunities to rationalise some legacy inefficiencies in the network.

FRA is based on full trajectory operations. Thus, FRA concept brings increased flight predictability, reduced uncertainty for the Network which in turn can lead to capacity increases for ATM which will also benefit the user (SESAR, 2014).

Several ACCs and ANSPs already implemented fully or partially Free Route Airspace with further phased implementations planned by all FABs/ANSPs over the period 2013-2019, including cross border operations then full free route implementation. Free Route operations are already operational in Portugal (24hrs), Maastricht (24hrs, night and week-end in parts of the Area of Responsibility- AoR), Karlsruhe (24hrs in parts of the AoR), Ireland (24 hrs), Austria - night, Finland - night and weekend, Zagreb, Belgrade, the Former Yugoslav Republic of Macedonia and joint Free Route in Denmark and Sweden. The implementation is coordinated through the NM European Route Network Improvement Plan (ERNIP) and the Network Operations Plan following the Strategic Objectives and Targets set in the Network Strategic Plan and in the Network Manager Performance Plan (SESAR, 2014).

In Europe, there are many initiatives for the implementation of free route airspace. The first states, in which the FRA was implemented, were Sweden, Portugal and Ireland. The introduction of the FRA is easier to Portugal and Ireland due to the fact that their airspace extends above the Atlantic Ocean, through which leads the transit flight paths Europe - America thus to almost zero climbing / descent to / from the defined FRA area.

From March 2011 142 ‘new direct routes’ become available to the airspace controlled by MUAC (EUROCONTROL, 2011b). Those routes contributed to the reduction of the flight time and the engine use, reduction of the fuel use, CO_2 emissions and to the costs occurring from the high traffic density in the European airspace. For safety reasons those routes were conducted during the night but also during the weekend. They are also the first step to the «Free Route Airspace Maastricht (FRAM) programme» that aims to implement those routes to a daily and 24hours scale. The expected benefit of this change is 1.16 million Km less per year, meaning 3,700 tonnes of fuel less, 12,000 tonnes of CO_2

and 37 tonnes less NOX in comparison to the previous routes (EUROCONTROL, 2011b). In Figure 27, the estimated implementation progress of FRA is presented during the years.

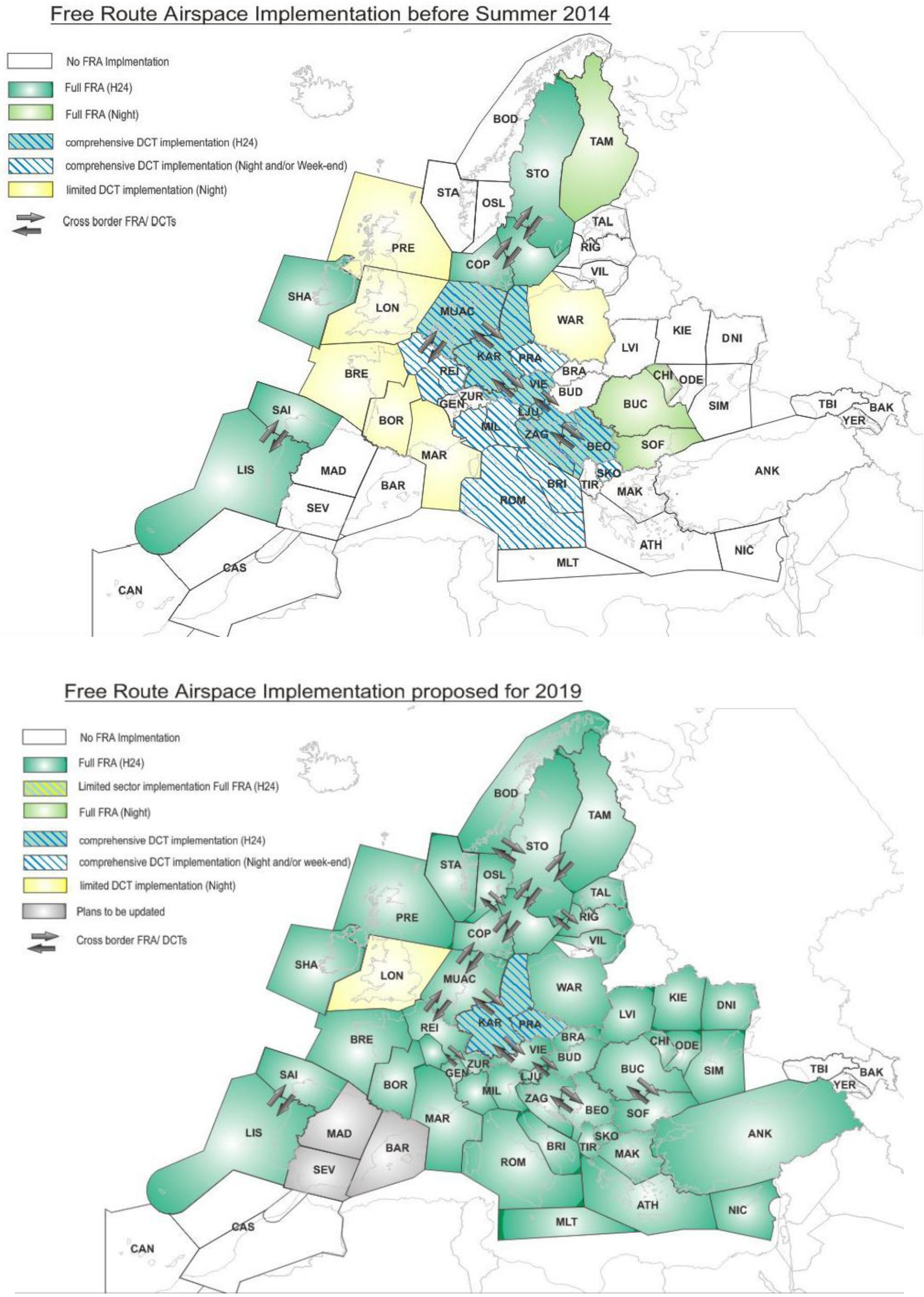


Figure 27: Free Route Airspace Implementation 2014-2019 (NM, 2015)

The main problem is an insufficient ATC system, which cannot cope with the requirements of the FRAs. For example, it can be expected that a free-selected trajectories of a given number of aircraft will create a higher workload to Air Traffic Controller compared to an adherence of predefined airways serving for the same amount of aircraft. Another example is that a dynamic Flight Data Processing (FDP) makes a correct ordering of sectors for flights more difficult. Therefore, today's ATC systems only support FRAs to a limited extent.

4.6.4.6 Flexible Use of Airspace Concept

The Flexible Use of Airspace Concept (FUAC) uses airspace structures and procedures that are particularly suited for temporary allocation and/or utilisation, such as Conditional Routes (CDRs), Temporary Reserved Areas (TRAs), Temporary Segregated areas (TSAs), Cross-Border Areas (CBAs), Reduced Coordination Airspace (RCA) and Prior Coordination Airspace (PCA). In order to improve the airspace utilisation in both a fixed route network and a free route environment, these airspace structures will be implemented according to the specific requirements (EUROCONTROL.int, 2016f).

According to Commission Regulation 2150/2005 Flexible Use of Airspace is "an airspace management concept described by the International Civil Aviation Organisation (ICAO) and developed by the European Organisation for the Safety of Aviation (EUROCONTROL), according to which airspace should not be designated as either purely civil or purely military airspace, but should rather be considered as one continuum in which all users' requirements have to be accommodated to the maximum extent possible."

According to Commission Regulation 2150/2005 'airspace management cell (AMC)' means a cell responsible for the day-to-day management of the airspace under the responsibility of one or more Member States. According to Commission Regulation 2150/2005 'airspace restriction' means a defined volume of airspace within which, variously, activities dangerous to the flight of aircraft may be conducted at specified times (a ‘Danger Area’); or such airspace situated above the land areas or territorial waters of a State, within which the flight of aircraft is restricted in accordance with certain specified conditions (a ‘Restricted Area’); or airspace situated above the land areas or territorial waters of a State, within which the flight of aircraft is prohibited (a ‘Prohibited Area’)”.

According to the Commission Regulation 2150/2005 the following principles shall be applied for the FUAC:

(a) coordination between civil and military authorities shall be organised at the strategic, pre-tactical and tactical levels of airspace management through the establishment of agreements and procedures in order to increase safety and airspace capacity, and to improve the efficiency and flexibility of aircraft operations;

(b) consistency between airspace management, air traffic flow management and air traffic services shall be established and maintained at the three levels of airspace management enumerated in point (a) in order to ensure, for the benefit of all users, efficiency in airspace planning, allocation and use;

(c) the airspace reservation for exclusive or specific use of categories of users shall be of a temporary nature, applied only during limited periods of time based on actual use and released as soon as the activity having caused its establishment ceases;

(d) Member States shall develop cooperation for the efficient and consistent application of the concept of flexible use of airspace across national borders and/or the boundaries of flight information regions, and shall in particular address cross-border activities; this cooperation shall cover all relevant legal, operational and technical issues;

(e) air traffic services units and users shall make the best use of the available airspace.

4.7 Summary

The Single European Sky is an ambitious initiative of the European Commission. The SES aims to improve safety and capacity of the airspace, to make the air traffic management more cost efficient and to reduce the environmental impact of aviation operations. The most important regulation for SES is the Performance Regulation. The performance regulation sets targets, the so-called Performance Indicators, to the ANSPs in the four Key

Performance Areas, the Capacity, Safety, Cost Efficiency and Environment. In the environment area, the most important KPI is the horizontal en-route flight efficiency.

After 2012, the horizontal en-route flight efficiency continued to improve. That trend continues until today. In 2012, the actual horizontal en-route extension was 5.15% of the GCD, quite close to the desired target (5.12%). Regional initiatives regarding FRA continue to bring benefit to environment and the harmonised approach in relation to Network Manager (NM) ensures the linkage of the different initiatives (EUROCONTROL, 2013). Finally, the KPAs are characterised by trade-offs and synergies. For instance, improving safety reduces the cost efficiency due to the high investment in infrastructure. Reducing delays improves the flight efficiency.

5 Elaborations from Literature Review and Experts Consultation

The environment is a dynamic and evolving system of natural and human factors. In the environment, living organisms operate or human activities take place. Environment has a direct or indirect, immediate or long-term effect or influence on the living beings or on human actions at a given time, and in a circumscribed area (Raven et al, 2015).

The environmental awareness differs from airline to airline. There are some airlines that they take measured to reduce their carbon footprint and mitigate their negative externalities. The Lufthansa group for example, has taken many actions ranging from fleet modernisation to green buildings. The Lufthansa Group is also a member of the Sustainable Aviation Fuel Users Group (SAFUG) and of the Aviation Initiative for Renewable Energy in Germany e.V. (aireg) (Lufthansa Group, 2016). Environmental actions depend on the size of the airline. It should be noted that being environmentally friendly is a costly practice. Small airlines for instance may not be in position to afford green actions (e.g. use of biofuels)

Developing environmental projects increases the cost of the airline, but at the same time, the economic objectives of firms may not conflict the environmental objectives. Following an environmental strategy might be a plan for operational expansion of an airline. For instance, it is very common airlines to sign MoU with biofuel providers. Some airlines (like KLM, Iberia, Virgin Atlantic, Azul airlines, Air France, United, American Airlines and Alaska airlines) have used biofuels and other airlines have not (e.g. Astra Airlines). It is evident then that within the same category of stakeholders there are different objectives and behaviours that need to be managed. Apart from that complying with environmental regulations and improving the environmental performance, is an action that requires effort and hides transaction costs.

It is unquestionable that the environment is priceless for the social welfare. Hence, there are several government policies to regulate actions and operations related to the environmental impact. In order for regulation to be implemented in the most efficient way and be followed ethically and fully, the understanding of the stakeholders is critical in order to manage them. This chapter will discuss the theory of multi-stakeholder analysis and management as well as the importance of transaction costs for environmental regulations.

5.1 Multi-stakeholder Analysis and Management

Stakeholder Analysis (SA) is a methodology used to facilitate institutional and policy reform processes by accounting for and often incorporating the needs of those who have a 'stake' or an interest in the reforms under consideration (Pigman, 2007). In order to conduct an effective stakeholder analysis interviews were conducted directly with the stakeholders involved in the specific policy area. The content and questions of the interviews focused on background information on the policy making process, information that identifies key stakeholders from a variety of groups in the reform process, and questions about stakeholder power and interest in EU ETS and SES. The number of interviews was determined by taking into consideration field conditions and logistical constraints (e.g. sensitivity, access, time, budget, etc.).

It is of critical importance to evaluate each stakeholder's power and likely impact on the policy making process and this is done through several steps. The first step is to form a consortium and then to identify their position to the reform. This leads to the creation of groups/clusters that support, oppose or are indifferent to reform. The next step is to categorise the stakeholder data according to the power/influence and salience of each stakeholder. The regulator needs to understand their position in terms of the reform therefore it is critical to categorise the stakeholders according to the following attributes (worldbank.org, 2001):

- Promoters: Stakeholders who prioritise high the policy reform and their actions can impact the implementation of the policy.
- Defenders: Stakeholders who prioritise high the policy reform but their actions do not have an impact on the implementation of the policy.
- Latents: Stakeholders whose actions can affect the implementation of the policy but who prioritise low the reform policy •
- Apathetics: Stakeholders whose actions cannot affect the implementation of the reform policy and at the same time attach a low priority to this policy

The identification of the stakeholders and the application of the above categories, are necessary so at to determine appropriate responsive strategies (e.g. which stakeholders to target for negotiations and trade-offs, or which to buttress with resources and information, etc.). The Stakeholder Analysis among others aims to reveal and hence supports the stakeholder management approaches for balancing the power among weaker groups.

According to Stoney and Winstanley (2001) stakeholder management approaches can be described following the five dimensions: political perspectives; purpose and objectives of considering stakeholders; value of considering stakeholders; considering stakeholder intervention levels; degree of stakeholder enforcement. There are different methodologies developed by individuals, companies, universities and government bodies for stakeholder identification and management.

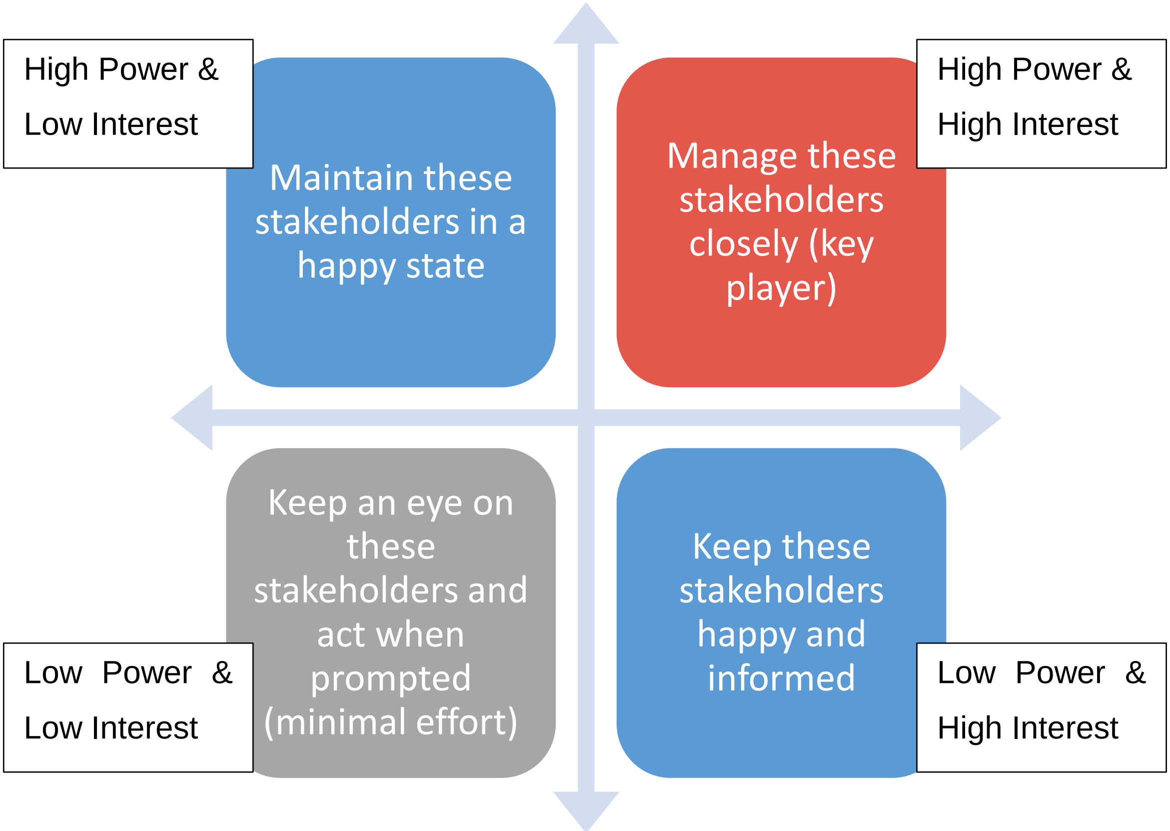
The stakeholders face four major attributes (Stoney and Winstanley, 2001), the stakeholders' position on the reform issue, i.e. SES and EU ETS; the level of influence (negotiation power) they hold; the level of interest they have in SES and/or EU ETS; and the group/coalition to which they belong or can reasonably be associated with. These attributes are identified through various data collection methods, including interviews with experts and with the actual stakeholders directly, as well as from literature review and public announcements.

Jones et al. (2007) claimed that there are five categories of stakeholder cultures that are further subdivided into three typologies: amoral (i.e. agency culture or managerial egoism), limited morality (i.e. corporate egoism and instrumentalism) and broad morality (i.e. morality and altruism). Moreover, the position is related with the motives someone has. The motives can be idealistic/altruistic, individual, corporate or strategic (Jones et al. 2007).

Moreover, the stakeholders have power over a regulation. The power is described as the capacity to induce, persuade or coerce the actions of others and is displayed. Moreover, it can be displayed in different ways. It can be displayed as force, i.e. coercive power, material or financial resources, i.e. utilitarian power, or symbolic resources, i.e. normative power (Johnson et al., 2010; Ihlen and Berntzen, 2007).

The level of influence depends on the stakeholder's power for promoting its position on the regulatory reform. The priority and importance the stakeholder attaches to SES and/or EU ETS shows the level of interest or salience it has. The following matrix depicts the relationship of power and interest in an organisation. The power differential between an entity and its stakeholders will inform the strategies and tactics for dealing with each other (Kolk and Pinkse, 2006). The list of stakeholders is long and they have different opinions and interest that many times are a major source of conflict. Hence, SES and EU ETS regulations are influenced on several dimensions and in different ways.

Table 16: Power-Interest Matrix (Johnson and Scholes, 2010; Olander, 2007)



Managing relationships in order to motivate stakeholders to behave in ways that support the objectives of SES and EU ETS is of critical importance for the social welfare. Thus, stakeholder management should be applied. According to Moloney (2006) stakeholder management can be an effective way to influence the achievement of the goals. For Vogwell (from Chinyio and Olomolaiye, 2010) stakeholder management is about creating the most positive environment in which to develop a project. According to Goodpaster (from Chinyio and Olomolaiye, 2010) there are 3 approaches for dealing with stakeholders: the strategic approach; the Multi-fiduciary approach; and the Stakeholder synthesis approach. Due to the nature of the stakeholders and the complexity of the relationships and interest, a mixed approach is more appropriate for handling the situation. The Stakeholder synthesis approach assumes a moral responsibility of the stakeholders which in this case cannot be granted since most of the stakeholders are competing with each other and/or don't have a direct benefit from the achievements of the regulatory schemes, i.e. SES and EU ETS. The Multi-fiduciary approach assumes a fiduciary responsibility to stakeholders, allotting them equal stakes with shareholders, something that cannot be achieved since by nature they cannot have the same stakes/benefits. The strategic approach allots shareholders' profit a greater priority above the interests of other stakeholders. In this case, since the decision taker is the regulator the point of concern is the passenger in the narrow sense of SES and EU ETS, but when considering the general equilibrium of the system the industry and the research and development enables should be taken under considerations.

5.2 Transaction Cost Economics theory and externalities

Transaction costs are extremely high for solving externalities (Rao, 2003). Externality is the basis of environmental economics, whereas transaction is the basis of transaction cost economics. Environmental problems are a kind of competition over conflicting uses for scarce resources and the question that arises is who has the property rights of the resource. Who owns the clean air? Obviously, everyone has the right for clean air, but at the same time, the airspace users have the right to use the sky. Assigning property rights faces tremendous legal, cultural and technological barriers.

Transaction cost theory deals with the coordination problem between more than two parties in conflict over resource use and potentially involves a transfer of property rights (McCann, 2013; Schniederjans and Hales, 2016). Environmental problems are fundamentally problems of poorly defined property rights (Coase, 1960). Once property rights have been assigned, the goods can be traded and the market place will reach a Pareto-efficient outcome according to Nalebuff (Rao, 2003). According to Coase when one assigns property rights, the market will be completed and efficient outcomes would be produced, since traditional externalities are the reflection of a missing market.

Nalebuff (from Rao, 2003) noticed that TC show that a market-based property rights (PR) approach is not a universal solution for environmental problems. Specifying PR aims to identify the stakeholders, and their rights and duties, in the sustainable use of specific resources. There are two big categories of environmental resources, a) res communis and b) res nullius. Res communis are “assets of global common interest but not amenable to state sovereign control; these are also referred to as common property resources”. Res nullius is “an asset amenable to control/acquisition/ownership or use but not yet in the possession of any entity of legal existence; these are also referred to as open-access resources” (Rao, 2003: 153). PR as well as liability rules (LR) apply to the resources in the res communis category (Rao, 2003).

Since legally valid methods of global environmental accounting and sharing of responsibilities do not exist, global environmental externalities remain the norm (Rao, 2003). PR and LR are very important for sharing of responsibilities in the governance of the global environment and coherent with the role of TC (Rao, 2003).

Frequency, asset specificity, and uncertainty of the transaction depend on the size and the type of the stakeholder (McCann, 2013; Cacho et al, 2013). For example, a small airline like Bluebird Airways has higher costs to develop a trading strategy than Lufthansa for instance due to the necessary expertise already being developed in the big company. The same concept can be applied to ANSPs. Moreover, the more complex the regulatory scheme is, the higher the transaction costs. Companies need time to adapt to changes.

Another important concept is Institutional Transaction Costs (ITC). ITC consist of (Rao, 2003: 155):

- Legislative or regulatory enactment costs;
- Implementation costs;

- Monitoring costs and
- Enforcement costs

This part of TCE makes sense when it is applied to the Performance Regulation Scheme of the Single European Sky (SES). The performance scheme has legislative or regulatory enactment cost, cost related to setting the targets for the KPAs, implementation cost for the targets, monitoring cost to check the progress of the states/FABs as well as enforcement cost.

Trading pollution rights is a policy instrument for controlling environmental externalities that first appeared during 1970s as cost-effective alternative to direct regulation by the government (Rao, 2003). Dales proposed the concept of marketable permits to allocate pollution reduction to private entities as a mechanism for cost-effective implementation, which was also explored by Montgomery (Rao, 2003).

There is interdependence between the governmental institutions and the private market institutions. The government of private market institutions depends on the quality of the governance of the governmental institutions (Rao, 2003). This observation though depends on the country, since there are some countries where the general quality of these institutions is still lagging far behind those of some of the developed economies.

According to Rao (2003) what are considered to be costs in the short term may essentially be viewed as investments for a return in the long run. This means that in case adaptation costs involve or lead to higher efficiency, these costs become negative and thus net benefits.

The Coase theorem states that the assignment of private property rights could lead to an efficient outcome assuming zero transaction costs and common knowledge among participants in the environmental damage resolution or compensation negotiation (Brunner and Enting, 2014). The fact is that the ill-defined enforceable property rights create externalities, but the application of property rights does not mean that efficient environmental solutions are given.

Since expenditures for the obligations of the emissions trade cannot be used to realize emission abatement measures, all transaction costs are “deadweight losses”. According to Stavins (from Frasch, 2007:48) “Macroeconomic theory states that transaction costs hinder the cost-effective allocation of tradable permits as the volume traded decreases, which results in an increase of macroeconomic abatement costs”. In EU ETS the occurred Transaction Costs derive from non-trade related activities, therefore the above aspect is less important, since the effect on trade volume is not as significant as new institutional economics would expect.

According to Stavins (1995) the following three sources for transaction costs exist in the context of emissions trading (Owen & Hanley, 2004: 144):

1. search and information;
2. bargaining and decision;
3. monitoring and enforcement.

Montero (from Owen & Hanley, 2004) expanded the approach of Stavins (1995), explained further the issue of transaction costs in a tradable permit system and confirmed the result that in the presence of transaction costs and uncertainty, the resulting permit price will be higher than that of a least cost solution. Montero (from Owen & Hanley, 2004) shows for the case of NOX abatement in the US, that despite considerable transaction cost, the cost-saving potential of a tradable permit system as compared with a command and control approach is substantial. In emissions trading, the net buyers in the carbon market have to pay for the transactions costs via increased permit prices, whereas for carbon tax the TC are commonly borne by the regulator, or may partially be rolled over to the taxpayer (Owen & Hanley, 2004).

According to Helndl (2012) if, for example, transaction costs from environmental regulation are non-linear, alter the marginal condition for cost-minimization of firms and have a more severe impact on smaller firms or emitters compared to larger ones, then those policies induced ‘frictions’ could lead to larger optimal firm-size or larger optimal size of regulated sources of emissions in equilibrium. This may also work as a market entry barrier; thus, weakening competition.

According to Montero (from Owen & Hanley, 2004) provided that agents willing to trade have to enter the market, find one another, communicate (negotiate price and quantity), and sign the corresponding legal contract, some level of transaction costs is always likely to exist – as in any market transaction. The regulatory requirements of trading permits are low.

Stavins (from Heindl, 2012) states that if TC enters in a non-linear fashion into the cost function, the optimal amount of emissions under regulation e^*_{TC} is no longer independent of initial free allocation received by a carrier, which also implies that actual emissions levels under transaction costs differ from first-best emissions levels $e^*_{TCi} \neq e^*_i$. This means that the permit price in equilibrium differs no matter of transaction costs (Helndl, 2012).

Every carrier is having different TC, since the carriers differ in size and strength. Carriers are free to choose how much effort they will put in ETS after they met minimal requirements for compliance. The basis for creating equations on ETS and TC is the following (Helndl, 2012):

Costs for a single firm depend on individual abatement costs c(e) ≥0, the exogenous permit price p≥0 and emissions e≥ 0. The firm for a given level of production faces the problem (Heindl, 2012:6):

$$\mathbf{min}_{\boldsymbol{e}}[\boldsymbol{c}(\boldsymbol{e}) + \boldsymbol{p} * \boldsymbol{e}] \quad (1)$$

Deriving by e yields the cost-minimizing level of emissions e* where the permit price equals marginal abatement costs:

$$-c'(e)=p \qquad (2)$$

Overall emissions e are decomposed by e=a+u, where a is the free allocation received by the firm with a≥ 0 and u is the amount of permits that must be purchased for compliance or can be sold due to over-allocation.

Bargaining is itself a transaction cost (Usher, 1998). Thus, there are inherent fundamental flaws in the assertions with Coasean proposals (Rao, 2003: 51). Bargaining/negotiations costs can be reduced substantially by exchanges like European Climate Exchange, because they provide standardized contracts and historical price information to facilitate negotiation.

When a carrier chooses to trade then the p ∗ e, becomes p(a+u). Since carriers choose the optimal amount of transactions and consequently aim to minimize transaction costs given their specific needs then the corresponding condition for minimizing costs and the marginal condition are:

$$\mathbf{min}_{\boldsymbol{e}}[\boldsymbol{c}(\boldsymbol{e}) + \boldsymbol{pe} + \boldsymbol{f}(\boldsymbol{e} - \boldsymbol{a})] \qquad (3)$$

$$-c'(e)=p+f'(e-a) \qquad (4)$$

For airlines, the highest transaction costs occur from Monitoring, Reporting and Verification (MRV) of emissions and permit trading. Carriers are obligated to measure or calculate emissions. This process is time demanding because data on emissions have to be collected on the installation level and have to be analysed for emissions reporting each year. Emissions data must be verified by a certified and independent third party, which generates costs. Finally, the data have to be reported to the national authorities in a standardized form, which again is time demanding.

These costs are likely to be dependent on emissions-levels with relatively high fixed costs and resulting scale economies in MRV activities. So, if MRV related TC are $g(e) \geq 0$, the cost function will be:

$$\mathbf{min}_{\boldsymbol{e}}[\boldsymbol{c}(\boldsymbol{e}) + \boldsymbol{pe} + \boldsymbol{g}(\boldsymbol{e})] \qquad (5)$$

and the corresponding marginal condition:

$$-c'(e)=p+g'(e) \qquad (6)$$

Many airlines in order not to have Transaction costs related to MRV chose to ask for help from intermediaries to outsource this service to others, e.g. EUROCONTROL. Another important cost is the one related to abatement strategies. Carriers face informational costs when searching for appropriate technology for carbon offsetting or alternative solutions. Reinvestment and replacement of existing fleet for instance is an extremely costly action. Given the abatement and the related transaction costs term $h(e) \geq 0$, the cost function will be:

$$\mathbf{min}_{\boldsymbol{e}}[\boldsymbol{c}(\boldsymbol{e}) + \boldsymbol{pe} + \boldsymbol{h}(\boldsymbol{e})] \qquad (7)$$

and the corresponding marginal condition:

$$-c'(e)=p+h'(e) \qquad (8)$$

Nevertheless, innovations and changes might occur outside of the environment of the carriers and can prove beneficial for carbon offsetting and thus costs. For instance, the harmonisation of European Sky through Functional Airspace Blocks, can lead to better flight efficiency and thus less fuel consumption, costs and emissions.

As far as the search transaction costs are concerned, they are reduced substantially, since greenhouse gas markets are facilitated by exchanges such as the European Climate Exchange (ECX) and buyers and sellers find each other quite easily. Carriers can obtain up to a specific percentage credits from the Kyoto Mechanisms. The Joint Implementation (JI) provides for the creation of emissions reduction units (ERUs), whereas the Clean Development Mechanism (CDM) provides for the creation of certified emissions reductions (CERs). Therefore, CDM and JI are directly connected to EU ETS.

McKloskey et al. (from Chadwick, 2006:260) defined CDM transaction costs as “that part of a CER’s price that cannot be attributed to the physical process of removing GHGs from the atmosphere”. Chadwick (2006) argued that this definition does not take under consideration the demand effects on CER market prices and thus adjustment is required to separate the TC effects from the demand effects. According to Chadwick (2006) CDM transaction costs are especially important because the financial sustainability of CDM projects is so closely linked to the size of the CER revenue stream.

Under the existence of TC market outcomes rely on the structure and the rules of surrounding institutions. Institutions have the effect of giving some actors more influence or less costly influence (so that one party can shift the outcome to their favour with less effort than the other can), over outcomes than others and shift market equilibria away from the original “optimum” (Chadwick, 2006).

5.2.1 Transaction Costs Categories in EU ETS and SES

Transaction Costs Economic (TCE) theory may be used to highlight certain issues in the Performance Regulation Scheme of the Single European Sky (SES) and European Union

Emissions Trading Scheme (EU ETS). This is because there are legislative and regulatory enactment costs related to the KPAs, such as implementation costs to meet the targets; monitoring costs to check the progress of the states/FABs; and enforcement costs to make the scheme work. Search and information, bargaining and decision, monitoring and enforcement of the Performance scheme create transaction costs (TC) for the SES stakeholders.

The stakeholders experience the SES in a different way. For instance, the ANSPs are the ones that are regulated and the CAAs or the EC are the regulators. The transaction costs differ among the stakeholders because they focus on different elements. For instance, an ANSP is not responsible for considering alternative policies, but a policymaker/regulator is. Thus, the ANSP would have zero transaction costs for the category alternative policies. The importance of every category is different for the different stakeholders. The focus on the SES is on the policy makers, since for the ANSPs the main cost are the compliance measures, i.e. the cost of considering and adopting new systems and infrastructure. Transaction costs for policymakers/regulators emerging from the Performance scheme regarding the KPA of environment may be categorised as follows:

Table 17: Transaction costs categories for policymakers/regulators emerging from the Performance scheme regarding the KPA of environment (Source: own elaboration)

Categories	Description
Alternative policies	➢ Develop alternative solutions ➢ Evaluate the alternative solutions ➢ Decision for the implementing policy
Development and Implementation of the regulation scheme	➢ Quantification of historic emissions ➢ Development of emission outlooks ➢ Decision for an application rule ➢ Measures to overcome “frictions” and negotiation with stakeholders

Categories	Description
	➢ Assessment of participants ➢ Adaptation or purchase of software ➢ Material costs Set up of organizational structures and assignment of responsibilities ➢ Fees for Information, training
Monitoring	➢ Design of a monitoring concept ➢ Implementation of an internal monitoring system ➢ Ongoing monitoring
Reporting and verification	➢ Quantification of annual emissions ➢ Compilation of an emissions report ➢ Verification of an emissions report ➢ Delivery of data for ex-post-control
Compliance measures	➢ Identification of compliance measures ➢ Offering recommendations and support ➢ Decision about imposing non-compliance penalties
Strategy	➢ Design of the strategy for NSAs, ANSPs ➢ Design of the regulation enforcement procedure ➢ Design of the abatement strategy

As already mentioned, SES and consequently FABs aim to improve the performance of airspace through ANSPs and NSAs for airspace users. FABs aim to achieve carbon offsetting through setting environmental targets. Another scheme that can use the benefits deriving from FABs is the EU ETS. The EU ETS is a Market Based Mechanism (MBM) and introduced the 'cap and trade' principle, according to which a cap is set on the total amount of greenhouse gases that can be emitted by all participating installations. 'Allowances' for emissions are then auctioned off or allocated for free, and can subsequently be traded. Installations must monitor and report their CO_2 emissions, ensuring they hand in enough allowances to the authorities to cover their emissions. Monitoring, reporting and verification result in transaction costs whose largest part is passed to the airspace users. To lower transaction costs, many airlines related to monitoring chose to outsource this service to others, e.g. EUROCONTROL. Transaction costs for airlines deriving from the inclusion of aviation in EU ETS can be categorised in the following categories:

Table 18: Transaction costs categories for airlines deriving from the inclusion of aviation in EU ETS (Source: own elaboration)

Categories	Description
Application (Scheme design)	➢ Quantification of historic emissions ➢ Development of emission outlooks ➢ Decision for an application rule ➢ Compilation of an application ➢ Where necessary, compilation of a benchmark ➢ Verification of the application ➢ Fees for annual allocation ➢ Fees for emissions register
Implementation of emissions Management	➢ Information, training ➢ Assessment of obligation to participate in the EU ETS ➢ Set up of organizational structures and assignment of responsibilities ➢ Adaptation or purchase of software ➢ Material costs
Monitoring	➢ Design of a monitoring concept ➢ Implementation of an internal monitoring system ➢ Ongoing monitoring
Reporting and verification	➢ Quantification of annual emissions ➢ Compilation of an emissions report ➢ Verification of an emissions report ➢ Delivery of data for ex-post-control
Abatement measures	➢ Identification of abatement measures ➢ Decision about abatement measures
Trade	➢ Transactions fees (exchange fees, broker fees, clearing) ➢ Trade and negotiation

Categories	Description
	➢ Market observation
Strategy	➢ Definition of the risk strategy ➢ Definition of the trade strategy ➢ Definition of the abatement strategy

As far as EU Emissions Trading Scheme in aviation is concerned, the focus is on the airlines and the policy makers. The categories of transaction costs are different. The transaction costs for the policy makers/regulators are similar to those of the SES. The regulator spends a lot of effort on developing alternative policies, evaluating the options and deciding on the policy to be implemented, i.e. the EU ETS. The second category is the development and the implementation of the regulation scheme. The policy maker needs to understand the aviation industry and its effect on the environment and set the parameters for the regulation. This phase of the reform bears high transaction costs, since during this period, experts from different areas are needed to set the regulatory framework. The categories of Monitoring, Reporting and Verification related to the quantification of emissions, the compilation of reports, the verification of report and the delivery of data for ex-post-control. Another important category of TC for the regulator is the compliance measures and the strategy. In this category the guidelines for the companies is included as well as the strategy for enforcing the regulation and any abatement strategy. Transaction costs for policy makers/regulators deriving from the inclusion of aviation in EU ETS can be categorised in the following categories:

Table 19: Transaction costs categories for policy makers/regulators deriving from the inclusion of aviation in EU ETS (Source: own elaboration)

Categories	Description
Alternative policies	➢ Develop alternative solutions ➢ Evaluate the alternative solutions

Categories	Description
	➢ Decision for the implementing policy
Development and Implementation of the regulation scheme	➢ Quantification of historic emissions ➢ Development of emission outlooks ➢ Decision for an application rule ➢ Measures to overcome “frictions” and negotiation with stakeholders ➢ Compilation of an application ➢ Where necessary, compilation of a benchmark ➢ Verification of the application ➢ Assessment of participants in the EU ETS ➢ Adaptation or purchase of software ➢ Material costs Set up of organizational structures and assignment of responsibilities ➢ Fees for Information, training
Monitoring	➢ Design of a monitoring concept ➢ Implementation of an internal monitoring system ➢ Ongoing monitoring
Reporting and verification	➢ Quantification of annual emissions ➢ Compilation of an emissions report ➢ Verification of an emissions report ➢ Delivery of data for ex-post-control
Compliance measures	➢ Identification of compliance measures ➢ Decision about imposing non-compliance penalties
Strategy	➢ Definition of the strategy for companies ➢ Definition of the enforcing the regulation ➢ Definition of the abatement strategy

All companies by nature look for lower costs thus are looking for lower TC. Through de-minimis rule for airlines the smallest carries are protected from TC and at the same time the regulators. The benefit of including them to EU ETS is smaller than the cost. TC are also closely related to the spot price of permits. If the price is too low and Transaction costs too high, then some airlines might prefer not to optimise their green policy as much as possible. When policies like EU ETS are implemented there are usually complaints or resistance towards the policy itself or the way the policy is implemented. These "frictions" are basically costs, as Hicks (1935) supported.

Apparent rigidities and frictions towards a full scope EU ETS from the early beginning might exert a positive role as a buffer against excessive fluctuations in traffic, prices and fair competition. It needs to be highlighted that apart from economic agents, but also organizations and companies react to "frictions". Everyone from the stakeholders can be the source of the "friction" or the reaction to the "friction". For instance, in the case of stop the clock, A4A was the "friction" and AEA was the reaction.

5.3 Summary

Both EU ATS and SES are quite complex reforms and their management can be quite difficult. The management of the stakeholders in proved very demanding due to the fact that the geographical scope is very extended, there are a lot of companies and entities to manage, but most importantly there are quite diverse stakeholders. The regulators should manage the airspace users, the other regulators, the institutions, the system suppliers, the manufacturers, the ANSPs, the military entities, etc. The regulator should understand the stakeholders, their level of influence as well as their power. As explained above the level of influence depends on the stakeholder's power for promoting its position on the regulatory reform.

The most difficult part is not developing the concepts and the regulations around the schemes, but implementing them. There are many hidden cost around the implementation of the reforms. The theory of transaction costs was initially developed for the environmental regulations and can be adopted in the SES and EU ETS reforms. The researcher base on literature review, participant observation and consultation developed some categories of transaction costs in EU ETS and SES. Those categories involve costs associated with the alternative policies, the development and implementation of the regulation scheme, the monitoring, reporting and verification, the compliance measures and strategies.

6 Research methodology

Research is a process of steps used to collect and analyse information to increase our understanding of a topic or issue”. It consists of three steps: Pose a question, collect data to answer the question, and present an answer to the question according to Creswell (2008).

According to Williams (2007: 65) the research process is ‘systematic in that defining the objective, managing the data, and communicating the findings occur within established frameworks and in accordance with existing guidelines’. Saunders et al. (2015) classified research into six stages and named the model as ‘the research onion’. This model is depicting the issues underlying the choice of data collection techniques and analysis procedures (Saunders et al., 2015).

6.1 Research philosophy

Ontologies is ‘the term used to refer to the shared understanding of some domain of interest which may be used as a unifying framework to solve the above problems in the above described manner’ (Uschold & Gruninger, 1996:5). Ontology is the study of being, that is, the nature of existence and what constitutes reality (Gray, 2014: 19). According to Saunders et al. (2015) ontology relates to assumptions regarding the nature of reality. While ontology embodies understanding what is, epistemology tries to understand what it means to know. Epistemology provides a philosophical background for deciding what kinds of knowledge are legitimate and adequate. Epistemology concerns what is acceptable and legitimate. A similar concept is worldviews. Worldview means ‘a basic set of beliefs that guide action’ according to Guba (1990, 17). Another type of research assumptions is axiology, which refers to values and ethics.

After defining ontology and epistemology, the terms objectivism and subjectivism need to be clarified too. Objectivism, ontologically defined embraces realism. This means that reality exists independently of consciousness (Saunders et al., 2015). The target is to find the objective truth without influenced from feelings and values. At the same time though, objectivism does not entail the rejection of subjectivity: subjective views can be studied (their values, attitudes and beliefs) but it should be done objectively (Bunge, 1993).

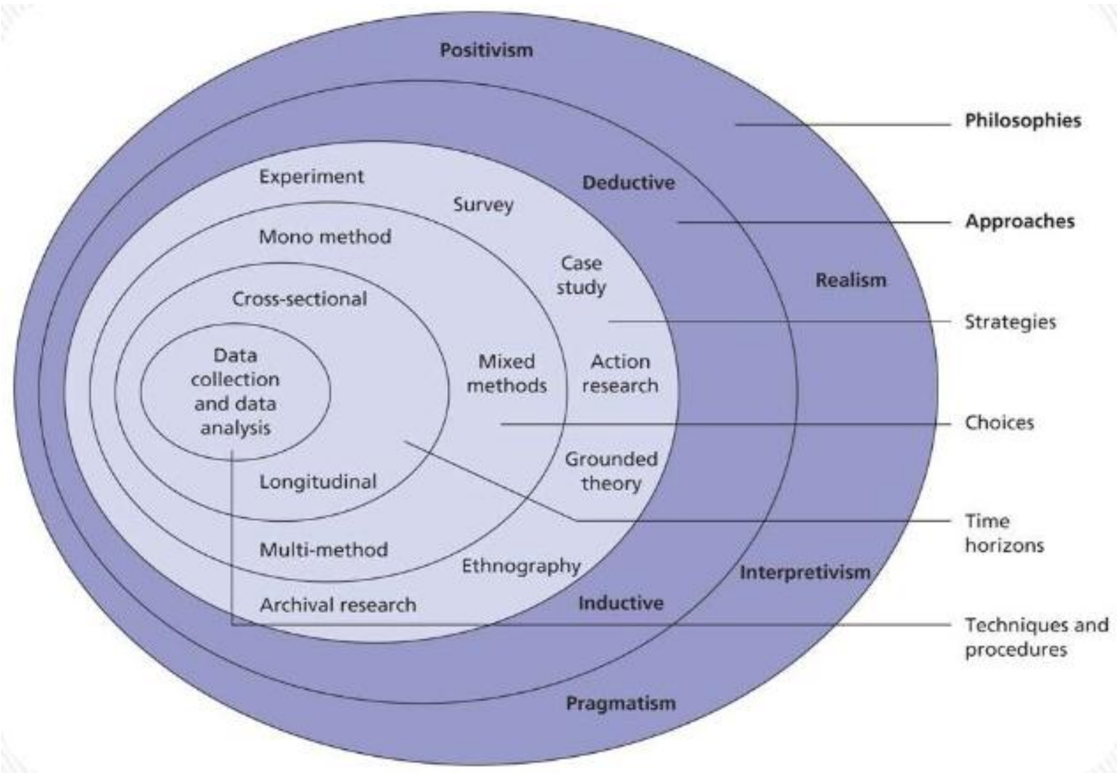


Figure 28: The research onion (Saunders et al., 2015)

There are four major philosophies of research, positivism, realism, interpretivism, postmodernism and pragmatism (Figure 28). Positivism regards the attempt to obtain predictive and descriptive information related to the social reality and the external world as the main purpose of science. According to this philosophy, only phenomena that can be observed will lead to the production of credible data. Moreover, the researcher is very independent of and neither affects nor is affected by the subject of the research (Remenyi et al., 1998).

Another epistemological position is this of realism. According to this position, the senses show us the truth and not our mind as the idealism supports. Realism can be categorised to critical realism and direct realism. Direct realism states that element itself and the sensations it conveys is enough to explain the element. On the other hand, critical realism makes an extra step by saying that it is also the mental processing that goes on sometime after that sensation meets our senses. Pragmatism is a deconstructive paradigm that advocates the use of mixed methods in research, “sidesteps the contentious issues of truth and reality” (Feilzer, 2010: 8), and “focuses instead on ‘what works’ as the truth regarding the research questions under investigation” (Tashakkori & Teddlie, 2010: 713). Hence this approach focuses more on the ‘What’ and ‘How’.

Interpretivism claims that it is important for the researcher to find differences between humans in their roles. The challenge of this research philosophy is that the researcher should understand the research subjects and see the world from their point of view. The philosophy that is followed in this PhD Thesis is **Interpretivism**. In this thesis, the methods used capitalised on a dynamic setting resulting from different expert opinions expressed with the help of Delphi method and unstructured interviews. The latter were based on a free flow discussion and expressed subjective opinions. Based on those subjective opinions the researcher tried to interpret the socially constructed reality.

When examining concepts like EU ETS and SES, interpretivism is more appropriate to capture the complexity of those reforms, explain the governance issues and implement a causal effect analysis. Many researchers in the area of business and management, particularly in the fields of organisational behaviour, marketing and human resource management have used interpretivism. It should be noted that generalizability of EU ETS and SES is not of critical importance for this philosophy, since the aviation environment is constantly changing, but generalizability for the aviation governance and policy is.

One step ahead of interpretivism is constructionism, also known as social constructionism. This views reality as being socially constructed. The **constructionism** research philosophy was also followed in the PhD thesis since it deemed vital to identify the subjective meaning that motivate the actions of the aviation stakeholders involved in SES and EU ETS. Aviation players in respect to their group, placed many different interpretations of the situations in which they found themselves. These interpretations affect their actions and the interaction they have with other players. The aviation players may not share the same mentality. Therefore, the aim of the researcher is to understand the subjective reality of each aviation player and explain their motives and actions regarding EU ETS and SES in a meaningful way.

6.2 Data collection techniques

Data selection is of critical importance for all researches. Date can be qualitative and quantitative, so the research can be categorised as qualitative or quantitative research. What constitutes a quantitative research method involves a numeric or statistical approach to research design. Leedy and Ormrod (2012) alleged that quantitative research is specific in its surveying and experimentation, as it builds upon existing theories. The methodology of a quantitative research maintains the assumption of an empiricist paradigm (Creswell, 2013). Qualitative research provides an important insight into interpersonal relationships (Tracy, 2013). It can be used to understand groups and organisations or even a range of societal issues that arise from particular cultural contexts (Yin, 2015; Hogan et al, 2011). Qualitative research builds its premises on inductive, rather than deductive reasoning. It is from the observational elements that pose questions that the researcher attempts to explain. The strong correlation between the observer and the data is a marked difference from quantitative research (Williams, 2007).

The mixed methods approach to research is an extension of rather than a replacement for the quantitative and qualitative approaches to research, as the latter two research approaches will continue to be useful and important (Johnson & Onwuegbuzie, 2004).

According to Creswell (2013) a mixed methods approach is one in which the researcher tends to base knowledge claims on pragmatic grounds (e.g., consequence-oriented, problem-cantered, and pluralistic). It employs strategies of inquiry that involve collecting data either simultaneously or sequentially to best understand research problems. The data collection also involves gathering both numeric information (e.g., on instruments) as well as text information (e.g., on interviews) so that the final database represents both quantitative and qualitative information.

Qualitative research is a holistic approach that involves discovery (Williams, 2007). Qualitative research can also be described as an effective model that occurs in a natural setting that enables the researcher to develop a level of detail from being highly involved in the actual experiences (Creswell, 2013). According to Flick (2009) the qualitative research features are the following:

- Appropriateness of methods and theories
- The perspectives of the participants and their diversity
- Reflexivity of the researcher and the research
- Variety or approaches and methods in qualitative research

For qualitative data collection, there are three broad categories, the indirect observation, the direct observation and the elicitation or talking to people (Bernard et al, 2016). Elicitation is interviewing, asking questions to people. The interviews can be structured, semi-structured or unstructured. The main advantage of unstructured or semi-structured interviews is that it offers flexibility and the interviewer can modify the order and details of how topics are covered. This requires self-discipline and a trained memory to recall the information. Unstructured interviews look and sound like casual conversations, but they are not. Many times is the only way to get information from some experts. On the other hand, if one wants to compare ideas and practices across people or groups then similarity in the level and the kind of information is necessary.

The research methodologies that were selected for this research project are two: a) participant observation combined with unstructured interviews based on a free flow discussion and b) the Delphi Method. Each method has a different process and objective. Having different and complementary methods offers a better insight to the aviation governance issues and benefits the discussion and the arguments developed by the researcher and complements the Multi- Stakeholder Analysis and Management that is used to better analyse the results and contribute to the development of an ideal reform mechanism.

6.2.1 Participant Observation

Participant observation is a process where the researcher can observe a setting to collect data (Glesne & Peshkin, 1992). Participant observation is widely used in social sciences and especially to ethnographic research. The participant observer comes to a social situation with two purposes: a) to engage in activities appropriate to the situation and b) to observe the activities, people, and physical aspects of the situation (Spradley, 2016; Weissinger, 2005). This qualitative method aims at understanding the diverse perspectives of any given community and at the interplay among them. The researcher accomplishes this by either only observing or by both observing and participating to the activities held by the community (Musante and DeWalt, 2010). The participants' observation for ethnographic research takes place in the location/environment of the community.

The participant observation was conducted at EUROCONTROL for the continuous period between December 2013 and August 2015. During this period, the researcher participated to projects related to SES and ETS as well as meetings like the NSA Coordination

Platform. After August 2015, the researcher participated to a meeting organised by European Commission about the EU ETS.

During the period of participant observation research, unstructured interviews were conducted that contributed also to the development of some of the Delphi research questions. In total seven interviews were conducted. The seven interviewees had different backgrounds. Two of them are senior experts at IATA (interviewee N.07 and interviewee N.06), the other two are senior consultants/academics in aviation and environment (interviewee N.05 and interviewee N.04), one expert is working in the NGO Transport and the Environment (interviewee N.03), one senior expert at European Commission (interviewee N.02) and one senior expert at EUROCONTROL (interviewee N.01). The interviewees requested their profile to remain anonymous without stating their roles or backgrounds. The airlines' opinions are represented via IATA and the passengers' opinion is represented by the NGO. Their help was valuable and due to their anonymity they had a more sincere and critical approach to SES and EU ETS.

The information and data obtained through participant observation enhance the understanding of the social, cultural and economic contexts of the participants' environment; the relationship among and between people, ideas, norms and events; and peoples' behaviours and activities. The researcher obtains a nuanced understanding of communities' complexities than can come only from personal experience. Through this research method, the researcher can get information previously unknown that is crucial for project design, data collection as well as interpretation of other data. On the other hand, participant observation is very time consuming and extremely difficult to keep notes and document the data while the researcher is in the act of participating and observing. Finally, a third challenge is being objective. The researcher should diversify what is observed and what is interpreted from what is seen. Hence, it is important to filter out personal biases.

It is of critical importance to establish categories of information that are worth observing. For this specific research, the elements that were observed looking only at the people are the following:

- Verbal behaviour and interactions: Who speaks to whom and for how long; who initiates interaction; languages or dialects spoken; tone of voice; their rank.
- Physical behaviour and gestures: What experts do, who does what, who interacts with whom, who is not interacting
- Expert rotation: In which meetings experts participate, who they are (ethnicity, age, educational profile); turnaround of the experts and directors.
- Experts who stand out: The characteristics of these experts and their group; what differentiates them from others; whether other experts consult them or they approach other experts.

The participant observation was used in this PhD thesis in order to identify the different players of the aviation game and to better understand the relationships among the participants as well as the complexity of the positions. Moreover, participants' observation was selected as the first stage of this research project in order to facilitate and develop relationships with key informants, stakeholders and gate keepers whose assistance was needed for the research topic to become a reality. Often participant observation is used in conjunction with interviewing to collect data in the participant's words (Bogdan & Biklen, 2006).

6.2.2 Delphi Method

The Delphi method can be characterized as the one that forms the communication process of a group so that this process is effective allowing a group of individuals, to enable as a whole to deal with a complex issue (Linstone & Turoff, 2002). According to Linstone & Turoff (2002) the traditional application of Delphi technique was forecasting, but it has been used in gathering current and historical data not accurately known or available, exploring urban and regional planning options, putting together the structure of a model, delineating the pros and cons associated with potential policy options, developing causual relationships in complex economic or social phenomena and distinguising and clarifying real and perceived human motibations. Delphi method has been succesfully been used in various fields. Delphi is the best tool to gather in-depth information from a panel of aviation experts who are geographically dispersed.

To achieve this structured communication someone should (Linstone & Turoff, 2002):

- Provide feedback of the individual contributions of information and knowledge
- Provide an assessment of the crisis and the views of the group
- Offer the opportunity to the individuals to revise their views
- Provide some degree of anonymity for individual answers.

The Delphi method has several applications. It can be used for example as (Linstone & Turoff, 2002): a) prediction method, b) for the collection of current and historical data not accurately known or available, c) for identifying the significance of historical events, d) to outline the pros and cons associated with potential policy options, e) to development of causal relationships in complex economic or social phenomena, g) distinguish and clarify the real and perceived human motivation.

Furthermore, the Delphi method is a method for structuring a group communication process so that the process is effective in allowing a group of individuals as a whole to deal with a complex problem (Van der Duin, 2016). The implementation of SES and EU ETS is problematic and lacks of substantial knowledge regarding the governance issues and the difficulties associated with their implementation and success.

This method is used in order to study in more details a specific or contemporary topic and is conducted during multiple rounds. In the first round, a panel of experts, either as a group in the same room or individually in different areas, are asked about their opinion regarding the specific topic. The opinions of all the participants are summarised and sent back to the participants in order to develop new ideas or to revise their already stated ideas. This can be done many times in order to reform ideas and summarise opinions.

Table 20: Use of Delphi method

Researcher	Topic	Rounds	Participants
Gustafson, Shukla, Delbecq, & Walster (1973).	Estimate almanac events to investigate Delphi accuracy	2	4
Czinkota & Ronkainen (1997)	Impact analysis of changes to the International business environment.	3	1
Kuo & Yu (1999)	Identify national park selection criteria.	1	28
Nambisan et al. (1999)	Develop a taxonomy of organizational mechanisms.	3	6
Lam, Petri, & Smith (2000)	Develop rules for a ceramic casting process.	3	3
Delbari et al (2016)	An investigation of key competitiveness indicators and drivers of full-service airlines using Delphi and AHP techniques	2	30
Varho et al (2016)	Futures od distributed small scale renewable energy in Finland- a Delphi study of the opportunities and obstacles up to 2025	2	18

There are two types of Delphi, the Delphi Exercise and the Delphi Conference (Linstone & Turoff, 2002). The first one is like the ‘paper and pencil’ version, according to which a questionnaire is sent to a group and after it is answered, it is returned to the researcher in order to summarise the results. The researched based on the results, designs a new questionnaire for the group. The group will have at least one opportunity to reconsider its initial statements based on the collective position of the group towards the topic. This is the most common form of Delphi.

Delphi Conference is the most modern form of Delphi research and it substitutes in a high degree the research team with the computer that is programmed to conduct the drawing of the results. This version of Delphi has the advantage that it eliminates the delay from summarising/consolidating every round, making the process in more real time communication system. Unfortunately, it does not offer any flexibility, since the terms of communication should be clearly defined before the start of the research (Linstone & Turoff, 2002).

Delphi method is conducted in four phases no matter which form it has (Linstone & Turoff, 2002). The first phase is related with the search of the topic, where every individual offers additional information that believes is related to the topic. The second phase is about the understanding of the opinions of the group regarding the topic. If there is a disagreement among the participants for the topic, this disagreement is researched in the third phase of the Delphi so as to understand the reasons of the disagreement. Finally, the last phase is the analysis and evaluation of the findings.

The Delphi method is successful only when emphasis is given to specific aspects (Van der Duin, 2016). The researcher should not pass his/her ideas and opinions to the participants, or to oversimplify the structure of the Delphi method and not to allow other aspects of the problem to be expressed.

In terms of communication with the groups, there are different ways of doing that. The main techniques of communication with a group are conference telephone call, committee meeting, formal conference or seminar, conventional Delphi and real time Delphi. The effectiveness of the group communication technique is related mainly to the size of the group, the length and the number of interactions and the occurrence of interaction by individual. When Delphi is conducted with a small group size, psychological effects may be minimised. Conducting a Delphi study can be time-consuming (Hsu & Sandford, 2007).

Linstone and Turoff (2002) stated that Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem. To accomplish this ‘‘structured communication’’ the following are provided: some feedback of individual contributions of information and knowledge; some assessment of the group judgment or view; some opportunity for individuals to revise views; and some degree of anonymity for the individual responses.

Anonymity, iteration, controlled feedback and statistical aggregation of group response are the four key features that define and characterise Delphi method (Skulmoski et al, 2007). In the traditional Delphi method, participants are not usually aware of the identity of other panellists. By protecting the identity of participants, the potential risk of self-censorship is reduced (Ballantyne, Hughes & Bond, 2016). Moreover, it offers panellists the opportunity to modify their views as they respond to those of others without the social pressure that exists in face-to-face meetings. Using individual communication or online research the potential of individual group members dominating the group-decision process as often occurs in planning meetings and focus groups can be avoided.

Iteration, i.e. the repetition of the questionnaires over a number of rounds, gave to individuals the opportunity to change their initially stated opinions and judgement without any pressure from the group. The process is mainly as a series of rounds; in each round every participant worked through a questionnaire which was returned to the researcher who collected, edited, and returned to every participant a statement of the position of the whole group and the participant’s own position. A summation of comments made each participant aware of the range of opinions and the reasons underlying those opinions Ludwig (1997).

The Delphi method is very different from the traditional survey in terms of the procedure. Regarding sampling Delphi's power does not rely on statistical power of the group size, but rather on group dynamics and expertise. Finally, in Delphi method the participants are not anonymous to the researcher; hence construct validation is permitted. It needs to be highlighted that respondents are always anonymous to each other, but the researcher knows them and has the opportunity to follow up for clarifications and further qualitative data offering richness of data.

6.3 Design of the instrument

Research design according to Yin (2013) is the logical sequence that connects the empirical data to a study's initial research questions and ultimately to its conclusions. The PhD thesis has two main pillars, the literature review and the primary research. The literature review is the basis for understanding sustainable development in aviation. In the literature review, two case studies, the SES and the EU ETS reforms, were examined by looking at their aims and technical details. The research methods that were applied in the order they were conducted are the participant observation, the Delphi method and the unstructured interviews. The flow chart (Figure 29) shows the process that was followed to conduct this research.

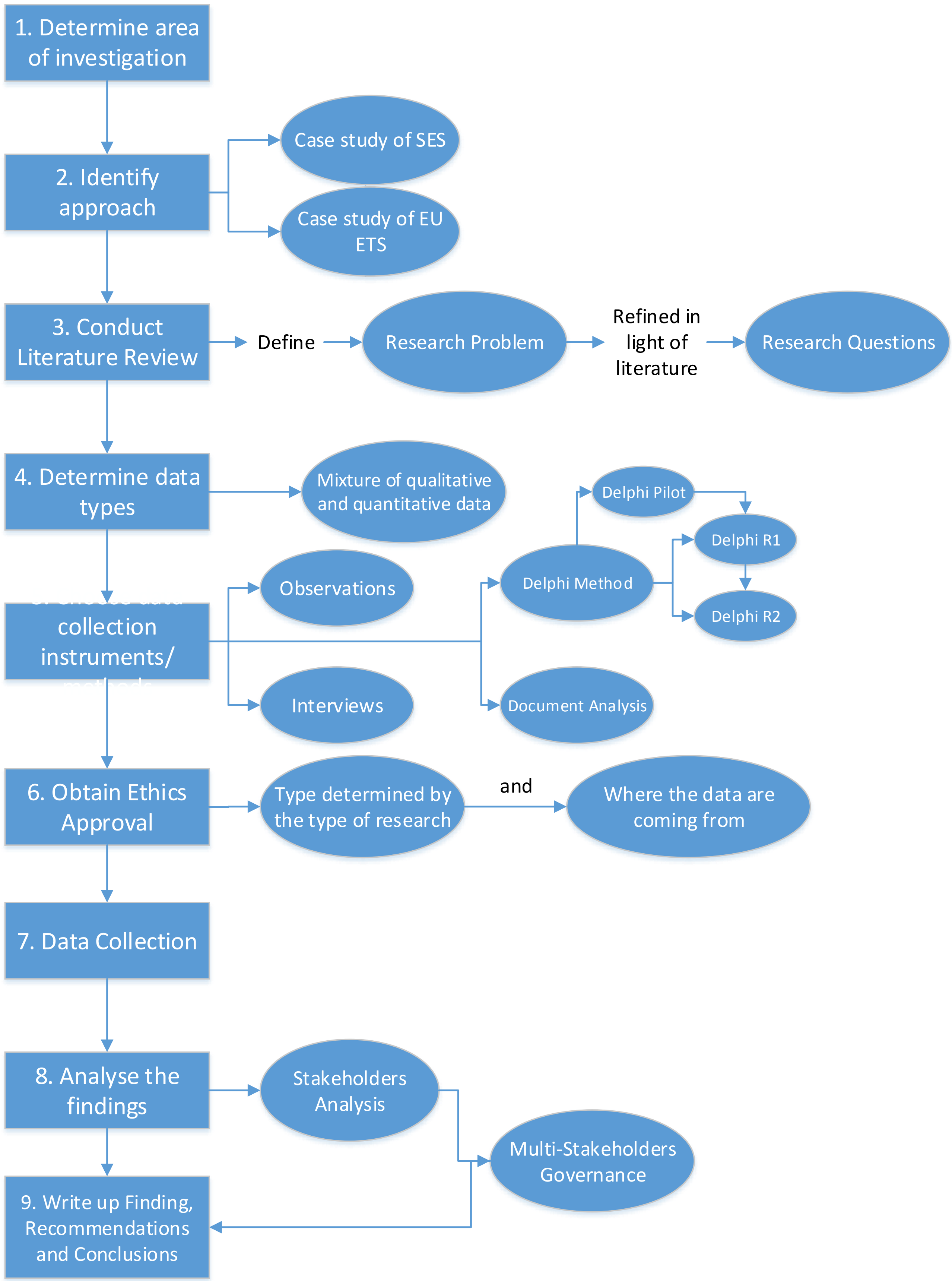


Figure 29: The Research Journey

The participant observation was done at EUROCONTROL that is the Network Manager of Single European Sky and the Reporting, Verification and Monitoring of emissions facilitator for European Union Emissions Trading Scheme. The researcher stayed at EUROCONTROL from December 2013 to August 2015, i.e. 20 months. During this period, the researcher participated in a number of meetings with the EC, NSAs, CAAs, ANSPs, Airlines and other Institutions. Those meetings offered an excellent opportunity to identify the relevant stakeholders and define the groups. Moreover, many participants were approached through those meetings and using the snowball effect the sample was defined. This research method was invaluable in determining whom to recruit for the study and how best to recruit them.

The researcher used data collected through participant observation in order to improve the design of Delphi method. The first questionnaire was developed based on the literature review and then it was circulated to EUROCONTROL members for their valuable opinion. Then a second version of the questionnaire was developed, where the questionnaire was split in two having different set of questions but having the same approach and objective. Then the two new questionnaires were given to a panel of experts (consisting of CAAs, EUROCONTROL, EC and ANSPs representatives) for their consideration and as a pilot survey. The questionnaires were then reviewed again based on their feedback and a new set of questionnaires were developed. Those questionnaires after three revisions were the final questionnaires that were distributed for the first round of Delphi Method (please see Appendix5 and 6).

6.3.1 Questionnaires design and Pilot Survey

The first questionnaire was developed by the researcher during April 2014 (see Appendix4) and was test on two employees of EUROCONTROL, two employees of ANSPs and two employee of airlines. The questionnaire was returned less than half filled in. The respondents reported that they could not reply to most of the questions because it was either too sensitive information and had political implications or it was out of their expertise. Therefore, it was decided to have two set of questionnaires, one for the EU ETS and one for the SES that would have a link with each other.

The researcher developed two set of questionnaires that were sent for consultation to two academics and two EUROCONTROL members. After two weeks of revisions and corrections and thanks to their valuable experience and kind guidance the final version of questionnaires was developed. The two questionnaires had different cover page to help the participants diversify them. The second page of the questionnaires was a thank you/welcome note by the researcher and the principal supervisor. Finally, each questionnaire had a project description to introduce the participants to all the elements of the research areas. The questionnaires started with briefly explaining the Single European Sky and the Functional Airspace Blocks (FABs). Then a brief description of EU ETS was given. In a separate section, the focus of the questionnaires was stated. Moreover, the nature of the questions and the time requirements as well as the next step were clearly expressed. The final part of the introduction section was the brief presentation of the research team, i.e. the PhD candidate and the principal supervisor. The questionnaires that were developed after consultation can be found in the Appendix 5 and 6. The 1st questionnaire was returned on the 11th June 2014 and the last one on the 11th May 2015. The 1st questionnaire of the second round was received on the 1st July 2015 and the last on the 29th April 2016. The process proved very time consuming, but the results were very satisfying.

The participants were asked to rate some statements using a scale from 1-5, where 1 stands for strong disagreement and 5 for strong agreement giving also an opportunity to make comments. Summated scales (or Likert-type scales) are developed by utilizing the item analysis approach wherein a particular item is evaluated based on how well it discriminates between those persons whose total score is high and those whose score is low. In some other questions, the participants were asked to divide 100 points to different parameters. This method is the method of rank order: Under this method of comparative scaling, the respondents are asked to rank their choices. The participants in this case were given the opportunity to add other factors they deemed appropriate.

The last two questions in both questionnaires are the connecting questions for the two schemes, but there were also some other underlying questions that had similarities between the two questionnaires. The question about the factors that lead to carbon neutral growth is one of the most important questions for linking the EU ETS with the SES. In this question different options to achieve carbon neutral growth are given. The participants were asked to share 100 point to the options among the different options. The critical point is whether the participants regard a single option as the only one possible to achieve for carbon neutral growth: alternatively, in case of combined options what other ways to be used. If the participants choose more than one option then this proves the need for policy coordination. In particular, the options considered are the following:

1. The EU ETS leads to carbon neutral growth
2. Individual carbon offsetting programs from airlines lead to carbon neutral growth
3. Individual carbon offsetting programmes from states lead to carbon neutral growth
4. Horizontal en route flight efficiency
    a. Direct routes lead to carbon neutral growth
    b. Wind optimal routes lead to carbon neutral growth
    c. Flexible Use of Airspace (FUA) leads to carbon neutral growth
    d. Free Route Airspace (FRA) leads to carbon neutral growth
5. Other

The factors 1, 2 and 3 are related to Market Based Measures, whereas the factor 4, i.e. Horizontal en route flight efficiency is related to operational improvements. The factor 5 was given for the participants to give points if they wish to other factors, for example vertical flight efficiency, or biofuels, or technological improvements. The last question was an open-ended question to give the respondents the opportunity to give their opinion on the connection of EU ETS and SES.

For the second round of the Delphi method, one additional element was introduced. In was evident from the individual/separate unstructured interviews that one element that was leading to the slow implementation and deliverables of SES and secondly EU ETS was the complexity of the mechanism and hence the additional time and effort the stakeholders had to give. Hence, the element of transaction costs was implemented. Following the interviews and advices from key experts the transaction costs were categorised in groups and subgroups and the Delphi survey participants were asked to do a comparative scaling, i.e. to rank them in terms of their importance for the success of the reform schemes and to state their opinion for their importance in general (see Appendix 7 and 8).

The survey stopped in the second round because there were no major changes of the experts' opinions. There are three parametric statistical methods to check the consensus and reliability in a Delphi study (Shah and Kalaian, 2009): a) the coefficient of variation (CV); b) the Pearson correlation coefficient and c) the F-test. English and Kernan (from Shah and Kalaian, 2009) used the coefficient of variation (CV) to determine the stopping rule. According to Shah and Kalaian (2009) the CV is the best procedure to obtain reliability in a Delphi study. If the magnitude of CV for an item was found to be too large, the corresponding statement was needed to be modified and required an additional round(s) of questionnaire administration. That was the case in this survey; hence, the second round was the last round of the research.

The Coefficient of Variation can take values between 0 and $\sqrt{N-1}$, where N refers to the sample size. The maximum value of CV is reached when all observations but one are equal to zero (Abdi, 2010). Therefore, the CV in the EU ETS survey may take values ranging from 0-5.48. In the case of SES survey, the CV can take values from 0-5.39. When the CV is closer to 0 it is considered low and when it is closer to 5 it is considered high.

6.3.2 Target participants and sample

All elements in a population must be examined in order to collect accurate data. When the data is collected from the entire population, it is considered a census. When the population of a study is big, a sample is considered as the most appropriate and realistic way of research. Sampling is observing a part in order to glean information about the whole is an almost instinctive human act (Creswell, 2013). Given the complexity of the problem, the following groups were selected to participate in the survey:

- Industry: Senior managers working in airlines and ANS provision companies
- Government: Senior managers working in Civil Aviation Authorities (CAAs), National (NSAs) and aviation organisations
- Academia: Academic institutions and researchers working on aviation management related programs

The Chain-referral sampling or snowball sampling is a non-random (nonprobability) sampling technique in which a research participant is selected who then identifies further participants whom he or she knows, often useful for finding hidden populations (Beins and McCarthy, 2012). Because it was very difficult to identify the real expert and to make contact with him or her, the researcher kindly asked the participants and other people that were approached to participate to provide references to others that might be interested and qualified to participate in the survey.

Quota sampling was an aim in order to achieve balance among the backgrounds of the participants. Quota sampling is ‘a non-random (nonprobability) sampling technique in which subgroups, usually convenience samples, are identified and a specified number of individuals from each group are included in the research (Beins and McCarthy, 2012).

To select the candidates, two types of non-random sampling were used, a) purposive sampling and b) snowball sampling. Purposive sampling is also known as judgmental, selective or subjective sampling, is a type of non-probability sampling technique. Purposive sampling is a non-random (nonprobability) sampling technique in which participants are selected for a study because of some desirable characteristics, like expertise in some area (Beins and McCarthy, 2012). In this specific area, the participants were requested to have knowledge in both areas of ANSPs environmental regulations and Airlines environmental regulations. Finding someone who is an expert in both regulating the supply and the demand side of aviation was proven extremely difficult. Thus, the approach of two different questionnaires with some common questions was decided. No incentives were provided to the respondents for completing the questionnaires.

The stakeholders involved in SES and ETS are the following:

1. ANSPs
2. Airport Operators
3. Air Traffic Navigation staff
4. Airspace users
5. Regulators and Administrators
6. Academics and individuals

The target population are the stakeholders involved in both Single European Sky and European Union Emission Trading Scheme in Aviation. According to EASA there are almost 6,000 individual aircraft operators that provide commercial passenger and cargo services in Europe. The fact that there are 6,000 aircraft operators does not mean that the population for this survey is 6,000, because some of them are in the minimum criteria for EU ETS and thus they are excluded from obligatory submission of allowances. According to Sandbag (2013) 1169 airlines and operators participated in the EU ETS, 788 (67%) of which were international, with the remaining 381 (33%) being EU airline. The USA has the highest number of airlines participating in the scheme, 470 (40% of the total), but the majority are smaller operators, such as company or private jets. Thus under the stop the clock principle the airlines obliged to comply with EU ETS are only 381.

The European ANS system covers 37 Air Navigation Service Providers (ANSPs). The provision of air traffic services is the responsibility of every State under the ICAO Convention, and thus almost every State has its own Air Navigation Service Provider (ANSP). There are 29 ANSPs that are part of SES (28 EU Member States plus Norway and Switzerland). Luxembourg does not have its own ANSPs. Belgocontrol (Belgian ANSP) controls the lower Luxembourg airspace (up to FL 245), and the upper airspace (more than FL 245) is controlled by Maastricht UAC.

In terms of government authorities, regulators, administrators and institutions, the main stakeholders are European Commission (Directorate General for Climate Action and Directorate General for Mobility and Transport), Civil Aviation Authorities, EUROCONTROL (Network Manager for SES and MRV facilitator for EU ETS), International Air Transport Association (IATA), Ministries of Transport (when CAA is not managing the ETS). Moreover, individuals may be also considered as stakeholders of those changes. As Individuals we may consider the general aviation enthusiasts, the passengers and researchers. The passengers are not familiar with the implemented changes and thus their interest remains on the final product. The passengers are concerned about their safety, the travelling time and scheduling issues, the price of their tickets and some of them about their environmental footprint. This though does not qualify them to participate in such a study. The ones that hold a Private Pilot License (PPL) are not familiar with the en-route level and are under the minimum criteria of EU ETS, thus it is doubtful if they are familiar with SES and EU ETS implementation.

Individual researchers and academics that conduct research in this topic are considered as qualified participants. The population of those individuals is difficult to be estimated. Both inclusion of aviation in EU ETS and Single European Sky are new topics and the researchers working on those topics are limited. Furthermore, researchers are not that interested in ANSPs from the management perspective because ANSP is considered very technical and up to now the management of ANSPs was and it remains in a big part government owned and non-profit orientated.

Identification and attraction of qualified participants is considered very difficult. Nevertheless, the questionnaire was send to more than 260 qualified experts. The participation rate was around 15%. On the SES questionnaire 30 experts took part to the survey and on EU ETS 31 experts participated to the survey. The literature recommends 10-18 experts on a Delphi panel. Due to the complexity of the scheme as well as to the number of stakeholders involved, the number of 30 experts is deemed necessary.

6.4 Ethical considerations

In order to conduct participant observation, the researcher went to EUROCONTROL and the institution was informed about the presence of the researcher. The researcher did not publish or reveal any confidential or sensitive information obtained during the staying at the institution. The researcher when conducting participant observation, was discreet enough about who she was and what she was doing so as not to disrupt the usual activities, so people the researcher observed and interacted with did not feel that their privacy was in danger. When participating in meetings the identity of the researcher was revealed stating that she is member of the team and at the same is a researcher working on SES and EU ETS.

The researcher was extremely careful not to mislead the members about her role and purpose. When the researcher was participating only as observer and was informed that the issues and topics discussed are sensitive and confidential, the researcher did not state any of the points discussed. Some coded records were kept, but due to confidentiality reasons, this information cannot be shared. Nevertheless, thanks to those meetings the researcher obtained a more solid understanding and knowledge.

Anonymity is ensured to the participants of the Delphi survey. The implementation of FAB and in general the slow implementation of SES is a quite sensitive topic. In addition, the positions of Airlines and other stakeholders towards EU ETS due to the high competition and the political sense of the scheme is also considered as 'hot potato' and demands special treatment. Thus the participants wish to remain anonymous and their position as well as their company/organisation to remain secret.

Furthermore, participants were informed that they do not have to participate in the research and they can terminate their responses at any time. This constitutes voluntary participation. The participation is voluntary and the researcher's identity was made available to respondents. The respondents' anonymity is respected and it will remain anonymous. Moreover, the security/privacy of the data is of high importance. Respondents that requested not to be further contacted, were not sent any email and weren't further contacted by the researcher.

Response bias was avoided as much as possible. Response bias is 'a tendency for a respondent to answer in predictable ways, independent of the question content, such as always agreeing with a statement or always providing high or low ratings on a Likert scale' (Beins and McCarthy, 2012:100). Some of the questions are worded in such way to identify when the participant is biased. It was not any case where the respondent thought that he or she will be evaluated so as to tailor their responses to the survey. Shulruf, Hattie, and Dixon (2008) created a five-stage model of how people comprehend and respond to survey questions. In this model, respondents are seen as progressing through the following steps: (a) understanding the question, (b) establishing the context, (c) retrieving available information about related behaviours, (d) integrating information and assessing impression management, and (e) evaluating all the information and aligning it with the available range of responses. All the participants that fill in the questionnaire with the presence of the researcher seemed to spend a considerable mental processing and their answers were irrelevant to the researcher's personal opinion that was not at all communicated to them.

Accurate and credible findings are a function of validity and reliability (Creswell, 2013). According to Creswell (2012), validity can be achieved by any two of the eight strategies: prolonged engagement and persistent observation in the field; triangulation; peer review or debriefing; refining hypotheses as the inquiry advances; clarifying researcher bias from the outset of the study; the researcher solicits participants' views of the credibility of the findings and interpretations; 'rich and thick description' and external audits. Table 21 illustrates the validation strategies and how they were adopted.

Table 21: The Research Validation Strategies followed by the researcher (based on Creswell, 2012)

Validation strategies	Adoption in the research
1. Prolonged engagement and persistent observation in the field	Working almost two years at EUROCONTROL
2. Peer review or debriefing **3. External audits'**	This PhD thesis was supervised by one key professor and an advisory committee. In total 4 professors and 1 industry

	expert reviewed either the whole thesis or key parts of it.
4. The researcher solicits participants' views of the credibility of the findings and interpretations	Expert panel views were counted. This research was presented in workshops (COST Action TU 1408 Air Transport And Regional Development, German Aviation Research Society, EUROCONTROL) to get more feedback from the conference audience to adjust it and to increase its credibility. One-paged feedback was received from academics and industry experts.
5. Rich and thick description	Qualitative data (e.g. interviews) were collected and presented to give as much in depth information as possible

Finally, approval for reproducing the figures and table was granted from EUROCONTROL, the European Commission, the Intergovernmental Panel of Climate Change (IPCC), the European Energy Exchange (EEX) and the International Air Transport Association (IATA) (see Appendix 9).

6.5 Limitations of the research

Although the research was carefully prepared and had reached the aims, there were some unavoidable limitations. Because both SES and EU ETS in aviation are relevantly new schemes, the research was conducted on a small size of the population. It was extremely difficult to find qualified participants, but should more experts had participated in the research the results could be covering more areas and capture better the complexity of the systems and the need for interlinkages. The opinions of the fuel suppliers, the manufacturers and the system suppliers are not captured in this research. In addition, the literature review covers the contemporary expertise about environmental performance. Should further research be conducted about the emissions contributing to climate change, the focus of the regulations may be shifted to other areas.

Finally, the Delphi Method is a method that requires a lot of time to find and engage the participants that are based in different countries. Some participants shared more information than others did, leading to asymmetries of information regarding the organisations. There were some countries that were not represented. There were no participants from South West FAB and Performance Review Unit. The latest would have given a very important added value to the results.

The participant observation was conducted at EUROCONTROL that gave an excellent insight about the SES reform but a limited insight at the EU ETS reform. Should the participant observation be conducted at European Commission the researcher could have an insight of both the SES and the EU ETS. The interviewees did not allow the researcher to keep any records or notes of the interviews neither to reproduce their exact words. Therefore, the credibility and proper use of the findings of this method rely on the ability of the researcher to capture the position of the interviewees.

6.6 Summary

The research was conducted by a mix of methods. Semi structured interviews based on free flow discussions were used to research additional elements that a questionnaire could not capture. The participant observation taking place at EUROCONTROL enabled the researcher to obtain a wide knowledge of the topic, identify experts of SES and EU ETS areas and build a professional network. Moreover, the researcher participated to a series of meetings where due to confidentiality reasons, the information cannot be reproduced, but gave a more in depth knowledge and understanding to the researcher that helped her to build and better interpret the results collected by the Delphi method.

The elements that were taken under consideration for selecting Delphi method as the most appropriate method for this PhD thesis were a) the scope and object of enquiry, b) the precision required, c) the participants' engagement and d) the impartiality of the researcher. The Delphi method was deemed as the most appropriate to research the SES and EU ETS topics. The Delphi method due to the complexity of the topic and the lack of experts being familiar with both areas, was conducted using two sets of questionnaires, the SES/FAB questionnaire and the EU ETS questionnaire. The Delphi method was terminated in the second round since the Difference of Coefficient of Variation was very low, proving consensus among the groups and the participants.

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7 The findings of the Delphi Method

This chapter presents the data collected by the questionnaires following the Delphi Method and their discussion. The research methods followed are the Delphi method, semi structured interviews and participant observation. The Delphi method is conducted in two rounds. The Delphi method was applied for both cases, i.e. SES and EU ETS, having two separate questionnaires with some common areas. For every set of questionnaire, there were around 30 participants. The Likert scale was used in some of the questions ranging from 1 to 5, where 1 stands for strong disagreement, 2 for disagreement, 3 for neutral position, 4 for agreement and 5 for strong agreement. In other questions, the participants were asked to share 100 points among the statements. In both questionnaires, an additional question about the Transaction Costs was added in the second round. The questions of the two questionnaires are listed in section 7.1.

For the second method, around seven experts were interviewed. The interviews replies are presented in different parts of this PhD thesis as by this way more added value was added in the arguments. The last method that was followed is the participant observation, where the researcher attended a series of meetings with the EC, CAAs, NSAs, ANSPs, EUROCONTROL, airlines and academics as well as by spending a big amount of time at EUROCONTROL. The participant observation results are depicted as the critical analysis of the theoretical framework and at the identification of the factors affecting the implementation and the performance of SES and EU ETS.

7.1 First round of the Delphi Method

The Delphi method was conducted in two rounds. In this section, the first round is presented. The questions for the first round of EU ETS questionnaire are the following:

- Q1. Please assess the extent to which you agree with the following statements.

- Q2. Please assess the impact of different allowances allocation methods to the aviation sector (was removed in the 2nd round)
- Q3. Please divide 100 points over the different allowance allocation methods that you deem as appropriate for the allocation of allowances to the airlines, where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.
- Q4. In order to link the different ETSs (like New Zealand or Shanghai ETS) with entire scheme and not only in aviation, the following factors should be applied to the same degree. Please assess the extent to which you agree with the following statements.
- Q5. Please divide 100 points over the different factors that lead to carbon neutral growth, where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.
- Q6. Do you think that there is a connection between EU ETS and Functional Airspace Blocks (FABs)? If yes, why? (was removed in the 2nd round)

The questions for the first round of SES questionnaire are:

- Q1. Please evaluate the major FAB Improvement Areas (FIAs) that have been identified as the most promising areas according to the degree of the potential benefit coming from the establishment of FABs.
- Q2. Please assess the extent to which you agree with the following statements
- Q3. Please divide 100 points over the different factors that affect horizontal en route flight efficiency, where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.
- Q4. Please divide 100 points over the different factors that affect the use of the civil/military airspace structures (Free Route Airspace, Flexible use of Airspace),

where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.

- Q5. Please evaluate the following factors according to their contribution to emissions' reduction.
- Q6. Please divide 100 points over the different factors that lead to carbon neutral growth, where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.
- Q.7. Do you think that the present charging scheme is enough to avoid fragmentation because of intra and inter FAB competition? What do you propose? (was removed in the 2^{nd} round)
- Q8. Do you think that there is a connection between FABs and Emissions Trading Scheme (EU ETS)? If yes, why? (was removed in the 2^{nd} round)

7.1.1 The EU Emissions Trading Scheme Questionnaire descriptive analysis

This section is devoted to the descriptive presentation of the finding of the first round for the EU ETS questionnaire and will proceed question by question. The tables provide information about the participation rate (N), the range of the replies given (Min for minimum value and Max for maximum value given), the mean, Standard Deviation (SD) and Coefficient of Variation (CV) also known as Relative Standard Deviation (RSD). The coefficient of variation (CV) is the ratio of the standard deviation of an item's rating score to its corresponding mean across panellists. This coefficient, unlike the standard deviation, is not affected by the unit of measurement. The statements are ordered by higher to lower mean.

As may be seen in Table 22, for some of the statements all the 31 participants expressed their opinion for some others there were 27 replies. The standard deviation values show that there is a small spread of the replies and indicates that despite the groups where they belong they have consensus in their opinions. One interesting statement is that lobbying around allocation of allowances affects the economic dimension of the EU ETS. The majority of 27 participants agreed with these statements. The average value is 4 which stands for agreement, the Standard Deviation (SD) was 0.83 and the coefficient of variation (CV) was 0.21. The statements ‘It is possible to link the EU ETS and the other Emissions Trading schemes and have a global ETS’; ‘The carbon market’s stability is vulnerable because of the continuous changes in legislation’; ‘Additional fuel savings will also be achieved owing to better fuel use predictability’; and ‘The EU ETS is causing competition issues to airlines’ had a mean ranging from 3.5-3.9. The factors ‘The EU ETS will lead the airlines to merge in order to obtain more emissions allowances’ and ‘Route optimisation is sufficient enough for carbon neutral growth’ had the lowest means.

Table 22: Q1 Position of participants on EU ETS (1st round EU ETS Q)

Descriptive Statistics						
	N	Min	Max	Mean	SD	CV
The economic dimension of the EU ETS drives heavy lobbying around allocation of EU ETS allowances.	27	2	5	4.00	0.83	0.21
It is possible to link the EU ETS and the other Emissions Trading schemes and have a global ETS.	31	1	5	3.87	1.06	0.27
The carbon market’s stability is vulnerable because of the continuous changes in legislation.	30	2	5	3.73	0.98	0.26
Additional fuel savings will also be achieved owing to better fuel use predictability.	28	1	5	3.64	0.95	0.26
The EU ETS is causing competition issues to airlines	31	1	5	3.52	1.39	0.40
Using biofuels is a promising solution for carbon offsetting.	30	1	5	3.33	1.24	0.37
The EU ETS can result in carbon leakage.	29	1	5	3.31	1.04	0.31
The multi-period nature of allocations (i.e. banking and borrowing flexibility) drives dependence both upon post-2012 decisions and creates risk of perverse incentives	28	1	5	3.29	0.90	0.27

Descriptive Statistics						
	N	Min	Max	Mean	SD	CV
The monitoring, reporting and verification of emissions in the EU ETS is effective.	31	1	5	3.26	1.13	0.35
The EU ETS is vulnerable to frauds, for instance VAT fraud and 'phishing' scams.	28	1	5	3.25	1.35	0.42
The carbon market stability is vulnerable because of the low prices of the allowances.	29	1	5	3.21	1.15	0.36
Postponing the auctions can force the prices of allowances to increase.	29	1	5	3.17	1.14	0.36
The EU ETS is source of profit-making incentives unprecedented in the history of environmental policy	27	1	5	3.04	1.40	0.46
The creation of carbon as a "financial instrument" can lead to sufficient carbon reduction.	28	1	5	3.00	1.09	0.36
The corresponding large proportion of free allocation underlies legal stresses and a scope for distortions.	28	1	4	2.89	0.96	0.33
There are small emissions reductions relative to 'business-as-usual' and this leads to instabilities related to economics, policies and time frames) in the EU ETS.	28	1	4	2.75	0.89	0.32
The free allocation of allowances to the airlines must be stricter.	31	1	5	2.71	1.27	0.47
The cap of EU ETS is too generous.	30	1	5	2.67	1.32	0.50
The inclusion of aviation in the EU ETS will influence negatively the development of non-European airlines if they are included in EU ETS.	31	1	5	2.65	1.36	0.51
The EU ETS will lead the airlines to merge in order to obtain more emissions allowances.	31	1	5	2.42	1.34	0.55
Route optimisation is sufficient enough for carbon neutral growth.	30	1	5	2.03	1.22	0.60

The second question was about the impact of different allowances allocation methods to the aviation sector (Table 23). This question was not taken under consideration because many participants found it difficult to reply and the participation rate was too low to extract results. Due to that it was not added to the second round.

Table 23: Question about the impact of different allowance allocation methods (1st round EU ETS Q)

	Auctioning	Grandfathering	Repeated benchmarking	One off benchmarking
The cost of EU ETS is passed to ticket or freight prices				
Airlines have windfall profits				
Airlines demands more allowances				
Technical improvements and industry measures are implemented				

The third question about the different allowance allocation methods received 24 replies (Table 24). When the mean is taken under consideration, the allocation method with the highest mark is benchmarking (mean=39%) followed by auctioning (mean=37%) and the least ideal method taking under consideration the mean is the grandfathering rights (mean=24%). The Standard deviation for all the allocation methods is very high, which shows that the mean is not representative. The CV as explained in the methodology chapter can take values from 0-5.48. In this case, the CV is higher compared to the other question, but it is still considered as low.

Table 24: Ideal allocation method (1st round EU ETS Q)

Descriptive Statistics						
	N	Min	Max	Mean	SD	CV
Benchmarking	24	0	100	39.25	26.12	0.67
Auctioning	24	0	90	36.58	26.08	0.71
Grandfathering	24	0	90	24.17	27.17	1.12

The next question is very important given the recent developments with ICAO Assembly and the proposed Global Market Based Measure (Table 25). The participants were given a set of factors that need to be the same for linking the different ETSs (like New Zealand or Shanghai ETS) across the world to create a global scheme. The 27 participants agreed with all the factors stated and did not add any additional factor. The average for all the statements is 4.2.

Table 25: Factors to be considered for linking different ETSs (1st round EU ETS Q)

Descriptive Statistics						
	N	Min	Max	Mean	SD	CV
There are the same Monitoring, Reporting and Verification (MRV) rules for allowances	27	1	5	4.56	1.81	0.40
There is the same eligibility of offset credits	26	1	5	4.39	1.81	0.41
There are the same rules governing new entrants and closures	27	1	5	4.33	1.82	0.40
There is the same stringency of enforcement	27	1	5	4.33	1.80	0.42
There are the same registries' rules	26	1	5	4.31	1.83	0.42
The same allocation methods are applied	27	1	5	4.22	1.87	0.44
There is the same stringency of targets	27	1	5	4.15	1.88	0.45
There are the same compliance periods	27	1	5	3.89	2.03	0.52
There are the same banking provisions	27	1	5	3.67	1.04	0.28

Both the SES and the EU ETS questionnaires, as explained in the methodology chapter, have a common question. The replies of the EU ETS participants are summarised in Table 26. The 26 participants who replied to this question gave the most points to the horizontal en-route flight efficiency that is related with the 4 following factors: Direct routes lead to carbon neutral growth; Wind optimal routes lead to carbon neutral growth; Flexible Use of Airspace (FUA) leads to carbon neutral growth; and Free Route Airspace (FRA) leads to carbon neutral growth. The second most important factor is the EU ETS according to 26 experts. The CV are very high in all factors. The comparison between the SES and the EU ETS replies to this question is done in the second/final round of Delphi.

Table 26: Factors leading to carbon neutral growth (1st round EU ETS Q)

Descriptive Statistics						
	N	Min	Max	Mean	SD	CV
The EU ETS leads to carbon neutral growth.	26	0	94	21.46	25.31	1.18
Individual carbon offsetting programs from airlines lead to carbon neutral growth.	26	0	40	12.39	12.32	1.00
Other	26	0	60	11.35	17.75	1.57
Flexible Use of Airspace (FUA) leads to carbon neutral growth	26	0	30	11.31	8.21	0.73
Wind optimal routes lead to carbon neutral growth	25	0	45	10.76	10.29	0.96
Free Route Airspace (FRA) leads to carbon neutral growth	26	0	40	10.35	9.17	0.89
Individual carbon offsetting programmes from states lead to carbon neutral growth.	26	0	30	10.15	10.19	1.00
Direct routes lead to carbon neutral growth	26	0	40	10.15	8.67	0.85
Other	26	0	45	2.41	9.34	3.88

The final question of the EU ETS questionnaire asked the participants if they believe that there is a connection between SES (FABs) and Emissions Trading Scheme (EU ETS). The 45% of the participants believe that there is a connection between SES and EU ETS. The 16% believe that there is no connection between the two schemes. The 39% of the participants did not reply to the question (Figure 30).

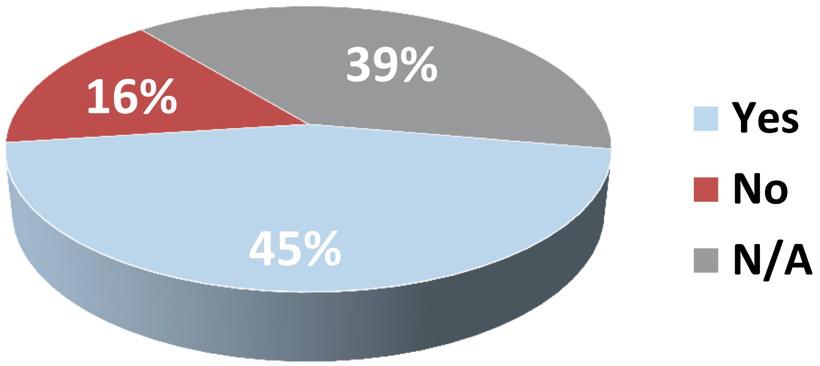

Figure 30: Connection between SES (FABs) and EU ETS (1st round of EU ETS Q)

7.1.2 The Single European Sky (FABs) Questionnaire descriptive analysis

This section gives a descriptive presentation of the finding of the first round for the Single European Sky questionnaire. Around 30 experts participated voluntarily and anonymously to the first round of the SES questionnaire.

The participants were asked to evaluate the major FAB Improvement Areas (FIAs) that have been identified as the most promising areas according to the degree of the potential benefit coming from the establishment of FABs (Table 27). Most of the participants kept a neutral position regarding the FAB Improvement Areas (FIAs) that have been identified as the most promising areas according to the degree of the potential benefit coming from the establishment of FABs. The areas that noted a positive position are the Common Operational Procedures, Synergies in Air Traffic Flow and Capacity Management (ATFCM), Communication Data Sharing, Harmonised ATM system and Reduction of Emissions. Having an average CV at 30%, it is proven that there is consensus among the experts in this question.

Table 27: Areas benefitted from the establishment of FABs (1st round SES Q)

Descriptive Statistics						
	N	Min	Max	Mean	SD	CV
Synergies in ATFCM	28	2	5	3.96	0.79	0.20
Harmonised ATM system	28	1	5	3.96	1.20	0.30
Reduction of emissions	28	2	5	3.96	0.96	0.24
Common Operational Procedures	28	2	5	3.93	0.77	0.20
Common Flight Inspection	28	1	5	2.93	0.81	0.28
Communication Data Sharing	28	2	5	3.89	0.83	0.21
Airspace consolidation	28	1	5	3.82	1.12	0.29
Common Routes Network design	28	1	5	3.79	1.03	0.27
Common Sector Design	28	1	5	3.64	1.03	0.28
Common Safety Management System	28	2	5	3.64	0.95	0.26
Surveillance Data sharing	27	1	5	3.63	1.12	0.31
Improved cooperation with Militaries	28	1	5	3.54	1.11	0.31
Common ATCO Training	28	2	5	3.50	0.84	0.24
Common R&D	27	1	5	3.15	0.99	0.31
Common Procurement	27	1	5	3.15	1.17	0.37
Sharing of navigation aids	27	1	5	3.15	1.03	0.33
Common AIS & MET	28	1	5	3.14	1.18	0.38
Other	4	3	5	4.00	1.16	0.29

The most important replies in the second question are for the importance and need of SES and the contribution of SES to the environmental performance (Table 28). Almost all the participants agreed that the European airspace was necessary to change (statement: 'The airspace before SES did not need to be changed' mean= 1.93), but not all FABs are fully operational (statement 'All FABs are fully operational': mean= 2.04). The CV in all the statements with the exemption of the 'All FABs are fully operational' and the 'the airspace before SES did not need to be changed' gather consensus among the participants.

Table 28: Position of participants on SES and the environment (1st round SES Q)

Descriptive Statistics						
	N	Min	Max	Mean	SD	CV
The reorganisation of the European Sky was necessary.	29	1	5	4.04	1.12	0.28
The European airspace network today can benefit from a significant level of dynamism through the application of the Flexible Use of Airspace (FUA) concept.	28	1	5	3.79	0.96	0.25
Due to inherent safety (minimum separation requirements between aircraft) requirements, the level of "inefficiencies" cannot be reduced to zero at system level.	29	1	5	3.66	1.08	0.30
FABs bring routes closer to the optimum "Great Circle" route and reduce extended flight paths.	29	1	5	3.55	1.12	0.32
Due to capacity (organisation of traffic flows) requirements, the level of "inefficiencies" cannot be reduced to zero at system level.	29	1	5	3.45	1.24	0.36
The main environmental KPI should be the estimated economic value of CO_2 emissions due to route extension.	29	1	5	2.83	1.34	0.47
The horizontal component is of higher economic and environmental importance than the vertical component of the Flight efficiency.	29	1	4	2.59	0.95	0.37
All FABs are fully operational.	27	1	5	2.04	1.09	0.54
The airspace before SES did not need to be changed.	29	1	5	1.93	1.19	0.62

The horizontal en route flight efficiency is a key factor for reducing the emissions in en route level (Table 29). The participants characterised as the most important factors affecting the horizontal en route flight efficiency: a) the airspace structure; b) the flight planning capabilities; and c) the user preferences. The high CV suggests different opinions among the participants and lack of consensus.

Table 29: Factors affecting horizontal en route flight efficiency (1st round SES Q)

Descriptive Statistics						
	N	Min	Max	Mean	SD	CV
Route structure and availability affect horizontal en route flight efficiency.	24	5	50	27.71	12.25	0.44
Availability of airspace (utilisation of civil military structures) affects horizontal en route flight efficiency.	24	5	40	18.67	10.43	0.56
Flight planning capabilities (use of software, repetitive flight planning) affect horizontal en route flight efficiency.	24	0	30	14.25	7.43	0.52
User preferences regarding fuel affect horizontal en route flight efficiency.	24	0	40	10.58	10.48	0.99
Tactical ATC routings affect horizontal en route flight efficiency.	24	0	20	10.42	5.30	0.51
User preferences regarding time affect horizontal en route flight efficiency.	24	0	30	8.58	6.65	0.78
Special events such as ATC strikes affect horizontal en route flight efficiency.	24	0	30	8.33	6.54	0.79
Other	24	0	25	1.46	5.41	3.71

According to 27 participants, the most important factor affecting the use of the civil/military airspace structures (Free Route Airspace, Flexible use of Airspace) are political issues (Table 30). This factor gathered on average 43% with a standard deviation equal to 29. The coefficient of variation is 0.67, which implies that there is limited consensus among the participants.

Table 30: Factors affecting the Civil Military cooperation (1st round SES Q)

Descriptive Statistics						
	N	Min	Max	Mean	SD	CV
Political issues	27	0	100	42.96	28.93	0.67
Flight planning capabilities (use of software, repetitive flight planning)	27	0	60	13.41	13.08	0.98
Special events	27	0	60	13.41	16.53	1.23
Existing ICAO ATM procedures	27	0	30	9.70	9.53	0.98
Aspects related to position information and radar vectoring	27	0	30	9.33	8.09	0.87
Other	27	0	100	10.82	27.14	2.51

The fifth question focused on the factors contributing to emissions' reduction (Table 31). The 30 participants agreed that the most important factors contributing to emissions' reduction are the operational measures, like FUA, FRA and CDOs. Whereas they stated that the emissions trading does not contribute to emissions' reductions. For the SES in general the average was 3.67 and the SD 1.09. The SD was on average below 30% proving consensus among the participants. One participant added two factors that contribute to the emissions reduction. One of those was the 'ICAO Global Market Based Measure (GMBM)' and the other was the 'new technologies'.

Table 31: Factors contributing to emissions' reduction (1st round SES Q)

Descriptive Statistics						
	N	Min	Max	Mean	SD	CV
Shortest feasible routes	29	1	5	4.14	0.88	0.21
Implementing continuous descent approaches	30	2	5	4.10	0.71	0.17
Use of Eco-friendly engines	30	1	5	4.10	0.85	0.21
Flexible Use of Airspace	30	2	5	4.07	0.83	0.20
Free Route Airspace	29	2	5	4.03	0.82	0.20
Improving load factors	30	2	5	3.70	0.79	0.22
Use of Bio fuels	30	1	5	3.67	1.12	0.31
Single European Sky	30	1	5	3.67	1.09	0.30
Reduced traffic because of economic crisis	30	1	5	3.27	1.11	0.34
Airlines develop offsetting programs	29	1	5	3.24	1.15	0.36

Descriptive Statistics						
	N	Min	Max	Mean	SD	CV
EU Emissions Trading Scheme	30	1	5	2.90	1.19	0.41
Trading Certified Emissions Reductions (CERs)	29	1	5	2.83	1.14	0.40
Trading Verified or Voluntary Emissions Reductions (VERs)	29	1	5	2.62	1.12	0.43
Other	3	5	5	3.33	2.89	0.87
Other	1	5	5	5.00		

The common question with the EU ETS questionnaire about the factors leading to carbon neutral growth was answered by 25 participants (Table 32). The EU ETS and the carbon offsetting schemes gathered around 43% and the en route flight efficiency scored 48%. The replies to this question are quite diverse and there is very low consensus among the participants. This is proven by the relatively high standard deviation and coefficient of variation.

Table 32: Factors leading to carbon neutral growth (1st round SES Q)

Descriptive Statistics						
	N	Min	Max	Mean	SD	CV
The EU ETS leads to carbon neutral growth.	25	0	50	17.52	13.94	0.80
Individual carbon offsetting programs from airlines lead to carbon neutral growth.	25	0	40	15.12	12.02	0.80
Flexible Use of Airspace (FUA) leads to carbon neutral growth	25	3	40	12.72	8.39	0.66
Free Route Airspace (FRA) leads to carbon neutral growth	25	0	50	12.32	10.29	0.84
Wind optimal routes lead to carbon neutral growth	25	0	40	11.72	8.84	0.75
Direct routes lead to carbon neutral growth	25	0	40	11.68	9.75	0.83
Individual carbon offsetting programmes from states lead to carbon neutral growth.	25	0	30	10.72	9.74	0.91
Other	25	0	35	6.00	11.18	1.86
Other	25	0	45	2.60	9.70	3.73

The seventh question about the charging scheme received the following replies:

> *'A common charging scheme based on the ideal route and not on the actual trajectory can be the solution' (*IATA; CAA; EUROCONTROL; CAA)'.
>
> An ANSP added *'Common FAB unit-rate (or EU wide) with compensation scheme could be the answer'.*
>
> A representative of a government body stated that *'it depends on the political strength of the EU to reduce charges'.*
>
> An airline's representative said that *'There is no such a thing as a "present charging scheme" because the regulations change every year. The charging scheme which is currently on the table (cost relative to route in European airspace) will move flights to routes passing just outside of Europe, extending flight times and increasing CO_2 emissions'.*
>
> *No. For some ANSP's the targets were not very ambitious as their unit rates were below target so they only raised the unit rates. For some others, the target was unrealistic. It was very ambitious to set same targets for all but I don't think it works in practice. Should we allow those FAB's that deliver to take over those FAB's who don't?* (Airline)
>
> Another expert stated that *'Present charging scheme goal is to return the additional ANS revenues to the Users. In addition, the ultimate goal is to create single charging zone within the FABs – with one unit rate per FAB. FAB single unit rate would ensure equal distribution of flights that are based on operational requirements and not on cost efficiency requirements as the flights are organized today within the FABs (some states are more expensive than others within the FAB and thus Users would rather fly cheaper route than more direct route – while this would have negative impact on CO_2 emission – but this would be more cost effective for the User, even though they would have higher CO_2 emission)'.*

It is evident from the above replies that the participants are not happy with the charging scheme. The current charging scheme is not set realistically, the implementation is lacking political strength and there are consequences to the environmental performance, since airlines select routes with cheaper unit rates and the charging scheme is not done based on the Great Distance Cycle between the city pairs. Therefore, the airlines fly longer routes to pay less for ANS, consuming more fuel and having higher emissions.

The last and eighth question was the same as the EU ETS questionnaire. As illustrated in Figure 31 Figure 31: Connection between SES (FABs) and EU ETS (1st round of SES

Q)the 33% of the participants believe that there is a connection between SES (FABs) and EU ETS and the 33% believes that there is not. The 1/3 of the participants did not reply to the question.

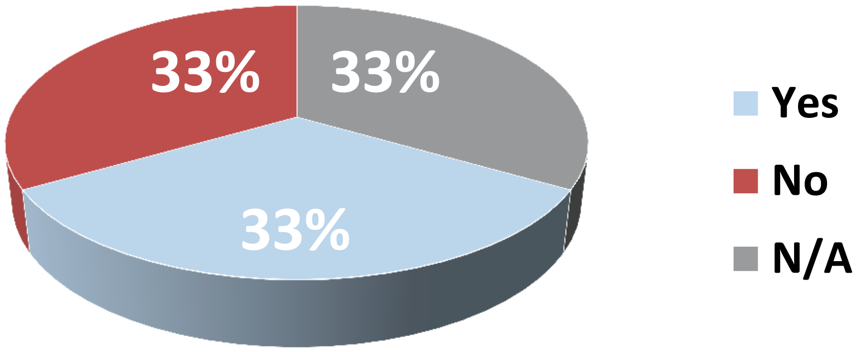

Figure 31: Connection between SES (FABs) and EU ETS (1st round of SES Q)

7.2 Second round of Delphi Method

The second round is the final round of the Delphi Method. In this round two additional questions were added to the SES and the EU ETS questionnaires based on the 5th chapter of the literature review and as explained in the methodology chapter. In the EU ETS two questions from the first round was removed. The one question that was removed is "Please assess the impact of different allowances allocation methods to the aviation sector". The participation to this question was very low to extract any credible results. Hence it was removed. Finally, the 5th question 'Do you think that there is a connection between EU ETS and Functional Airspace Blocks (FABs)? If yes, why?' was also removed. This question was already answered indirectly by other questions within the questionnaire. Apart from this, its elimination will counterbalance the introduction of two other questions. The following questions were added to the EU ETS questionnaire in the 2nd round of Delphi Method:

- Q5: In the following table, please allocate 100 points over the various factors associated with transaction costs for policymakers/regulators emerging from the aviation EU ETS scheme. The most important factor gets the highest number of points and the least important factor gets the lowest number of points. You are allowed to allocate points to as many factors as you wish.
- Q6: Overall, how important do you consider transactions costs to be for the effective functioning of the aviation inclusion in the EU ETS scheme? Please mark the box.

As far the SES questionnaire is concerned, two questions were replaced by new. The questions that were deleted are the 'Do you think that the present charging scheme is enough to avoid fragmentation because of intra and inter FAB competition? What do you propose?' and 'Do you think that there is a connection between FABs and Emissions Trading Scheme (EU ETS)? If yes, why?'. The participation to the first question was very low and therefore, findings and conclusions could not be drowned from this. The second question as in the case of EU ETS questionnaire was addressed indirectly by other statements within the questionnaire. The following questions were added to the SES questionnaire in the 2nd round of Delphi Method:

- Q7. In the following table, please allocate 100 points over the various factors associated with transaction costs for stakeholders emerging from the environment KPA in the SES Performance scheme. The most important factor gets the highest number of points and the least important factor gets the lowest number of points. You are allowed to allocate points to as many factors as you wish.
- Q8. Overall, how important do you consider transactions costs to be for the effective functioning of the environment KPA in the SES Performance scheme? Please mark the box.

In this section, the findings will be presented using descriptive statistics. Descriptive statistics describe, show or summarize data in a meaningful way. The tables give information about the participants' number, the minimum and the maximum values, the mean, the standard deviation and the coefficient of variation. Firstly, the finding of the EU ETS questionnaire are given and the findings of the SES questionnaire.

Moreover, this section will also present the differences of the first and second round of the Delphi method. The comparison will be made based on the difference of coefficient of variation between the first round and the second round of the EU ETS and the SES questionnaires. Moreover, the common questions of the EU ETS and the SES questionnaires will be analysed in order to identify any commonalities or differences to the options of the experts. It should be highlighted that the profiles of the experts participating in the EU ETS questionnaires are more orientated to the airline business whereas the experts participating to the SES questionnaire are more orientated to the ANSPs business.

As mentioned in the methodology chapter the CV will be used to compare the two rounds of the Delphi method. A small CV value is an indication that the amount of variation was small. A large value of the coefficient of variation (CV) for an item in the Delphi survey (larger than 1) indicates that the responses of the experts are scattered compared to the mean of the responses for the item. As stated in the methodology chapter the absolute difference of the coefficient of variation will be used to identify any changed between the rounds and prove the stability of responses. Should the absolute difference of the CV (ΔCV) in round 1 (CV_R1) and the CV in round 2 (CV_R2) is small, there is no need to add an additional round since the participants did not revise their opinions.

7.2.1 The EU Emissions Trading Scheme Questionnaire descriptive analysis (2nd round)

Around 30 experts participated in the second round of the EU ETS questionnaire (Table 33). Most of the respondents do not believe that EU ETS causes competition issues, since they disagreed with the first three statements. They also do not believe that the route optimisation is sufficient for achieving carbon neutral growth. One important statement that had a mean of 4.03 (SD=0.94), i.e. the participants agreed with the statement is that it is possible to link the EU ETS and the other Emissions Trading schemes and have a global ETS. Surprisingly, the average for the statement 'the cap of EU ETS is too generous' is 2.71 which is a disagreement. Finally, they have a neutral position towards agreement with mean=3.93 and Standard Deviation=0.8 that the economic dimension of the EU ETS drives heavy lobbying around allocation of EU ETS allowances. Consensus, as proved by the low CV, is achieved in this question.

The absolute difference of CV (ΔCV) is calculated by deducting the CV of round 1 (CV_R1) from the CV of round two (CV_R2). The first question of the EU ETS questionnaire had on average 0.056 ΔCV. The values ranged from 0.00 to 0.13. The participants gave the exact same value to the additional fuel savings statement. The statements that the participants slightly revised their opinions in this question were 'The cap of EU ETS is too generous'; 'The EU ETS is source of profit-making incentives unprecedented in the history of environmental policy'; 'There are small emissions reductions relative to 'business-as-usual' and this leads to instabilities related to economics, policies and time frames) in the EU ETS'; 'Route optimization is sufficient enough for carbon neutral growth' and 'Postponing the auctions can force the prices of allowances to increase'.

Table 33: Q1 Position of participants on EU ETS (2nd round EU ETS Q)

Descriptive Statistics							
	N	Min	Max	Mean	SD	CV	ΔCV
It is possible to link the EU ETS and the other Emissions Trading schemes and have a global ETS.	29	1	5	4.03	0.94	0.23	0.04
The economic dimension of the EU ETS drives heavy lobbying around allocation of EU ETS allowances.	29	2	5	3.93	0.80	0.20	0.01
The carbon market's stability is vulnerable because of the continuous changes in legislation.	30	2	5	3.70	0.88	0.24	0.02
Additional fuel savings will also be achieved owing to better fuel use predictability.	28	1	5	3.68	0.94	0.26	0.00
The EU ETS is causing competition issues to airlines	30	1	5	3.47	1.20	0.34	0.06
Using biofuels is a promising solution for carbon offsetting.	28	1	5	3.39	1.23	0.36	0.01
Postponing the auctions can force the prices of allowances to increase.	28	2	5	3.36	0.78	0.23	0.13
The monitoring, reporting and verification of emissions in the EU ETS is effective.	30	1	5	3.27	0.91	0.28	0.07
The multi-period nature of allocations (i.e. banking and borrowing flexibility) drives dependence both upon post-2012 decisions and creates risk of perverse incentives	28	1	4	3.25	0.84	0.26	0.01
The EU ETS can result in carbon leakage.	29	2	5	3.24	0.91	0.28	0.03
The EU ETS is vulnerable to frauds, for instance VAT fraud and 'phishing' scams.	29	1	5	3.17	1.10	0.35	0.07
The carbon market stability is vulnerable because of the low prices of the allowances.	28	1	5	3.11	0.96	0.31	0.05
The creation of carbon as a "financial instrument" can lead to sufficient carbon reduction.	29	1	5	3.00	0.93	0.31	0.05
The corresponding large proportion of free allocation underlies legal stresses and a scope for distortions.	28	1	4	2.86	0.76	0.26	0.07
The EU ETS is source of profit-making incentives unprecedented in the history of environmental policy	30	1	5	2.83	0.99	0.35	0.11

Descriptive Statistics							
	N	Min	Max	Mean	SD	CV	ΔCV
There are small emissions reductions relative to 'business-as-usual' and this leads to instabilities related to economics, policies and time frames) in the EU ETS.	29	1	4	2.76	0.58	0.21	0.11
The inclusion of aviation in the EU ETS will influence negatively the development of non-European airlines if they are included in EU ETS.	30	1	5	2.73	1.17	0.43	0.08
The cap of EU ETS is too generous.	30	1	5	2.71	1.07	0.40	0.10
The free allocation of allowances to the airlines must be stricter.	30	1	5	2.70	1.21	0.45	0.02
The EU ETS will lead the airlines to merge in order to obtain more emissions allowances.	30	1	5	2.29	1.19	0.52	0.03
Route optimisation is sufficient enough for carbon neutral growth.	30	1	4	1.77	0.86	0.49	0.11

Most of the 24 participants believe that benchmarking is the ideal method of allowances allocation (Table 34). The auctioning method had a mean of around 36% and the grandfathering method gathered 23 points. It should be noted that most of the participants selected more than two methods of allocations had quite different opinions.

The participants in the second round gave almost the same points as in the first round in the auctioning method. The ΔCV was 0.05. Moreover, the participants gave less points to the grandfathering method and more points to the benchmarking method in the second round. This is also supported by the ΔCV result.

Table 34: Ideal allocation method (2nd round EU ETS Q)

Descriptive Statistics							
	N	Min	Max	Mean	Std. Deviation	CV	ΔCV
Benchmarking	24	0	80	41.04	24.27	0.59	0.08
Auctioning	24	0	90	36.25	24.10	0.66	0.05
Grandfathering	24	0	75	22.71	22.02	0.97	0.15

In the Q1 question of this questionnaire the average reply from the 29 participants to the statement about the possibility of linking EU ETS with other schemes was 4.03 showing that they agree that it can happen(Table 35). The Q3 question is related to this and is: 'Q3. In order to link the different ETSs (like New Zealand or Shanghai ETS), the following factors should be applied to the same degree'. Please assess the extent to which you agree with the following statements (1 stands for strong disagreement, 2 for disagreement, 3 for neutral position, 4 for agreement and 5 for strong agreement). The 26-27 participants replied that the main factor that needs to be the same is the Monitoring, Reporting and Verification (MRV) rules for allowances (mean=4.26). They expressed a rather neutral opinion for the banking provisions, the compliance periods and the stringency of the targets.

The question about the factor for linking different ETSs had a ΔCV ranging from 0.06 to 0.26. The lowest ΔCV value was noted in the banking provisions factor, whereas the highest value was in the allocation methods and the compliance periods. The ΔCV average in this question was equal to 0.20.

Table 35: Factors to be considered for linking different ETSs (2nd round EU ETS Q)

Descriptive Statistics							
	N	Min	Max	Mean	SD	CV	ΔCV
There are the same Monitoring, Reporting and Verification (MRV) rules for allowances	27	1	5	4.26	0.90	0.21	0.19
There is the same stringency of enforcement	26	2	5	4.19	0.85	0.20	0.21
There is the same eligibility of offset credits	26	2	5	4.19	0.80	0.19	0.21
There are the same rules governing new entrants and closures	26	3	5	4.15	0.73	0.18	0.22
The same allocation methods are applied	26	2	5	4.12	0.82	0.20	0.24
There are the same registries' rules	27	2	5	4.04	0.81	0.20	0.20

Descriptive Statistics							
	N	Min	Max	Mean	SD	CV	ΔCV
There are the same banking provisions	26	2	5	3.65	0.80	0.22	0.06
There are the same compliance periods	26	2	5	3.65	0.94	0.26	0.26
There is the same stringency of targets	26	2	5	3.88	0.95	0.25	0.20

The question about the factors leading to carbon neutral growth was answered by 26-27 experts (Table 36). The operational factors contributing to carbon neutral growth had an average score of 44% and the EU ETS and carbon offsetting schemes received 32%. There was one participant that gave 94% to EU ETS and there was no consensus among the participants. The CV in all the cases was high compared to the other questions.

The average ΔCV was 0.08. The prices of ΔCV ranged from 0 to 0.15. All prices were very low, which indicates that the participants did not revise their opinions regarding the factors leading to carbon neutral growth in the second round of the Delphi method.

Table 36: Factors leading to carbon neutral growth (2nd round EU ETS Q)

Descriptive Statistics							
	N	Min	Max	Mean	SD	CV	ΔCV
The EU ETS leads to carbon neutral growth.	27	0	94	20.67	25.16	1.22	0.04
Flexible Use of Airspace (FUA) leads to carbon neutral growth	27	0	50	12.74	10.97	0.86	0.13
Individual carbon offsetting programs from airlines lead to carbon neutral growth.	27	0	40	12.11	12.17	1.00	0.00
Free Route Airspace (FRA) leads to neutral growth carbon	27	0	40	11.07	9.75	0.88	0.15
Wind optimal routes lead to carbon neutral growth	27	0	45	10.33	10.10	0.98	0.02
Individual carbon offsetting programmes from states lead to carbon neutral growth.	27	0	30	9.89	10.09	1.02	0.13

Descriptive Statistics							
	N	Min	Max	Mean	SD	CV	ΔCV
Direct routes lead to carbon neutral growth	27	0	40	9.85	8.65	0.88	0.12
Other	27	0	60	10.93	17.54	1.61	0.07
Other	27	0	45	2.50	9.51	3.81	0.07

The CV in the second round was smaller than the CV in the first round. Moreover, the absolute difference of CV between the two rounds reached a small value. Therefore, stability is reached and no additional round or action is needed.

In the second round of the questionnaires, the element of Transaction cost was introduced. The participants were asked to share 100 points over the different categories (identified by the researcher) where the most important factor gets the highest number of points (Table 37). They were also given the option of adding a category themselves. The highest score was noted to the Implementation of Emissions Management category, followed by the Monitoring, Reporting and Verification as well as the application. The Abatement measures category had the lowest score (mean=6.97%). There was consensus for the category of 'Application' (CV=0.42) and 'Implementation of Emissions Management' (CV=0.49), but there was no agreement on the other categories.

Table 37: Transaction costs categories (2nd round EU ETS Q)

Descriptive Statistics						
	N	Min	Max	Mean	SD	CV
Application	26	0	30	14.78	6.24	0.42
Implementation of Emissions Management	26	0	50	22.66	11.09	0.49
Monitoring	26	0	45	14.01	11.05	0.79
Reporting and verification	26	0	45	16.86	10.28	0.61
Abatement measures	25	0	15	6.97	5.16	0.74
Trade	26	0	25	10.01	7.54	0.75
Strategy	26	0	30	9.40	6.23	0.66
Other	25	0	10	1.40	3.07	2.19

Regarding the question about how important the transactions costs are for the effective functioning of the aviation inclusion in the EU ETS scheme, the 26 participants gave on average 3,65 which stands for neutral towards important. The important was the prevailing opinion.

7.2.2 The Single European Sky Questionnaire descriptive analysis (2nd round)

This section is about the responses of the participants in the SES questionnaire in the second round. Table 38 is about the areas that are benefited by the establishment of Functional Airspace Blocks. On average 26 participants replied to this question. The participants kept a neutral towards positive position regarding the FAB improvement areas that have been identified as the most promising areas according to the degree of the potential benefit coming from the establishment of FABs. The respondents identified the Common Operational Procedures, Synergies in ATFCM, Harmonised ATM system and Reduction of emissions as important FIAs. The Common Flight Inspection has been identified as unimportant FIA.

The absolute difference of coefficient of variation is used to identify if there are any changes in the opinions of the experts and groups in the second round of the SES questionnaire of the Delphi method. The first question about the areas benefitted by FABs had a very low ΔCV ranging from 0 to 0.07. Hence, stability was achieved.

Table 38: Areas benefitted from the establishment of FABs (2nd round SES Q)

Descriptive Statistics							
	N	Min	Max	Mean	SD	CV	ΔCV
Harmonised ATM system	26	1	5	4.12	0.95	0.23	0.07
Common Operational Procedures	26	2	5	4.04	0.77	0.19	0.01
Reduction of emissions	25	2	5	4.04	0.89	0.22	0.02
Airspace consolidation	26	1	5	3.88	0.95	0.25	0.04
Common Routes Network design	26	1	5	3.81	0.90	0.24	0.03

Descriptive Statistics							
	N	Min	Max	Mean	SD	CV	ΔCV
Communication Data Sharing	26	2	5	3.81	0.75	0.20	0.01
Common Sector Design	26	1	5	3.77	0.95	0.25	0.03
Common Safety Management System	26	2	5	3.69	0.88	0.24	0.02
Improved cooperation with Militaries	26	1	5	3.65	1.09	0.30	0.01
Surveillance Data sharing	26	1	5	3.54	0.99	0.28	0.03
Common ATCO Training	26	2	5	3.42	0.81	0.24	0.00
Common R&D	25	2	5	3.20	0.87	0.27	0.04
Common AIS & MET	26	1	5	3.15	1.19	0.38	
Common Procurement	26	1	5	3.08	1.02	0.33	0.04
Sharing of navigation aids	26	1	4	3.00	0.85	0.28	0.05
Common Flight Inspection	25	1	5	2.80	0.76	0.27	0.01
Other,	5	3	5	3.60	0.89	0.25	0.04

On average, 27 participants replied the question about SES and the environment in the second round (Table 39). Most of them agreed that the reorganisation of the European Sky was necessary and that the airspace had to change. They also agreed that the FABs are not fully operational. There were extremely small differences compared to the first round. The ΔCV ranged from 0.01 to 0.11. The maximum ΔCV was for the statement The airspace before SES did not need to be changed. More experts disagreed with this statement in the second round.

Table 39: Position of participants on SES and the environment (2nd round SES Q)

Descriptive statistics							
	N	Min	Max	Mean	SD	CV	ΔCV
The reorganisation of the European Sky was necessary.	28	1	5	4.21	0.96	0.23	0.05
The European airspace network today can benefit from a significant level of dynamism through the application of the Flexible Use of Airspace (FUA) concept.	27	1	5	3.78	0.97	0.26	0.01

Descriptive statistics							
	N	Min	Max	Mean	SD	CV	ΔCV
Due to inherent safety (minimum separation requirements between aircraft) requirements, the level of “inefficiencies” cannot be reduced to zero at system level.	28	1	5	3.75	1.00	0.27	0.03
FABs bring routes closer to the optimum “Great Circle” route and reduce extended flight paths.	27	1	5	3.52	0.98	0.28	0.04
Due to capacity (organisation of traffic flows) requirements, the level of “inefficiencies” cannot be reduced to zero at system level.	28	1	5	3.46	1.17	0.34	0.02
The main environmental KPI should be the estimated economic value of CO_2 emissions due to route extension.	27	1	5	2.96	1.22	0.41	0.06
The horizontal component is of higher economic and environmental importance than the vertical component of the Flight efficiency.	28	1	4	2.54	0.88	0.35	0.02
All FABs are fully operational.	26	1	5	1.92	0.89	0.46	0.08
The airspace before SES did not need to be changed.	28	1	5	1.79	0.92	0.51	0.11

The third question about the different factors that affect horizontal en route flight efficiency, was answered by 24 experts (Table 40). The experts suggested that the most important factors are the airspace structure, the flight planning capabilities and then the user preferences. The question about the factors affecting horizontal en route flight efficiency was the question that the experts revised their opinion the most compared to the rest of the questions. Nevertheless, the ΔCV was quite low. The average ΔCV was 0.19. The price is influenced by the high ΔCV of the factor 'other'. This factor was an optional additional factor and many of the experts did add one and it was marked with 0 points. Therefore, when considering stability and consensus for the replies, it is not taken under consideration. Stability was achieved in the question

Table 40: Factors affecting horizontal en route flight efficiency (2nd round SES Q)

Descriptive statistics							
	N	Min	Max	Mean	SD	CV	ΔCV
Route structure and availability affect horizontal en route flight efficiency.	24	5	50	27.92	10.52	0.38	0.06
Availability of airspace (utilisation of civil military structures) affects horizontal en route flight efficiency.	24	5	40	17.83	8.51	0.48	0.08
Flight planning capabilities (use of software, repetitive flight planning) affect horizontal en route flight efficiency.	24	5	25	14.67	5.83	0.40	0.11
Tactical ATC routings affect horizontal en route flight efficiency.	24	5	20	10.63	4.25	0.40	0.12
User preferences regarding fuel affect horizontal en route flight efficiency.	24	0	40	10.38	8.97	0.86	0.13
User preferences regarding time affect horizontal en route flight efficiency.	24	0	25	8.58	5.59	0.65	0.13
Special events such as ATC strikes affect horizontal en route flight efficiency.	24	0	20	7.96	5.07	0.64	0.15
Other	24	0	25	1.83	5.47	2.99	0.72

The Civil-Military cooperation is a very important element for the reorganisation of the airspace. Therefore, the participants were asked to prioritise the factors that affect the use of the civil/military airspace structures (Free Route Airspace, Flexible use of Airspace) as seen in Table 41. The factor 'political issues' gathered on average 43% and the remaining factors gathered 13-9%. The ΔCV of the Civil Military cooperation was very low, indicating that stability was achieved. The values ranged from 0.03 to 0.39. As explained above when the factor 'other' has a relative high ΔCV, it is not taken under consideration when examining if stability is achieved.

Table 41: Factors affecting the Civil Military cooperation (2nd round SES Q)

Descriptive Statistics							
	N	Min	Max	Mean	SD	CV	ΔCV
Political issues	26	0	100	43.12	27.13	0.63	0.04
Flight planning capabilities (use of software, repetitive flight planning)	26	0	35	13.04	9.49	0.73	0.25
Special events	26	0	50	12.85	15.37	1.20	0.03
Existing ICAO ATM procedures	26	0	30	9.12	7.92	0.87	0.11
Aspects related to position information and radar vectoring	26	0	30	9.12	7.66	0.84	0.03
Other	26	0	100	12.77	27.10	2.12	0.39

Around 27 participants evaluated the factors according to their contribution to emissions' reduction and only 3 added a factor (Table 42). The factors that are considered the most important by the participants are the FUA, the FRA, shortest routes, CDOs and use of eco-friendly engines. The factors Trading Certified Emissions Reductions (CERs) (mean=2.78), Trading Verified or Voluntary Emissions Reductions (VERs) (mean=2.54) and EU Emissions Trading Scheme (mean=2.93) were evaluated as unimportant. As listed in Table 42, the ΔCV of the opinions about factors contributing to emissions reduction is very low, proving stability among the Delphi method rounds. The minimum value of ΔCV was 0 and the maximum value was 0.08.

Table 42: Factors contributing to emissions' reduction (2nd round SES Q)

Descriptive Statistics							
	N	Min	Max	Mean	SD	CV	ΔCV
Shortest feasible routes	27	3	5	4.30	0.67	0.16	0.05
Flexible Use of Airspace	28	2	5	4.18	0.72	0.17	0.03
Implementing continuous descent approaches	28	3	5	4.14	0.71	0.17	0.00
Use of Eco-friendly engines	28	1	5	4.14	0.89	0.22	0.01
Free Route Airspace	27	2	5	4.11	0.70	0.17	0.03
Single European Sky	28	1	5	3.82	0.94	0.25	0.05
Improving load factors	28	2	5	3.68	0.77	0.21	0.01
Use of Bio fuels	28	1	5	3.57	1.14	0.32	0.01
Reduced traffic because of economic crisis	28	1	5	3.43	1.00	0.29	0.05
Airlines develop offsetting programs	27	1	5	3.26	1.02	0.31	0.05
EU Emissions Trading Scheme	28	1	5	2.93	0.98	0.33	0.08
Trading Certified Emissions Reductions (CERs)	27	1	5	2.78	1.01	0.36	0.04
Trading Verified or Voluntary Emissions Reductions (VERs)	26	1	4	2.54	0.99	0.39	0.04
Other	3	5	5	5.00			
Other	1	5	5	5.00			

The 24 participants that replied to the question about the factors leading to carbon neutral growth in the second round of the Delphi method gave points ranging from 0-50 (Table 43). The en-route flight efficiency factors gathered 47.21% and the EU ETS 17.5%, airlines' carbon offsetting schemes 15.67% and states' carbon offsetting schemes gathered 10.08%. The difference on replies from the first round of the Delphi method are minor. The ΔCV took prices ranging from 0 to 0.13. The average ΔCV was 0.042. Consensus and stability was achieved in this question too.

Table 43: Factors leading to carbon neutral growth (2nd round SES Q)

Descriptive Statistics							
	N	Min	Max	Mean	SD	CV	ΔCV
The EU ETS leads to carbon neutral growth.	24	0	40	17.50	11.59	0.66	0.04
Individual carbon offsetting programs from airlines lead to carbon neutral growth.	24	0	40	15.67	10.48	0.67	0.00
Free Route Airspace (FRA) leads to carbon neutral growth	24	0	50	12.58	9.94	0.79	0.01
Wind optimal routes lead to carbon neutral growth	24	0	40	12.17	8.13	0.67	0.04
Flexible Use of Airspace (FUA) leads to carbon neutral growth	24	0	20	11.54	4.90	0.42	0.13
Direct routes lead to carbon neutral growth	24	0	30	10.92	6.80	0.62	0.03
Individual carbon offsetting programmes from states lead to carbon neutral growth.	24	0	25	10.08	7.47	0.74	0.02
Other	24	0	30	5.50	9.13		
Other	24	0	37	2.38	8.43		

In the second round of the questionnaires, the element of Transaction cost was introduced (Table 44). The participants were asked to share 100 points over the different categories (identified by the researcher) where the most important factor gets the highest number of points. They were also given the option of adding a category themselves. On average 24 participants replied to this question. The category Development and Implementation of the regulatory scheme received 27%, the Monitoring 18%, the strategy received around 17.5% followed by the Reporting and verification (13%), the Alternative Policies (12%) and the Compliance category (9.5%). Less than 5 participants gave 5-15% to an additional category.

Table 44: Transaction costs categories (2nd round SES Q)

Descriptive Statistics						
	N	Min	Max	Mean	SD	CV
Development and Implementation of the regulatory scheme	24	10	45	27.15	9.46	0.35
Monitoring	24	10	45	18.07	10.02	0.55
Strategy	24	5	60	17.69	11.09	0.63
Reporting and verification	24	10	35	13.19	5.90	0.45
Alternative Policies	24	0	20	12.15	5.55	0.46
Compliance	23	0	17	9.20	4.29	0.47
Other	25	0	15	1.80	4.05	2.25

The mean for the question 'Overall, how important do you consider transactions costs to be for the effective functioning of the environment KPA in the SES Performance scheme' is 3.83 (standard deviation=0.64 and Coefficient of Variation=0.17). The minimum score was 3, i.e. neutral importance and the maximum was 5. The 24 participants either kept a neutral position or marked transaction costs as important for the effectiveness of environment KPA.

7.2.3 Comparison of the common questions of SES and EU ETS Questionnaires

The questionnaires of SES and EU ETS are connected. Apart from the two common questions, i.e. the question about the about factors leading to carbon neutral growth and the question if they believe that there is a connection between SES (FABs) and Emissions Trading Scheme (EU ETS), there were some common elements that were researched.

The SES questionnaire participants were asked about the biofuels use, the carbon offsetting schemes developed by airlines and the EU ETS. The EU ETS questionnaire participants were asked also about the biofuels use, and operational measures like the route optimisation and fuel predictability. 17 out of 29 experts in the EU ETS questionnaire had a positive opinion about the contribution of biofuels to the improvement of environmental performance and 7 had a negative opinion. The situation is the same at the

SES questionnaire where 16 out of the 28 experts expressed a positive opinion and only 4 expressed a negative opinion.

As far as the common question is concerned, Table 45 presents the average points the participants of the EU ETS and SES 2nd round questionnaire gave to the factors contributing to carbon neutral growth and the difference of mean. The difference in the mean is very low. Consequently, it can be assumed that consensus was reached among the experts in both questionnaires. As expected the EU ETS questionnaire shared more points to the EU ETS reform and less points to flight efficiency. Moreover, the experts in the first case shared more points to additional factors like the biofuel use and the fleet renewal.

Table 45: Differences of EU ETS and SES questionnaire participants of opinions about the factors leading to carbon neutral growth

Factors	EU ETS Q All Experts' position		SES Q All Experts' position		Difference of EU ETS – SES Mean
	Mean(a)	SD	Mean(b)	SD	ΔMean (a-b)
The EU ETS leads to carbon neutral growth.	20.26	25.16	17.50	11.59	2.76
Individual carbon offsetting programs from airlines lead to carbon neutral growth.	12.11	12.17	15.67	10.48	-3.56
Individual carbon offsetting programmes from states lead to carbon neutral growth.	9.89	10.09	10.08	7.47	0.19
Direct routes lead to carbon neutral growth	9.85	8.65	10.92	6.80	-1.07
Wind optimal routes lead to carbon neutral growth	10.33	10.10	12.17	8.13	-1.84
Flexible Use of Airspace (FUA) leads to carbon neutral growth	12.74	10.97	11.54	4.90	1.2
Free Route Airspace (FRA) leads to carbon neutral growth	11.07	9.75	12.58	9.94	-1.51
Other	10.93	17.54	5.50	9.13	5.43
Other	2.50	9.51	2.38	8.43	0.12

The common question if they believe that there is a connection between SES (FABs) and Emissions Trading Scheme (EU ETS) the 45% of the EU ETS questionnaire participants in the first round replied that there is a connection, while only the 33% of the SES questionnaire participants replied yes. The 16% of the EU ETS questionnaire participants kept a negative position as well as the 1/3 of the SES questionnaire experts. Despite those replies, as proven in Table 45, the EU ETS and SES are connected through their contribution to emissions reduction. The aim of EU ETS is to reduce the emissions where as one of the targets of SES is also the environmental efficiency.

7.2.4 Cross Tabulation of SES and EU ETS questionnaires (2nd round)

Cross-tabulation analysis, also known as contingency table analysis, will be used to analyse the categorical data. The importance of the Delphi method was to identify the existence or lack of consensus among the groups and within the groups regarding the reform occurring from the inclusion of aviation in EU ETS and the implementation of SES. It was decided to illustrate the cross tabulation of the second round only since this round is more important in terms of findings and conclusions. The findings should rely on a stabilised environment where the participants are less possible to change their opinion. Therefore, cross tabulation is applied only to the second round.

On the left side of the table are the statements/parameters, the second column are the scales and then the different categories of the respondents are given. The categories are Airlines, ANSPs, CAA/NSA, individual experts, governmental bodies (like PRB, Ministries and EUROCONTROL) and IATA. The number of the respondents is given in brackets. It should be noted that only European airlines participated in the survey.

7.2.4.1 Cross tabulation of EU ETS questionnaire (2nd round)

Table 46 lists all the 21 statements/positions that the different stakeholders were asked about. The first element that was evaluated is the effects of EU ETS to competition. It is interesting to see the differences in the replies of the different stakeholders. The 83% of the EU airlines that participated in the Delphi method believe that if EU ETS decided to extent the scope and include all the airlines, i.e. if the stop the clock decision is not renewed, those airlines will not be influenced negatively. On the other hand, IATA (84%) that represent the interests of many airlines across the world, believes that those non-EU airlines will be negatively affected. Moreover, almost all the participants believe that airlines will not be 'forced' to merge so as to get more allowances. Despite that, many of the participants believe that EU ETS is causing competition issues to airlines.

The seventh statement in Table 46 refers to the supply of allowances. Airlines, ANSPs, IATA and some experts believe that the amount of allowances that was given was fair. The 60% of the Government Bodies, the 40% of CAA/NSAs and the 29% of individual experts believe that the cap of EU ETS is too generous. The gap between the regulator and the airlines is quite evident in this statement. When the participants were asked about making the free allocation of allowances stricter (statement 11), the airline representatives (83%) and IATA (67%) commented that the allocation shouldn't be stricter, whereas all the ANSPs, the 40% of CAA/NSAs, the 29% of individual experts and surprisingly the 17% of IATA experts suggested stricter allocations. The government bodies' representatives kept a neutral position.

Moreover, the 20th statement 'The corresponding large proportion of free allocation underlies legal stresses and a scope for distortions' was not commented by the government bodies, whereas almost all the remaining respondents disagreed with the statement. This leads to the conclusion that the allocation method of the free allowances was not a result of strong lobbying and is not associated with distortions (distortions are associated with grandfathering of allowances). The replies of the participants regarding the lobbying around the allocation of allowance had an average value of 4, i.e. agreed that the economic dimension of EU ETS drives heavy lobbying. This finding is broadly consistent with the general expectations. 80% of the government bodies, 83% of IATA experts, 50% of ANSPs, 50% of CAAs, 83% of individual experts and 66% of airlines agreed with the statement. Surprisingly, 17% of airlines disagreed with the statement.

The element of globalisation of the reform was accessed through statement number 4 in Table 46. Only the 10% of the participants (i.e. 3 airline representatives) argued that linking the EU ETS with other ETSs around the world and creating a global scheme is not possible. The remaining 67% of airlines, 50% of the ANSPs, 100% of the CAAs, 72% of experts, the 50% of the government bodies and all the IATA experts participating in the survey believe that it is possible to link the ETS and create a global scheme[10]. The parameters that need to be taken under consideration are accessed in Table 35.

There is overwhelming evidence corroborating the issues that EU ETS is facing. Regarding the MRV effectiveness, the participants kept a quite neutral to positive position. The majority of the participants indicated that the continuous changes in the legislation (for instance the stop the clock in the first year of EU ETS and the CORSIA in less than 5 years from the enforcement of EU ETS) make the carbon market less stable. 40% of government bodies disagreed with the above statement, but surprisingly 20% of them agreed.

The individuals regardless of their group, had diverse opinions regarding the vulnerability of EU ETS to frauds. The minimum value they gave was 2 and the maximum was 5. 1/5 of the experts from governmental bodies disagreed with the statement and 2/5 agreed with the statement. The same findings were noted for the 9th statement too. 50% of the

[10] It should be noted that the EU ETS is incorporated in the ICAO Basket of Measures, but is not necessarily taken into consideration by ICAO CORSIA (see 3.9.1 section).

governmental bodies, 50% of IATA experts, 33% of airlines representatives and 67% of independent experts agreed that the carbon market stability is vulnerable due to low prices of the allowances. The majority of the participants agreed that postponing the auctions can force the prices of allowances to increase. 17% of airlines and 33% of IATA experts disagreed with that statement.

In the literature, several concerns were expressed about the carbon leakage. 50% of governmental bodies, 29% of individual experts and 17% of airlines believe that EU ETS can result to carbon leakage. However, the opposite opinion is supported by 33% of airlines, 50% of CAAs, 17% of IATA experts and 43% of experts. None of the representatives of government bodies believes that EU ETS can result in carbon leakage. There are quotas for receiving emissions from the flexible mechanism of Kyoto. The 21st statement in Table 46 received diverse opinions. There are some participants, regardless of their group that believe that the multi-period nature of allocations (i.e. banking and borrowing flexibility) drives dependence both upon post-2012 decisions and creates risk of perverse incentives, and others that do not.

In this question, various approaches to environmental problems were investigated. The participants were given statements about operational changes that may lead to carbon neutral growth. The use of biofuels is an issue that is more familiar to the airlines, IATA experts, individual experts and government bodies. All of those stakeholders though share a different opinion in this matter. The airlines are divided. 50% believes that the use of biofuels is a promising solution for carbon offsetting and the other half do not. This is related to the culture of the airline and the strategy of using biofuels or not is related with the availability. The northern European airlines like SAS and central Europe airlines with extended network like Lufthansa have invested in biofuels and have access to. Therefore, it is hypothesized that those airlines are more familiar with its use and are strong supporters of biofuels and others are not. 57% of the experts support the statement and the remaining 43% keep a neutral position. The 75% of the government bodies agreed with the statement.

Apart from biofuels use, the additional fuel savings will also be achieved owing to better fuel use predictability according to the participants. 83% of airlines, 100% of ANSPs, 75% of CAAs, 71% of individual experts and 50% of IATA experts agreed with the statement. 67% of government bodies disagreed. The airlines and the ANSPs are more familiar with route structures and excess fuel's contribution to fuel consumption. Therefore, their opinion is much more important in this statement.

An important finding is the fact that the participants have diverse opinions whether the carbon markets can lead to sufficient carbon reductions. In addition, the participants do not believe that route optimisation is sufficient for carbon neutral growth. It is important that 50% of ANSPs, 100% of airlines and IATA experts as well as 80% of government bodies supported this statement (Table 46). This means that neither SES nor EU ETS are sufficient to lead to carbon neutral growth and needs complementary policies.

Table 46: Crosstab Groups positions on EU ETS

Statement	Scale 1-5	Airlines (n=6)	ANSPs (n=2)	CAA/NSA (n=4)	Ind. Experts (n=7)	Government Bodies (n=5)	IATA (n=6)
1. The inclusion of aviation in the EU ETS will influence negatively the development of non-European airlines if they are included in EU ETS.	1	50%	0%	0%	29%	0%	17%
	2	33%	50%	0%	14%	40%	0%
	3	17%	50%	100%	29%	20%	0%
	4	0%	0%	0%	29%	40%	67%
	5	0%	0%	0%	0%	0%	17%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=5)**	**Ind. Experts (n=7)**	**Government Bodies (n=5)**	**IATA (n=6)**
2. The EU ETS will lead the airlines to merge in order to obtain more emissions allowances.	1	67%	50%	20%	29%	40%	0%
	2	17%	0%	20%	14%	20%	83%
	3	0%	0%	40%	43%	20%	0%
	4	0%	50%	20%	14%	20%	17%
	5	17%	0%	0%	0%	0%	0%

Statement	Scale 1-5	Airlines (n=6)	ANSPs (n=2)	CAA/NSA (n=4)	Ind. Experts (n=7)	Government Bodies (n=5)	IATA (n=6)
3. The EU ETS is causing competition issues to airlines	1	17%	0%	0%	14%	20%	0%
	2	0%	0%	25%	0%	0%	33%
	3	17%	0%	25%	29%	20%	17%
	4	33%	100%	50%	43%	40%	33%
	5	33%	0%	0%	14%	20%	17%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Ind. Experts (n=7)**	**Government Bodies (n=4)**	**IATA (n=6)**
4. It is possible to link the EU ETS and the other Emissions Trading schemes and have a global ETS.	1	17%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	0%
	3	17%	50%	0%	29%	50%	0%
	4	50%	0%	100%	43%	0%	33%
	5	17%	50%	0%	29%	50%	67%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Ind. Experts (n=7)**	**Government Bodies (n=5)**	**IATA (n=6)**
5. The monitoring, reporting and verification of emissions in the EU ETS is effective.	1	0%	0%	0%	0%	0%	17%
	2	17%	0%	0%	14%	0%	33%
	3	50%	100%	25%	29%	60%	33%
	4	17%	0%	75%	57%	20%	17%
	5	17%	0%	0%	0%	20%	0%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Ind. Experts (n=7)**	**Government Bodies (n=5)**	**IATA (n=6)**
6. The EU ETS is vulnerable to frauds, for instance VAT fraud and 'phishing' scams.	1	0%	0%	50%	0%	0%	0%
	2	33%	0%	0%	17%	20%	17%
	3	50%	50%	25%	33%	40%	50%
	4	0%	0%	25%	17%	40%	33%
	5	17%	50%	0%	33%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Ind. Experts (n=7)**	**Government Bodies (n=5)**	**IATA (n=6)**
7. The cap of EU ETS is too generous.	1	17%	0%	0%	14%	0%	17%
	2	50%	100%	0%	43%	20%	59%
	3	33%	0%	60%	14%	20%	33%
	4	0%	0%	40%	0%	60%	0%
	5	0%	0%	0%	29%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Ind. Experts (n=7)**	**Government Bodies (n=5)**	**IATA (n=6)**
8. The carbon market's stability is vulnerable because of the continuous changes in legislation.	1	0%	0%	0%	0%	0%	0%
	2	17%	0%	0%	0%	40%	0%
	3	17%	100%	0%	43%	40%	0%
	4	50%	0%	100%	29%	20%	67%
	5	17%	0%	0%	29%	0%	33%

Statement	Scale 1-5	Airlines (n=6)	ANSPs (n=2)	CAA/NSA (n=3)	Ind. Experts (n=7)	Government Bodies (n=4)	IATA (n=6)
9. The carbon market stability is vulnerable because of the low prices of the allowances.	1	0%	0%	0%	14%	25%	0%
	2	17%	0%	33%	0%	0%	33%
	3	50%	100%	0%	71%	25%	17%
	4	33%	0%	67%	14%	25%	50%
	5	0%	0%	0%	0%	25%	0%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=3)**	**Ind. Experts (n=7)**	**Government Bodies (n=4)**	**IATA (n=6)**
10. Postponing the auctions can force the prices of allowances to increase.	1	0%	0%	0%	0%	0%	0%
	2	17%	0%	0%	0%	0%	33%
	3	33%	50%	33%	57%	75%	50%
	4	33%	50%	67%	29%	25%	17%
	5	17%	0%	0%	14%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=5)**	**Ind. Experts (n=7)**	**Government Bodies (n=4)**	**IATA (n=6)**
11. The free allocation of allowances to the airlines must be stricter.	1	50%	0%	0%	14%	0%	50%
	2	33%	0%	0%	14%	0%	17%
	3	17%	0%	60%	43%	100%	17%
	4	0%	100%	40%	0%	0%	17%
	5	0%	0%	0%	29%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=3)**	**Ind. Experts (n=7)**	**Government Bodies (n=4)**	**IATA (n=6)**
12. Using biofuels is a promising solution for carbon offsetting.	1	17%	0%	0%	0%	25%	17%
	2	33%	50%	0%	0%	0%	17%
	3	0%	0%	0%	43%	0%	17%
	4	33%	50%	100%	57%	75%	0%
	5	17%	0%	0%	0%	0%	50%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=3)**	**Ind. Experts (n=7)**	**Government Bodies (n=5)**	**IATA (n=6)**
13. The creation of carbon as a "financial instrument" can lead to sufficient carbon reduction.	1	17%	0%	0%	0%	0%	17%
	2	17%	0%	0%	43%	20%	0%
	3	17%	50%	33%	43%	80%	67%
	4	33%	50%	67%	14%	0%	17%
	5	17%	0%	0%	0%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=3)**	**Ind. Experts (n=7)**	**Government Bodies (n=5)**	**IATA (n=6)**
14. Additional fuel savings will also be achieved owing to better fuel use predictability.	1	17%	0%	0%	0%	0%	0%
	2	0%	0%	0%	14%	67%	17%
	3	0%	0%	25%	14%	33%	33%
	4	50%	50%	75%	57%	0%	50%
	5	33%	50%	0%	14%	0%	0%

Statement	Scale 1-5	Airlines (n=6)	ANSPs (n=2)	CAA/NSA (n=3)	Ind. Experts (n=7)	Government Bodies (n=5)	IATA (n=6)
15. Route optimisation is sufficient enough for carbon neutral growth.	1	67%	50%	0%	43%	60%	50%
	2	33%	0%	25%	43%	20%	50%
	3	0%	50%	50%	14%	20%	0%
	4	0%	0%	25%	0%	0%	0%
	5	0%	0%	0%	0%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Ind. Experts (n=7)**	**Government Bodies (n=4)**	**IATA (n=6)**
16. The EU ETS can result in carbon leakage.	1	0%	0%	0%	0%	0%	0%
	2	17%	0%	0%	29%	50%	0%
	3	50%	100%	50%	29%	50%	83%
	4	0%	0%	50%	29%	0%	0%
	5	33%	0%	0%	14%	0%	17%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Ind. Experts (n=6)**	**Government Bodies (n=5)**	**IATA (n=6)**
17. The economic dimension of the EU ETS drives heavy lobbying around allocation of EU ETS allowances.	1	0%	0%	0%	0%	0%	0%
	2	17%	0%	0%	0%	0%	0%
	3	17%	50%	50%	17%	20%	17%
	4	33%	0%	50%	50%	80%	50%
	5	33%	50%	0%	33%	0%	33%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=5)**	**Ind. Experts (n=6)**	**Government Bodies (n=5)**	**IATA (n=6)**
18. The EU ETS is source of profit-making incentives unprecedented in the history of environmental policy	1	0%	0%	20%	17%	0%	17%
	2	17%	0%	0%	33%	40%	17%
	3	83%	50%	40%	33%	60%	50%
	4	0%	50%	20%	17%	0%	0%
	5	0%	0%	20%	0%	0%	17%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Ind. Experts (n=7)**	**Government Bodies (n=4)**	**IATA (n=6)**
19. There are small emissions reductions relative to 'business-as-usual' and this leads to instabilities related to economics, policies and time frames) in the EU ETS.	1	0%	0%	25%	0%	0%	0%
	2	17%	0%	0%	43%	0%	33%
	3	83%	100%	75%	43%	100%	67%
	4	0%	0%	0%	14%	0%	0%
	5	0%	0%	0%	0%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Ind. Experts (n=6)**	**Government Bodies (n=4)**	**IATA (n=6)**
20. The corresponding large proportion of free allocation underlies legal stresses and a scope for	1	17%	0%	0%	0%	0%	17%
	2	17%	50%	25%	17%	0%	0%
	3	67%	50%	75%	33%	100%	67%
	4	0%	0%	0%	50%	0%	17%

Statement	Scale 1-5	Airlines (n=6)	ANSPs (n=2)	CAA/NSA (n=3)	Ind. Experts (n=7)	Government Bodies (n=5)	IATA (n=6)
distortions.	5	0%	0%	0%	0%	0%	0%
21. The multi-period nature of allocations (i.e. banking and borrowing flexibility) drives dependence both upon post-2012 decisions and creates risk of perverse incentives	1	17%	0%	0%	0%	0%	0%
	2	17%	0%	0%	17%	25%	17%
	3	17%	0%	100%	17%	50%	33%
	4	50%	100%	0%	67%	25%	50%
	5	0%	0%	0%	0%	0%	0%

The method of allocation for allowances is of critical importance. There are three methods, benchmarking, grandfathering and auctioning. According to Table 47 the least preferred method for the airlines is the auctioning (max points=25%) and the most favourite is the benchmarking (max points=80%). The CAA/NSA showed almost equal preference for auctioning and benchmarking. The individual experts shared the least point to the grandfathering method and showed a preference for auctioning (max points=90%) and benchmarking (max points=60%).

The government bodies representatives deemed auctioning as a better method for allowances allocation. 60% of government representatives gave 0-10% to grandfathering and 80% gave less than 30 points (out of 100 points) to benchmarking, whereas 40% of government representatives gave 80-90 point to auctioning. The remaining 60% of government representatives with respect to auctioning gave less than 30 points. Despite that the policy makers believe that auctioning is a more appropriate method for allocation of emissions, the EU ETS for aviation is based on grandfathering. Both under grandfathering and benchmarking, allowances are allocated free of charge. The auctioning of allowances in aviation is quite limited. One element that is extremely interesting is that in the statement 17 of Table 46, 80% of government representatives supported that the economic dimension of EU ETS drives heavy lobbying around allocation of EU ETS allowances and in this section, they claim that auctioning is a better method for allocating allowances. The regulators though supports the grandfathering and benchmarking. A logical speculation would be that the heavy lobbying affected the regulation. For consistency purposes, the reported results are groups in scale increments of 10 points (i.e. 0-9, 10-19, etc.).

Table 47: Crosstab Groups points on allocation methods

Method	Scale 1-100	Airlines (n=4)	ANSPs (n=2)	CAA/NSA (n=3)	Experts (n=4)	Government (n=5)	IATA (n=6)
Grandfathering	0-9	0%	0%	67%	50%	40%	0%
	10-19	25%	0%	0%	25%	20%	33%
	20-29	50%	50%	0%	0%	0%	17%
	30-39	25%	0%	33%	0%	0%	17%
	40-49	0%	0%	0%	25%	20%	0%
	50-59	0%	50%	0%	0%	0%	17%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	20%	17%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Benchmarking	0-9	0%	0%	0%	0%	0%	17%
	10-19	0%	0%	0%	25%	60%	17%
	20-29	0%	0%	0%	0%	0%	0%
	30-39	0%	100%	33%	0%	20%	17%
	40-49	25%	0%	0%	25%	0%	0%
	50-59	0%	0%	33%	25%	0%	33%
	60-69	25%	0%	33%	25%	0%	0%
	70-79	0%	0%	0%	0%	20%	0%
	80-89	50%	0%	0%	0%	0%	17%
	90-100	0%	0%	0%	0%	0%	0%
Auctioning	0-9	25%	0%	0%	0%	0%	0%
	10-19	25%	50%	0%	0%	20%	33%
	20-29	50%	0%	0%	25%	0%	0%
	30-39	0%	0%	0%	25%	40%	17%
	40-49	0%	0%	67%	0%	0%	33%
	50-59	0%	50%	33%	25%	0%	17%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	20%	0%
	90-100	0%	0%	0%	25%	20%	0%

The element of global measures for the climate change was addressed with the question about linking the different ETSs (Table 48). Overall, the participants agreed with all the statements and have consensus for all the statements apart the statement for the stringency of targets. 17% of airlines, 50% of ANSPs and 25% of CAAs disagreed with the statement that in order to link the different ETS around the world with the EU ETS the same stringency of targets should be granted. The ANSPs opinion is not that important in this question and the airlines most probably had the benchmarking in mind and mainly the differences among the airlines in terms of readiness. None of the participants added an additional factor to the list created by the researcher.

Table 48: Crosstab Groups opinion on factors to be considered for linking different ETSs

Factors	Scale 1-5	Airlines (n=6)	ANSPs (n=2)	CAA/NSA (n=4)	Experts (n=5)	Government (n=4)	IATA (n=6)
There are the same Monitoring, Reporting and Verification (MRV) rules for allowances	1	0%	0%	0%	0%	0%	0%
	2	0%	50%	0%	0%	0%	0%
	3	17%	0%	25%	0%	0%	0%
	4	17%	50%	50%	80%	50%	33%
	5	67%	0%	25%	20%	50%	67%
Factors	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Experts (n=5)**	**Government (n=3)**	**IATA (n=6)**
There are the same banking provisions	1	0%	0%	0%	0%	0%	0%
	2	0%	50%	0%	0%	0%	0%
	3	83%	0%	50%	40%	33%	17%
	4	0%	50%	50%	40%	67%	50%
	5	17%	0%	0%	20%	0%	33%
Factors	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Experts (n=5)**	**Government (n=4)**	**IATA (n=6)**
There are the same registries' rules	1	0%	0%	0%	0%	0%	0%
	2	17%	50%	0%	0%	0%	0%
	3	17%	0%	25%	0%	0%	0%
	4	33%	50%	75%	80%	75%	50%
	5	33%	0%	0%	20%	25%	50%
Factors	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Experts (n=5)**	**Government (n=3)**	**IATA (n=6)**
There are the same rules governing new entrants and closures	1	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	0%
	3	33%	0%	25%	40%	0%	0%
	4	17%	100%	50%	40%	33%	67%
	5	50%	0%	25%	20%	67%	33%
Factors	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Experts (n=5)**	**Government (n=3)**	**IATA (n=6)**
The same allocation methods are applied	1	0%	0%	0%	0%	0%	0%
	2	17%	50%	0%	0%	0%	0%
	3	0%	0%	25%	0%	0%	0%
	4	33%	50%	50%	80%	67%	67%

Factors	Scale 1-5	Airlines (n=6)	ANSPs (n=2)	CAA/NSA (n=4)	Experts (n=5)	Government (n=4)	IATA (n=6)
	5	50%	0%	25%	20%	33%	33%
Factors	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Experts (n=5)**	**Government (n=3)**	**IATA (n=6)**
There is the same stringency of targets	1	0%	0%	0%	0%	0%	0%
	2	17%	50%	25%	0%	0%	0%
	3	17%	50%	0%	40%	0%	0%
	4	33%	0%	75%	40%	33%	67%
	5	33%	0%	0%	20%	67%	33%
Factors	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Experts (n=5)**	**Government (n=3)**	**IATA (n=6)**
There is the same stringency of enforcement	1	0%	0%	0%	0%	0%	0%
	2	17%	50%	0%	0%	0%	0%
	3	0%	0%	0%	20%	0%	0%
	4	33%	50%	75%	60%	33%	50%
	5	50%	0%	25%	20%	67%	50%
Factors	**Scale 1-5**	**Airlines (n=6)**	**ANSPs (n=2)**	**CAA/NSA (n=4)**	**Experts (n=5)**	**Government (n=4)**	**IATA (n=6)**
There is the same eligibility of offset credits	1	0%	0%	0%	0%	0%	0%
	2	17%	0%	0%	0%	0%	0%
	3	0%	50%	0%	20%	25%	0%
	4	17%	50%	33%	60%	75%	50%
	5	67%	0%	67%	20%	0%	50%

The 87% of the Delphi method participants replied to the question about the factors leading to carbon neutral growth (Table 49). The factor that contributes the least to carbon neutral growth is the individual carbon offsetting programmes from states. The maximum point this factor gathered was 30 points. The second least effective factor is individual carbon offsetting programmes implemented by airlines. Only 17% of airlines representatives gave to this factor more than 20 points. Surprisingly, 50% of individual experts gave more points than the airlines representatives. 25% of government bodies shared 40 points out of 100 to the individual carbon offsetting programmes from airlines.

As depicted in Table 49, 83% of airlines, 100% of ANSPs, 33% of CAAs, 68% of individual experts, 75% of government bodies and 83% of IATA experts shared less than 20 points to EU ETS. This factor did not reach the level of consensus of the other factors. There were 2 participants (individual expert and expert from government body) that gave more than 90 points to this factor and 3 participants (one expert from an airline, one CAA and one IATA expert) that gave 40-50/100 points. On average, the EU ETS gathered 21/100 points, the airlines' carbon offsetting schemes 12/100 points and the states' carbon offsetting schemes 10/100 points. Despite those findings, the policy makers give more emphasis to those solutions than the operational improvements. The operational improvements focus on the horizontal en-route efficiency. The researcher based on literature review and with the help of participants observation held at EUROCONTROL identified some factors contributing to flight efficiency. Those factors are: a) the direct routes; b) wind optimal routes; c) Flexible Use of Airspace (FUA); and d) Free Route Airspace (FRA).

The horizontal en-route flight efficiency gathered 45 out of 100 points. The ANSPs gave most of the points to FRA and FUA that contribute to direct routes and the least points to wind optimal routes. It should be noted that the ANSPs are responsible for their areas, where the wind optimal routes are not that important due to the short distance covered and the geography. The jet stream is mostly used for transatlantic routes. The airlines that have a network outside Europe and IATA gave more points to this factor. The airlines, IATA some individual experts and Government bodies added as a factor the technological changes to the airplanes and the use of alternative fuels. Those factors gathered on average 14 out of 100 points.

Table 49: Crosstab Groups and factors leading to carbon neutral growth

Statement	Scale 0-100	Airlines (n=6)	ANSPs (n=2)	CAA/NSA (n=3)	Ind. Experts (n=6)	Government Bodies (n=4)	IATA (n=6)
The EU ETS leads to carbon neutral growth	0-9	33%	100%	0%	50%	0%	33%
	10-19	17%	0%	33%	0%	25%	33%
	20-29	33%	0%	0%	33%	50%	17%
	30-39	0%	0%	33%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	17%
	50-59	17%	0%	33%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%

Statement	Scale 0-100	Airlines (n=6)	ANSPs (n=2)	CAA/NSA (n=3)	Ind. Experts (n=6)	Government Bodies (n=4)	IATA (n=6)
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	17%	25%	0%
Individual carbon offsetting programs from airlines lead to carbon neutral growth	0-9	50%	100%	33%	17%	50%	50%
	10-19	0%	0%	67%	17%	0%	33%
	20-29	33%	0%	0%	50%	0%	17%
	30-39	0%	0%	0%	17%	0%	0%
	40-49	17%	0%	0%	0%	25%	0%
	50-59	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Individual carbon offsetting programmes from states lead to carbon neutral growth	0-9	50%	100%	33%	33%	50%	83%
	10-19	33	0%	67%	0%	25%	17%
	20-29	0%	0%	0%	33%	0%	0%
	30-39	17%	0%	0%	33%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Direct routes lead to carbon neutral growth	0-9	100%	50%	0%	33%	100%	50%
	10-19	33%	0%	67%	50%	25%	17%
	20-29	0%	0%	33%	17%	0%	33%
	30-39	0%	0%	0%	0%	0%	0%
	40-49	0%	50%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Wind optimal routes lead to carbon neutral growth	0-9	67%	50%	0%	50%	50%	33%
	10-19	17%	50%	100%	33%	50%	17%
	20-29	0%	0%	0%	17%	0%	33%
	30-39	0%	0%	0%	0%	0%	17%
	40-49	17%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Flexible Use of Airspace (FUA) leads to carbon neutral growth	0-9	50%	0%	0%	67%	75%	17%
	10-19	33%	0%	66%	17%	25%	50%
	20-29	0%	50%	33%	17%	0%	17%

Statement	Scale 0-100	Airlines (n=6)	ANSPs (n=2)	CAA/NSA (n=3)	Ind. Experts (n=6)	Government Bodies (n=4)	IATA (n=6)
	30-39	17%	0%	0%	0%	0%	17%
	40-49	0%	0%	0%	0%	0%	0%
	50-59	0%	50%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Free Route Airspace (FRA) leads to carbon neutral growth	0-9	67%	0%	0%	50%	75%	33%
	10-19	33%	0%	66%	33%	25%	33%
	20-29	0%	0%	33%	17%	0%	33%
	30-39	0%	50%	0%	0%	0%	0%
	40-49	0%	50%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Other	0-9	33%	100%	100%	83%	50%	67%
	10-19	17%	0%	0%	0%	0%	0%
	20-29	17%	0%	0%	17%	0%	17%
	30-39	17%	0%	0%	0%	25%	17%
	40-49	0%	0%	0%	0%	0%	0%
	50-59	17%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	25%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Other	0-9	83%	100%	100%	100%	100%	80%
	10-19	0%	0%	0%	0%	0%	0%
	20-29	17%	0%	0%	0%	0%	0%
	30-39	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	20%
	50-59	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%

The second round of the Delphi method included two questions about the transaction costs as categorised by the researcher based on the literature review and participant observation (Table 50). The 26 experts that replied to this question deemed the implementation of emissions management as the costliest procedure. There is consensus among the participants regarding the application of EU ETS in comparison to the implementation. 100% of IATA experts and ANSPs, 17% of airlines and 60% of government bodies gave 30-50 points to the implementation of emissions management. 66% of airlines, 50% of individual experts and 40% of government bodies gave less than 15 points. This proves the different opinions for this factor.

The factor of monitoring gathered on average 11% of the points. 50% of the individual experts gave 25 points and 33% of airlines gave 45 points to this category. Consensus wasn't achieved by the participants. Surprisingly the government bodies and the CAAs, that are responsible for the monitoring, marked this category low. The category of reporting and verification that is mainly the responsibility of airlines gathered 17 points on average. The airlines, the individual experts and the government bodies gave most of the points to this category. Monitoring, Reporting and Verification (MRV) gathered 31 points out of 100 making it the costliest procedure for EU ETS.

Consensus was achieved in the abatement measures (Table 50). The replies ranged from 0 to 15 points. The 100% of airlines gave 0-5 points. Moreover, all the participants gave 0-25 points to the trade category. The category of strategy received points ranging from 0-30. 100% of airlines, 25% of CAAs, 75% of individual experts, 80% of government bodies and 83% of IATA experts gave 0-10 points to the strategy category. Only 20% of government bodies and 17% of IATA experts gave 20-30 points.

Table 50: Crosstab Groups and Transaction Cost categories

Statement	Scale 0-100	Airlines (n=6)	ANSPs (n=1)	CAA/NSA (n=4)	Ind. Experts (n=4)	Government Bodies (n=5)	IATA (n=6)
Application	0-9	17%	0%	0%	0%	0%	0%
	10-19	33%	100%	100%	100%	40%	83%
	20-29	33%	0%	0%	0%	60%	17%
	30-39	17%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%

Statement	Scale 0-100	Airlines (n=6)	ANSPs (n=1)	CAA/NSA (n=4)	Ind. Experts (n=4)	Government Bodies (n=5)	IATA (n=6)
	50-59	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Implementation of Emissions Management	0-9	33%	0%	0%	0%	0%	0%
	10-19	33%	0%	0%	50%	40%	0%
	20-29	17%	0%	100%	50%	0%	0%
	30-39	0%	100%	0%	0%	40%	100%
	40-49	0%	0%	0%	0%	20%	0%
	50-59	17%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Monitoring	0-9	17%	0%	0%	0%	20%	67%
	10-19	33%	0%	100%	50%	60%	33%
	20-29	17%	100%	0%	50%	20%	0%
	30-39	0%	0%	0%	0%	0%	0%
	40-49	33%	0%	0%	0%	0%	0%
	50-59	17%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Reporting and verification	0-9	33%	0%	50%	0%	0%	0%
	10-19	33%	100%	50%	50%	20%	33%
	20-29	17%	0%	0%	0%	80%	67%
	30-39	0%	0%	0%	50%	0%	0%
	40-49	17%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Abatement measures	0-9	100%	0%	0%	50%	75%	33%
	10-19	0%	100%	100%	50%	25%	67%
	20-29	0%	0%	0%	0%	0%	0%

Statement	Scale 0-100	Airlines (n=6)	ANSPs (n=1)	CAA/NSA (n=4)	Ind. Experts (n=4)	Government Bodies (n=5)	IATA (n=6)
	30-39	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Trade	0-9	67%	100%	0%	25%	60%	83%
	10-19	33%	0%	0%	50%	20%	17%
	20-29	0%	0%	100%	25%	20%	0%
	30-39	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Strategy	0-9	50%	0%	25%	75%	20%	67%
	10-19	50%	100%	25%	25%	60%	17%
	20-29	0%	0%	0%	0%	20%	0%
	30-39	0%	0%	0%	0%	0%	17%
	40-49	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%
Other	0-9	100%	100%	75%	75%	100%	100%
	10-19	0%	0%	25%	25%	0%	0%
	20-29	0%	0%	0%	0%	0%	0%
	30-39	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%

Regarding the question about how important the transactions costs are for the effective functioning of the aviation inclusion in the EU ETS scheme (Table 51), 33.3% of the airlines, 100% of ANSPs, 75% of individual experts, 80% of CAA/NSAs, 75% of the government bodies and 100% of IATA experts responded that it is an important cost. 16.7% of the airlines stated that TC are very important for the effectiveness of EU ETS.

Table 51: Crosstab Groups and importance of transaction costs

Statement	Scale 1-5	Airlines (n=6)	ANSPs (n=1)	CAA/NSA (n=5)	Ind. Experts (n=4)	Government Bodies (n=4)	IATA (n=6)
Overall, how important do you consider transactions costs to be for the effective functioning of the aviation inclusion in the EU ETS scheme?	1	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	0%
	3	50%	0%	20%	25%	25%	0%
	4	33%	100%	80%	75%	75%	100%
	5	17%	0%	0%	0%	0%	0%

7.2.4.2 Cross tabulation SES (2nd round)

As seen in Table 52, the creation of Single European Sky (SES) and Functional Airspace Blocks (FABs) aim to major reforms of the European airspace management and architecture. The participants reached consensus regarding the areas of improvement. IATA and the European airlines share very similar opinions. The government bodies have some differences with the ANSPs regarding the common ATCO training and research and development. EUROCONTROL and ANSPs have opposite opinions regarding the common flight inspection and the sector design. Nevertheless, on average the participants agreed on the factors.

Table 52: Crosstab Areas benefitted from the establishment of FABs and Groups

Statement	Scale 1-5	Airlines (n=3)	ANSPs (n=4)	CAA/NSA (n=4)	ECTL (n=2)	Ind. Experts (n=5)	Government Bodies (n=3)	IATA (n=5)
Common Routes Network design	1	33%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	0%	0%
	3	67%	25%	25%	50%	0%	33%	20%
	4	0%	50%	50%	50%	80%	67%	40%
	5	0%	25%	25%	0%	20%	0%	40%

Statement	Scale 1-5	Airlines (n=3)	ANSPs (n=4)	CAA/NSA (n=4)	ECTL (n=2)	Ind. Experts (n=5)	Government Bodies (n=3)	IATA (n=5)
Common Sector Design	1	0%	0%	0%	50%	0%	0%	0%
	2	0%	0%	0%	0%	0%	0%	0%
	3	33%	50%	25%	50%	0%	67%	40%
	4	0%	25%	75%	0%	80%	33%	20%
	5	67%	25%	0%	0%	20%	0%	40%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
Common Operational Procedures	1	0%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	0%	20%
	3	0%	0%	25%	50%	20%	33%	0%
	4	33%	75%	75%	0%	60%	67%	40%
	5	67%	25%	0%	50%	20%	0%	40%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
Airspace consolidation	1	33%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	0%	20%
	3	0%	25%	0%	50%	20%	33%	0%
	4	33%	75%	100%	0%	60%	67%	20%
	5	33%	0%	0%	50%	20%	0%	60%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
Synergies in ATFCM	1	0%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	50%	0%	0%	0%
	3	0%	0%	25%	0%	20%	0%	0%
	4	33%	75%	75%	0%	60%	67%	80%
	5	67%	25%	0%	50%	20%	33%	20%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=3)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
Common R&D	1	0%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	50%	0%	67%	20%
	3	33%	100%	67%	0%	80%	33%	60%
	4	33%	0%	33%	50%	0%	0%	0%
	5	33%	0%	0%	0%	20%	0%	20%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
Harmonised ATM system	1	0%	0%	0%	0%	0%	33%	0%
	2	0%	0%	25%	0%	0%	0%	0%
	3	0%	0%	0%	50%	0%	0%	0%
	4	0%	100%	75%	0%	60%	67%	40%
	5	100%	0%	0%	50%	40%	0%	60%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**

Statement	Scale 1-5	Airlines (n=3)	ANSPs (n=4)	CAA/NSA (n=4)	ECTL (n=2)	Ind. Experts (n=5)	Government Bodies (n=3)	IATA (n=5)
Common Procurement	1	0%	0%	0%	50%	0%	0%	0%
	2	0%	25%	50%	0%	0%	67%	40%
	3	67%	25%	0%	0%	80%	0%	40%
	4	0%	50%	50%	50%	0%	33%	20%
	5	33%	0%	0%	0%	20%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
Common AIS & MET	1	33%	0%	0%	0%	0%	33%	0%
	2	33%	25%	50%	50%	20%	33%	0%
	3	0%	25%	0%	0%	40%	0%	40%
	4	33%	50%	50%	0%	20%	33%	40%
	5	0%	0%	0%	50%	20%	0%	20%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
Surveillance Data sharing	1	0%	0%	0%	0%	20%	0%	20%
	2	0%	0%	0%	0%	0%	0%	0%
	3	0%	25%	0%	50%	80%	67%	20%
	4	33%	50%	100%	50%	0%	33%	60%
	5	67%	25%	0%	0%	0%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
Communication Data Sharing	1	0%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	0%	20%
	3	33%	0%	0%	50%	60%	67%	0%
	4	0%	75%	100%	50%	40%	33%	60%
	5	67%	25%	0%	0%	0%	0%	20%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
Sharing of navigation aids	1	33%	0%	0%	0%	0%	0%	20%
	2	67%	0%	25%	0%	0%	0%	0%
	3	0%	50%	25%	100%	100%	67%	40%
	4	0%	50%	50%	0%	0%	33%	40%
	5	0%	0%	0%	0%	0%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
Improved cooperation with Militaries	1	0%	0%	0%	0%	0%	0%	20%
	2	0%	0%	0%	50%	20%	33%	0%
	3	33%	25%	25%	0%	40%	0%	20%
	4	33%	50%	75%	0%	40%	0%	40%
	5	33%	25%	0%	50%	0%	67%	20%

Statement	Scale 1-5	Airlines (n=3)	ANSPs (n=4)	CAA/NSA (n=4)	ECTL (n=1)	Ind. Experts (n=5)	Government Bodies (n=3)	IATA (n=5)
Common Flight Inspection	1	0%	0%	0%	100%	0%	0%	0%
	2	33%	50%	25%	0%	20%	0%	20%
	3	67%	50%	50%	0%	60%	100%	80%
	4	0%	0%	25%	0%	0%	0%	0%
	5	0%	0%	0%	0%	20%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
Common Safety Management System	1	0%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	100%	0%	0%	20%
	3	67%	0%	25%	0%	40%	0%	20%
	4	0%	75%	75%	0%	60%	67%	40%
	5	33%	25%	0%	0%	0%	33%	20%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
Common ATCO Training	1	0%	0%	0%	0%	0%	0%	0%
	2	33%	25%	0%	0%	0%	0%	20%
	3	33%	50%	50%	50%	80%	0%	20%
	4	0%	25%	50%	50%	20%	67%	60%
	5	33%	0%	0%	0%	0%	33%	0%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=4)**	**Government Bodies (n=3)**	**IATA (n=5)**
Reduction of emissions	1	0%	0%	0%	0%	0%	0%	0%
	2	0%	25%	0%	50%	0%	0%	0%
	3	33%	0%	25%	0%	0%	0%	20%
	4	0%	50%	50%	0%	100%	100%	20%
	5	67%	25%	25%	50%	0%	0%	60%
Statement	**Scale 1-5**	**Airlines (n=0)**	**ANSPs (n=0)**	**CAA/NSA (n=1)**	**ECTL (n=0)**	**Ind. Experts (n=2)**	**Government Bodies (n=1)**	**IATA (n=1)**
Other	1	0%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	0%	0%
	3	0%	0%	100%	0%	100%	0%	0%
	4	0%	0%	0%	0%	0%	0%	100%
	5	0%	0%	0%	0%	0%	100%	0%

The environmental performance is correlated to Air Traffic Management. Table 53 lists the replies of 28 experts to 9 statements regarding SES and the environment. Surprisingly, 25% of airlines totally agreed with the statement that the airspace before SES did not need to be changed. The replies in this statement are in line with the replies to the 'The reorganisation of the European Sky was necessary' statement. The flight efficiency can be improved by optimal flight distances, i.e. horizontal component, and/or by optimal flight level, i.e. vertical component. One airline representative mentioned that the technological advances of airplanes are such that the airplanes can flight higher but are limited by ICAO standards. An ATCO mentioned that for capacity reasons the flight levels are altered by ATCOs. With respect to vertical and horizontal efficiency only 25% of CAAs and 20% of IATA experts expressed a positive opinion to that statement.

Moreover, most of the participants also agreed that due to capacity and safety requirements the inefficiencies cannot be reduced to zero at system level (Table 53). Only 25% of airlines, 33% of government bodies and 20% of IATA experts disagreed with the safety statement. The capacity requirements gathered more negative replies. Apart from the above mentioned participants, 50% of EUROCONTROL experts, 25% of ANSPs and an additional 33% of government bodies suggest that despite capacity requirements the level of inefficiencies can be reduced to zero at system level.

The 28 participants shared different opinions regarding the statement 'The main environmental KPI should be the estimated economic value of CO_2 emissions due to route extension'. Route extension may be caused by airspace congestion or restrictions. Airlines, CAAs, individual experts, government bodies and IATA had diverse opinions within their groups and among the groups. This is the case for the FABs and great cycle routes. It should be noted that on many occasions the Great Distance Circle may not be flown many times due to bad weather conditions that restrict the use of the airspace. Nevertheless, regarding the statement 'The European airspace network today can benefit from a significant level of dynamism through the application of the Flexible Use of Airspace (FUA) concept' the groups reached consensus towards a positive opinion with the exception of airlines representatives that kept a negative position.

Table 53: Crosstab Position of participants on SES and the environment and Groups

Statement	Scale 1-5	Airlines (n=4)	ANSPs (n=4)	CAA/NSA (n=4)	ECTL (n=2)	Ind. Experts (n=6)	Government Bodies (n=3)	IATA (n=5)
The airspace before SES did not need to be changed.	1	50%	25%	0%	50%	50%	33%	80%
	2	25%	75%	50%	50%	50%	33%	20%
	3	0%	0%	50%	0%	0%	33%	0%
	4	0%	0%	0%	0%	0%	0%	0%
	5	25%	0%	0%	0%	0%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**
FABs bring routes closer to the optimum “Great Circle” route and reduce extended flight paths.	1	25%	0%	0%	0%	0%	0%	0%
	2	25%	0%	0%	50%	0%	0%	20%
	3	25%	0%	25%	50%	40%	33%	20%
	4	25%	75%	50%	0%	60%	33%	60%
	5	0%	25%	25%	0%	0%	33%	0%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**
The European airspace network today can benefit from a significant level of dynamism through the application of the Flexible Use of Airspace (FUA) concept.	1	33%	0%	0%	0%	0%	0%	0%
	2	67%	0%	0%	0%	0%	0%	0%
	3	0%	0%	25%	0%	17%	33%	20%
	4	0%	75%	75%	50%	67%	33%	60%
	5	0%	25%	0%	50%	17%	33%	20%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**
The reorganisation of the European Sky was necessary.	1	25%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	0%	0%
	3	25%	25%	25%	0%	0%	0%	20%
	4	0%	25%	50%	100%	67%	33%	0%
	5	50%	50%	25%	0%	33%	67%	80%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**
The horizontal component is of higher economic and environmental importance than the vertical component of the Flight efficiency.	1	50%	0%	0%	50%	0%	33%	20%
	2	25%	50%	0%	0%	33%	0%	0%
	3	25%	50%	75%	50%	67%	67%	60%
	4	0%	0%	25%	0%	0%	0%	20%
	5	0%	0%	0%	0%	0%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**

Statement	Scale 1-5	Airlines (n=4)	ANSPs (n=4)	CAA/NSA (n=4)	ECTL (n=2)	Ind. Experts (n=6)	Government Bodies (n=3)	IATA (n=5)
Due to inherent safety (minimum separation requirements between aircraft) requirements, the level of “inefficiencies” cannot be reduced to zero at system level.	1	25%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	33%	20%
	3	25%	25%	25%	0%	50%	0%	0%
	4	25%	75%	75%	0%	50%	33%	40%
	5	25%	0%	0%	100%	0%	33%	40%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**
Due to capacity (organisation of traffic flows) requirements, the level of “inefficiencies” cannot be reduced to zero at system level.	1	25%	0%	0%	0%	0%	33%	0%
	2	0%	25%	0%	50%	0%	33%	20%
	3	25%	0%	25%	0%	33%	33%	20%
	4	25%	75%	50%	0%	50%	0%	40%
	5	25%	0%	25%	50%	17%	0%	20%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
The main environmental KPI should be the estimated economic value of CO_2 emissions due to route extension.	1	50%	0%	25%	50%	0%	0%	20%
	2	0%	0%	25%	0%	40%	33%	0%
	3	0%	50%	25%	50%	0%	33%	20%
	4	50%	50%	25%	0%	40%	33%	60%
	5	0%	0%	0%	0%	20%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=4)**	**Government Bodies (n=3)**	**IATA (n=5)**
All FABs are fully operational.	1	75%	25%	25%	50%	25%	0%	20%
	2	0%	75%	75%	50%	50%	33%	80%
	3	25%	0%	0%	0%	25%	33%	0%
	4	0%	0%	0%	0%	0%	0%	0%
	5	0%	0%	0%	0%	0%	33%	0%

The participants were provided with some factors affecting the horizontal en route flight efficiency. The most important factor in terms of the mean (mean=27.52) is the route structure and availability. The SES reform aims at improving this factor. The range of the points given was 5-50 and received an average value of 27.52 points out of 100. According to Table 54, 33% of airlines, 25% of ANSPs, 33% of CAAs, 50% of individual experts, 66% of government bodies gave 0-20 points. EUROCONTROL experts and

ANSPs that are the ones responsible for the route structure and availability gave 30-50 points.

The second most important factor (mean=17.83) is the utilisation of civil military structures. 33% of airlines, 25% of ANSPs, 50% of EUROCONTROL experts, 33% of government bodies and 20% of IATA experts gave 25-40 points. This element affects the route structure and availability factor. The good flight planning factor was higher evaluated by the non-airlines related experts. The Operational Control Centres (OCC) of airlines invest a lot of time to design their flights in the most efficient way focusing on the fleet availability and scheduling issues, therefore the environmental aspect is put aside in this part. The remaining of the factors received less than 10 points on average and there was consensus among the participants.

Table 54: Crosstabs Factors affecting horizontal en route flight efficiency and Groups

Statement	Scale 0-100	Airlines (n=3)	ANSPs (n=4	CAA/NSA (n=3)	ECTL (n=2)	Ind. Experts (n=4)	Government Bodies (n=3)	IATA (n=5)
Route structure and availability affect horizontal en route flight efficiency.	0-9	0%	0%	0%	0%	0%	33%	0%
	10-19	33%	25%	33%	0%	50%	33%	0%
	20-29	0%	25%	33%	0%	25%	33%	60%
	30-39	33%	50%	0%	50%	50%	33%	20%
	40-49	33%	25%	33%	0%	0%	0%	20%
	50-59	0%	0%	0%	50%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Availability of airspace (utilisation of civil military structures) affects horizontal en route flight efficiency.	0-9	33%	0%	33%	0%	0%	33%	0%
	10-19	33%	0%	33%	50%	0%	0%	60%
	20-29	33%	75%	33%	50%	50%	33%	20%
	30-39	0%	25%	0%	0%	0%	33%	0%
	40-49	0%	0%	0%	0%	0%	0%	20%
	50-59	0%	0%	0%	0%	0%	0%	20%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%

Statement	Scale 0-100	Airlines (n=3)	ANSPs (n=4	CAA/NSA (n=3)	ECTL (n=2)	Ind. Experts (n=4)	Government Bodies (n=3)	IATA (n=5)
Flight planning capabilities (use of software, repetitive flight planning) affect horizontal en route flight efficiency.	0-9	33%	0%	33%	0%	0%	0%	0%
	10-19	66%	50%	33%	50%	50%	33%	80%
	20-29	0%	50%	33%	50%	50%	67%	20%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
User preferences regarding time affect horizontal en route flight efficiency.	0-9	67%	50%	66%	50%	0%	67%	40%
	10-19	33%	50%	0%	50%	100%	33%	40%
	20-29	0%	0%	33%	0%	0%	0%	20%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
User preferences regarding fuel affect horizontal en route flight efficiency.	0-9	67%	25%	33%	50%	0%	66%	40%
	10-19	33%	75%	33%	5%	75%	0%	60%
	20-29	0%	0%	33%	0%	25%	0%	0%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	33%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Tactical ATC routings affect horizontal en route flight efficiency.	0-9	33%	25%	33%	50%	0%	33%	0%
	10-19	66%	75%	66%	50%	100%	0%	100%
	20-29	0%	0%	0%	0%	0%	67%	0%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Special events such as	0-9	33%	50%	67%	50%	50%	67%	40%

Statement	Scale 0-100	Airlines (n=3)	ANSPs (n=4	CAA/NSA (n=3)	ECTL (n=2)	Ind. Experts (n=4)	Government Bodies (n=3)	IATA (n=5)
ATC strikes affect horizontal en route flight efficiency.	10-19	66%	50%	33%	50%	50%	0%	60%
	20-29	0%	0%	0%	0%	0%	33%	0%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Other	0-9	33%	100%	100%	100%	100%	100%	100%
	10-19	33%	0%	0%	0%	0%	0%	0%
	20-29	33%	0%	0%	0%	0%	0%	0%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%

The reserved airspace for the military was foe many years a controversial topic of discussions for capacity issues. Undoubtedly, the cooperation of Civil and Military dimensions of aviation should be enhanced. The participants were asked to rank hierarchically the factors given by the researcher and to add any factor they deem important. The 26 experts shared 100 points and did not reach consensus within the group or among the groups (Table 55).

The political issues factor received on average 43 points. The points ranged from 0-100. 33% of airlines, 25% of CAAs, 100% of EUROCONTROL experts, 20% of individual experts and 33% of governmental bodies shared 0-10 points in this factor. 50% of ANSPs, 50% of CAAs, 20% of individual experts, 33% of airlines, 33% government bodies and 60% of IATA experts gave 30-45 points. 50% of ANSPs, 40% of individual experts and 40% of IATA experts gave to the political issues factor 50-70 points, whereas 33% of airlines and government bodies gave 80 points. 25% of individual experts gave 90 points and 20% of individual experts gave the maximum possible, i.e. 100 points to the political issues factor. The most important opinions are those of the ANSPs, the CAAs, EUROCONTROL and the government bodies (that include the Ministries of Transport). Those participants had diverse opinions on this factor. The flight planning capabilities, the special events, the ICAO ATM procedures, the position of information and radar vectoring had on average 10 points out of the 100. Those factors received 0-50 points and did not reach consensus within their group.

Five participants added a factor. One EUROCONTROL expert gave 40 points to Other Airspace management and route structure. One expert representing government bodies gave all the points, i.e. 100 points to the ‘Existing agreements and procedures at national level on one side, and on FAB level at the other side’. An individual expert gave 10 points to ‘Airline fleet modernization and equipment availability and rules and regulations of aircraft registering State’. An airline representative gave 100 points to the ‘Overall flight efficiency’. Lastly, one IATA expert representative gave 20 point to the communications of military airspace availability. The expert mentioned that many times that the military airspace is open e.g. on weekends, the flight planners and pilots are not aware of that route options. This is supported by the literature review regarding the use of Conditional Routes. Figure 25 in the Single European Sky chapter illustrated that many times despite that the CDRs are available, the airspace users do not take advantage of it.

Table 55: Crosstabs Factors affecting the Civil Military cooperation and Groups

Statement	Scale 0-100	Airlines (n=3)	ANSPs (n=4	CAA/NSA (n=4)	ECTL (n=2)	Ind. Experts (n=5)	Government Bodies (n=3)	IATA (n=5)
Political issues	0-9	33%	0%	0%	0%	0%	33%	0%
	10-19	0%	0%	25%	100%	20%	0%	0%
	20-29	0%	0%	0%	0%	0%	0%	0%
	30-39	0%	0%	25%	0%	20%	0%	20%
	40-49	33%	50%	25%	0%	0%	33%	40%

Statement	Scale 0-100	Airlines (n=3)	ANSPs (n=4	CAA/NSA (n=4)	ECTL (n=2)	Ind. Experts (n=5)	Government Bodies (n=3)	IATA (n=5)
	50-59	0%	0%	0%	0%	20%	0%	20%
	60-69	0%	50%	0%	0%	20%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	20%
	80-89	33%	0%	0%	0%	0%	33%	0%
	90-100	0%	0%	25%	0%	20%	0%	0%
Flight planning capabilities (use of software, repetitive flight planning)	0-9	66%	0%	25%	0%	20%	66%	20%
	10-19	33%	50%	50%	0%	40%	0%	80%
	20-29	0%	25%	25%	50%	40%	33%	0%
	30-39	0%	25%	0%	50%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Special events	0-9	67%	25%	25%	50%	20%	66%	20%
	10-19	0%	75%	25%	0%	80%	33%	60%
	20-29	0%	0%	0%	0%	0%	0%	0%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	33%	0%	25%	0%	0%	0%	0%
	50-59	0%	0%	25%	50%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Existing ICAO ATM procedures	0-9	67%	50%	50%	50%	20%	66%	20%
	10-19	33%	50%	50%	50%	60%	33%	40%
	20-29	0%	0%	0%	0%	20%	0%	20%
	30-39	0%	0%	0%	0%	0%	0%	20%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Aspects related to position information and radar vectoring	0-9	100%	25%	50%	0%	20%	66%	0%
	10-19	0%	75%	50%	50%	60%	33%	80%
	20-29	0%	0%	0%	50%	20%	0%	00%
	30-39	0%	0%	0%	0%	0%	0%	20%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%

Statement	Scale 0-100	Airlines (n=3)	ANSPs (n=4	CAA/NSA (n=4)	ECTL (n=2)	Ind. Experts (n=5)	Government Bodies (n=3)	IATA (n=5)
	90-100	0%	0%	0%	0%	0%	0%	0%
Other	0-9	67%	75%	75%	50%	60%	33%	60%
	10-19	0%	25%	25%	0%	40%	33%	40%
	20-29	0%	0%	0%	0%	0%	0%	0%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	50%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	33%	0%	0%	0%	0%	33%	0%

The literature on environmental protection shows a variety of approached for emissions reduction. The 28 participants were given a list of factor that according to the literature contribute to the reduction of CO_2 emissions (Table 56). The FUA and FRA reached consensus among the participants with only one individual experts disagree with the statement. The shortest feasible routes and the CDOs (that is mostly contributing to the local air quality) reached consensus. The factor ‘use of biofuels’ had a low CV (0.32) which means that consensus was reached across all the experts. Nevertheless, within the group of airlines, CAAs, IATA and government bodies there were different opinions expressed by the experts. Moreover, one EUROCONTROL expert questioned the use of eco-friendly engines contribution emissions reduction. In addition, one expert of IATA suggested that the load factors are improved to the maximum and there is no area of improvement in this factor. Someone, could argue that the replacement of small airplanes with bigger airplanes could improve the emissions per Revenue Passenger Kilometre (RPK).

The factor ‘reduced traffic due to economic crisis’ gathered different replies (Table 56). Despite the economic crisis the Air Transport Movements (ATM) have not decreased in reality. Nevertheless, should the ATM decrease the emissions will be decreased too. The trading of emissions, both Certified Emissions Reductions (CERs) and Verified Emissions Reductions (VERs), gathered many negative opinions. Only 33% of individual experts, 50% of EUROCONTROL experts and 33% of government bodies expressed a positive opinion to CERs. As far as VERs is concerned only 60% of individual experts suggested that could contribute to emissions reductions.

It is quite interesting that some airline (33%) and IATA (20%) experts that do not believe that offsetting schemes developed by airlines can reduce emissions. The government bodies kept a neutral position regarding this. Likewise, some experts do not believe that ETS can lead to emissions reduction. But there are also others that agree to the statements. There was no consensus among the experts regarding the offsetting and emission trading schemes. In addition, 50% of airlines did not believe that SES can contribute to emissions reduction. The airlines had a totally different opinion than IATA in this factor. A participant added the factor Airlines Fuel Saving Policy / System which can indeed reduce the fuel consumption. The fleet renewal can improve the fuel consumption hence the emissions. Finally, one expert commented that the complementarity of the measures could have a more positive effect to environmental performance.

The findings were quite unexpected regarding some of the statements. The most likely explanation of the negative opinions regarding some of the statements is that the participants wanted to make a point on the limitations of the measure or the unmatched expectations about their implementation.

Table 56: Crosstab Factors contributing to emissions' reduction and Groups

Statement	Scale 1-5	Airlines (n=4)	ANSPs (n=4)	CAA/NSA (n=4)	ECTL (n=2)	Ind. Experts (n=6)	Government Bodies (n=3)	IATA (n=5)
Flexible Use of Airspace	1	0%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	17%	0%	0%
	3	25%	0%	0%	0%	17%	0%	0%
	4	50%	50%	100%	50%	50%	33%	60%
	5	25%	50%	0%	50%	17%	67%	40%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
Free Route Airspace	1	0%	0%	0%	0%	0%	0%	0%

	2	0%	0%	0%	0%	20%	0%	0%
	3	25%	0%	0%	0%	20%	0%	0%
	4	75%	50%	100%	50%	40%	33%	80%
	5	0%	50%	0%	50%	20%	67%	20%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=1)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**
Shortest feasible routes	1	0%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	0%	0%
	3	25%	0%	0%	0%	0%	0%	40%
	4	50%	75%	50%	100%	50%	33%	20%
	5	25%	25%	50%	0%	50%	67%	40%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**
Implementing continuous descent approaches	1	0%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	0%	0%
	3	25%	0%	50%	0%	17%	33%	0%
	4	25%	75%	50%	100%	50%	0%	60%
	5	50%	25%	0%	0%	33%	67%	40%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**
Use of Bio fuels	1	25%	0%	25%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	33%	20%
	3	25%	75%	50%	0%	0%	33%	20%
	4	25%	25%	25%	50%	67%	33%	20%
	5	25%	0%	0%	50%	33%	0%	40%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**
Use of Eco-friendly engines	1	0%	0%	0%	50%	0%	0%	0%
	3	25%	25%	25%	0%	0%	0%	0%
	4	0%	50%	50%	50%	67%	67%	60%
	5	75%	25%	25%	0%	33%	33%	40%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**
Improving load factors	1	0%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	0%	20%
	3	0%	75%	75%	0%	33%	33%	40%
	4	50%	25%	25%	100%	33%	67%	40%
	5	50%	0%	0%	0%	33%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**
Reduced traffic because of economic crisis	1	25%	0%	0%	0%	0%	0%	0%
	2	25%	25%	0%	0%	33%	0%	0%
	3	0%	0%	25%	50%	17%	33%	80%
	4	25%	75%	75%	50%	33%	33%	20%
	5	25%	0%	0%	0%	17%	33%	0%

Statement	Scale 1-5	Airlines (n=3)	ANSPs (n=4)	CAA/NSA (n=4)	ECTL (n=2)	Ind. Experts (n=6)	Government Bodies (n=3)	IATA (n=5)
Trading Certified Emissions Reductions (CERs)	1	67%	0%	25%	0%	0%	0%	0%
	2	33%	0%	0%	0%	50%	0%	40%
	3	0%	100%	75%	50%	17%	67%	60%
	4	0%	0%	0%	0%	33%	0%	0%
	5	0%	0%	0%	50%	0%	33%	0%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=5)**	**Government Bodies (n=3)**	**IATA (n=5)**
Trading Verified or Voluntary Emissions Reductions (VERs)	1	67%	0%	25%	0%	0%	0%	0%
	2	33%	0%	0%	0%	20%	33%	60%
	3	0%	100%	75%	100%	20%	67%	40%
	4	0%	0%	0%	0%	60%	0%	0%
	5	0%	0%	0%	0%	0%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=3)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**
Airlines develop offsetting programs	1	0%	0%	0%	0%	17%	0%	20%
	2	33%	25%	0%	0%	17%	0%	0%
	3	33%	50%	50%	50%	0%	100%	20%
	4	0%	25%	50%	50%	50%	0%	60%
	5	33%	0%	0%	0%	17%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**
EU Emissions Trading Scheme	1	50%	0%	25%	0%	0%	0%	0%
	2	25%	25%	0%	0%	0%	0%	40%
	3	25%	75%	25%	50%	67%	67%	40%
	4	0%	0%	50%	0%	33%	33%	20%
	5	0%	0%	0%	50%	0%	0%	0%
Statement	**Scale 1-5**	**Airlines (n=4)**	**ANSPs (n=4)**	**CAA/NSA (n=4)**	**ECTL (n=2)**	**Ind. Experts (n=6)**	**Government Bodies (n=3)**	**IATA (n=5)**
Single European Sky	1	25%	0%	0%	0%	0%	0%	0%
	2	25%	0%	0%	0%	0%	0%	0%
	3	0%	25%	50%	50%	17%	33%	0%
	4	50%	75%	50%	0%	67%	67%	20%
	5	0%	0%	0%	50%	17%	0%	80%
Statement	**Scale 1-5**	**Airlines (n=1)**	**ANSPs (n=0)**	**CAA/NSA (n=0)**	**ECTL (n=0)**	**Ind. Experts (n=0)**	**Government Bodies (n=0)**	**IATA (n=2)**
Other	1	0%	0%	0%	0%	0%	0%	0%
	2	0%	0%	0%	0%	0%	0%	0%
	3	0%	0%	0%	0%	0%	0%	0%
	4	0%	0%	0%	0%	0%	0%	0%
	5	100%	0%	0%	0%	0%	0%	100%
Statement	**Scale 1-5**	**Airlines (n=0)**	**ANSPs (n=0)**	**CAA/NSA (n=0)**	**ECTL (n=0)**	**Ind. Experts (n=0)**	**Government Bodies (n=0)**	**IATA (n=1)**
Other	1	0%	0%	0%	0%	0%	0%	0%

	2	0%	0%	0%	0%	0%	0%	0%
	3	0%	0%	0%	0%	0%	0%	0%
	4	0%	0%	0%	0%	0%	0%	0%
	5	0%	0%	0%	0%	0%	0%	100%

The question that its replies are illustrated in Table 57 is the same question as the one in the SES questionnaire and refers to the different ways the carbon neutral growth can be achieved. 66% of airlines, 25% of individual the experts and ANSPs, 50% of EUROCONTROL experts, 60% of IATA experts and 33% of CAAs gave 0-10 points to the EU ETS. 50% of ANSPs, 33% of airlines, 67% of CAA/NSAs, 75% of individual experts and the 100% of government bodies gave 15-25 points to EU ETS. 25% of ANSPs, 50% of EUROCONTROL experts and 40% of IATA experts believe that the EU ETS contributes to carbon neutral growth by 30-40 points. The EU ETS received 18 points on average.

Regarding the individual carbon offsetting programs from airlines the 24 experts gave 16 points on average. 66% of airlines, 75% of ANSPs, 100% of CAAs, 100% of EUROCONTROL experts, 50% of individual experts, the 335 of government bodies and 100% of IATA experts gave 0-20 points. The remaining 33% of airlines, 25% of ANSPs, 50% of individual experts and 66% of government bodies gave 25-40 points (Table 57). The individual carbon offsetting programs from states received less points, with minimum 0 and maximum only 25 points. The airlines and IATA reached consensus in this question. Some induvial experts and ANSPs trust the states more than the governmental bodies and the CAAs that would be the ones responsible should state carbon offsetting schemes be implemented by states. The carbon offsetting schemes gathered on average 26 points out of 100.

The horizontal flight efficiency factor gathered on average 48 points out of 100. Some experts of the CAAs (33%) proved to be the biggest supporters of operational changes giving to the direct routes factor 30 points, whereas the FRA factor received 50 points. The airlines gave more factors to wind optimal routes, FUA and FRA than to direct routes. Yet IATA gave less points to FRA.

The participants added two more factors to the list. The additional factors that were proposed by more than one experts are the alternative fuels and the fleet renewal. Apart from those, the vertical flight efficiency and the Global market-based mechanism as collective programme by States were added. The additional factors gathered on average 8 points.

Table 57: Crosstab Factors leading to carbon neutral growth and Groups

Statement	Scale 0-100	Airlines (n=3)	ANSPs (n=4	CAA/NSA (n=3)	ECTL (n=2)	Ind. Experts (n=4)	Government Bodies (n=3)	IATA (n=5)
The EU ETS leads to carbon neutral growth.	0-9	66%	0%	33%	0%	25%	0%	20%
	10-19	0%	50%	0%	50%	0%	0%	40%
	20-29	33%	25%	67%	0%	75%	100%	0%
	30-39	0%	25%	0%	0%	0%	0%	20%
	40-49	0%	0%	0%	50%	0%	0%	20%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Individual carbon offsetting programs from airlines lead to carbon neutral growth.	0-9	33%	0%	33%	0%	0%	0%	40%
	10-19	0%	75%	67%	100%	50%	33%	60%
	20-29	33%	25%	0%	0%	50%	33%	0%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	33%	0%	0%	0%	0%	33%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Individual carbon offsetting programmes from states lead to carbon neutral growth.	0-9	100%	0%	33%	0%	25%	33%	60%
	10-19	0%	75%	67%	100%	50%	33%	40%
	20-29	0%	25%	0%	0%	25%	33%	0%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%

Statement	Scale 0-100	Airlines (n=3)	ANSPs (n=4	CAA/NSA (n=3)	ECTL (n=2)	Ind. Experts (n=4)	Government Bodies (n=3)	IATA (n=5)
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Direct routes lead to carbon neutral growth	0-9	66%	25%	0%	0%	50%	33%	20%
	10-19	33%	50%	66%	100%	50%	67%	40%
	20-29	0%	25%	0%	0%	0%	0%	40%
	30-39	0%	0%	33%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Wind optimal routes lead to carbon neutral growth	0-9	0%	25%	33%	0%	50%	67%	20%
	10-19	33%	75%	67%	50%	50%	33%	40%
	20-29	33%	0%	0%	50%	0%	0%	40%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	33%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Flexible Use of Airspace (FUA) leads to carbon neutral growth	0-9	0%	25%	0%	0%	50%	33%	20%
	10-19	100%	50%	100%	100%	50%	66%	60%
	20-29	0%	25%	0%	0%	0%	0%	20%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Free Route Airspace (FRA) leads to carbon neutral growth	0-9	0%	25%	0%	0%	50%	33%	60%
	10-19	100%	50%	66%	50%	50%	33%	20%
	20-29	0%	25%	0%	50%	0%	33%	20%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	33%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	20%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Other	0-9	67%	100%	100%	100%	50%	67%	60%
	10-19	0%	0%	0%	0%	25%	0%	20%

Statement	Scale 0-100	Airlines (n=3)	ANSPs (n=4	CAA/NSA (n=3)	ECTL (n=2)	Ind. Experts (n=4)	Government Bodies (n=3)	IATA (n=5)
	20-29	33%	0%	0%	0%	25%	33%	0%
	30-39	0%	0%	0%	0%	0%	0%	20%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Other	0-9	67%	100%	100%	100%	100%	100%	80%
	10-19	0%	0%	0%	0%	0%	0%	0%
	20-29	33%	0%	0%	0%	0%	0%	0%
	30-39	0%	0%	0%	0%	0%	0%	20%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%

The new question about TCE was answered by 24 participants (Table 58). The most important category of transaction costs was the ‘Development and Implementation of the regulatory scheme’ with 27 points on average. This category did not reach consensus among the participants. 100% of airlines, 25% of CAAs, 75% of individual experts and 20% of IATA experts gave 10-20 points to this category, whereas 100% of government bodies gave 25-30 points, 80% of IATA experts gave 25-35 points, 75% of CAA gave 30-40 points and 100% of ANSPs gave 30-45 out of 100 points.

The monitoring category gathered on average 18 points. Most of the participants gave less than 20 points with the exception of 67% of airlines that gave 45 points, 33% of ANSPS giving 30 points and 25% of individual experts that gave more than 50 points to this category. The reporting and verification category gathered less points (mean=13). Almost all the participants gave 10 point to this category. The most points (35) were given by 25% of individual experts. This category reached consensus by the experts. The compliance category with mean equal to 9 reached also consensus among the experts.

The ‘alternative policies’ category received 0 to 20 points and there was consensus among the respected experts. On the other hand, the category ‘strategy’ gathered on average 18 points out of 100 but the expert did not agree on its value. This category received 5-60 points. All the participants gave less than 30 points to this category, apart from 33% of airlines that gave 60 points. Nevertheless, there was consensus within the groups but not across the groups. Out of the 24, 5 participants added an additional category. This category received 5-15 points. The participants did not add any further details.

Table 58: Crosstab Transaction Costs in SES and Groups

Statement	Scale 0-100	Airlines (n=3)	ANSPs (n=4	CAA/NSA (n=3)	ECTL (n=2)	Individual Experts (n=4)	Government Bodies (n=3)	IATA (n=5)
Alternative Policies	0-9	33%	100%	0%	0%	25%	0%	0%
	10-19	67%	0%	100%	50%	50%	67%	80%
	20-29	0%	0%	0%	50%	25%	33%	20%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Development and Implementation of the regulatory scheme	0-9	0%	0%	0%	0%	0%	0%	0%
	10-19	100%	0%	0%	0%	50%	0%	0%
	20-29	0%	0%	25%	50%	50%	33%	40%
	30-39	0%	33%	50%	0%	0%	67%	60%
	40-49	0%	66%	25%	50%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Monitoring	0-9	0%	0%	0%	0%	0%	0%	0%
	10-19	33%	0%	75%	100%	25%	33%	100%
	20-29	0%	67%	25%	0%	75%	67%	0%
	30-39	0%	33%	0%	0%	0%	0%	0%
	40-49	67%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	25%	0%	25%	0%	20%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%

Statement	Scale 0-100	Airlines (n=3)	ANSPs (n=4	CAA/NSA (n=3)	ECTL (n=2)	Individual Experts (n=4)	Government Bodies (n=3)	IATA (n=5)
	90-100	0%	0%	0%	0%	0%	0%	0%
Reporting and verification	0-9	0%	0%	0%	0%	0%	0%	0%
	10-19	100%	100%	100%	100%	75%	66%	60%
	20-29	0%	0%	0%	0%	0%	33%	40%
	30-39	0%	0%	0%	0%	25%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Compliance	0-9	0%	100%	0%	0%	0%	0%	40%
	10-19	33%	0%	100%	100%	100%	100%	60%
	20-29	0%	0%	0%	0%	0%	0%	0%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Strategy	0-9	0%	33%	25%	0%	0%	0%	0%
	10-19	67%	0%	50%	0%	50%	67%	60%
	20-29	0%	33%	25%	100%	50%	33%	40%
	30-39	0%	33%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	33%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%
Other	0-9	100%	100%	75%	100%	100%	100%	60%
	10-19	0%	0%	25%	0%	0%	0%	40%
	20-29	0%	0%	0%	0%	0%	0%	0%
	30-39	0%	0%	0%	0%	0%	0%	0%
	40-49	0%	0%	0%	0%	0%	0%	0%
	50-59	0%	0%	0%	0%	0%	0%	0%
	60-69	0%	0%	0%	0%	0%	0%	0%
	70-79	0%	0%	0%	0%	0%	0%	0%
	80-89	0%	0%	0%	0%	0%	0%	0%
	90-100	0%	0%	0%	0%	0%	0%	0%

Regarding the transaction costs in SES the participants in the question 'Overall, how important do you consider transactions costs to be for the effective functioning of the environment KPA in the SES Performance scheme?' reported that this cost is important. 67% of airlines, 67% of ANSPs, 75% of CAA/NSAs, 50% of EUROCONTROL experts, 50% of individual experts, 67% of government bodies and 40% of IATA experts stated that is an important cost for the effectiveness of SES performance scheme. 20% of IATA experts, 33% of government bodies and 50% of EUROCONTROL experts marked it as a very important parameter.

7.3 Summary

The questionnaires developed after consultation with key aviation professionals proved effective for the purpose of the present research. With few exceptions, the participants seem to have comprehended the questions and did not add other factors or. From the Delphi research that has been carried out in two rounds from May 2014 until May 2016, it may be deduced that the experts identified some key issues affecting the efficiency of the EU ETS and SES reforms. The majority of the participants agreed that reorganization of the airspace and the implementation of the SES were necessary. Moreover, the participants agreed that the implementation of the SES is quite slow. The different components of SES were evaluated and the added value of SES and FABs was verified.

As far as the inclusion of aviation to the EU ETS is concerned, the participants agreed that the EU ETS contributes towards the reduction of aviation emissions. Concerns were expressed regarding the technical terms and conditions of EU ETS. Nevertheless, all the participants agreed that the carbon neutral growth cannot be achieved only via EU ETS. Factors such as flight efficiency were highly prioritized. This was also the result that emerged from the SES questionnaires.

Stability and consensus were achieved in most of the factors both within the group but also among the groups for both questionnaires. Summing up the results from the Delphi method, it may be concluded that there is no single factor leading to carbon neutral growth, albeit a combination. The factors that contribute to carbon neutral growth in the aviation sector are the EU ETS and carbon-offsetting scheme, flight efficiency, technological fleet improvements and the use of alternative fuels.

The addition of the question regarding the transaction cost categories of the EU ETS and SES reforms in to the Delphi second round proved very wise because the participants' replies offered valuable information. All the participants in both questionnaires agreed that transactions costs occur due to the implemented reforms. Different importance factors were given to the different categories. As far the EU ETS is concerned, the most important categories were the implementation of emissions management and the monitoring, reporting and verification of allowances. As far as the SES is concerned, the most important transaction cost categories were the development and implementation of the regulatory scheme, the monitoring of the scheme and the strategy of the scheme.

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8 Discussion

This section analyses the aviation environment stakeholders and the dynamics in relation to Single European Sky and European Union Emissions Trading Scheme as captured from the participant observation, the unstructured interviews and the Delphi Method. In this chapter, the results from the primary research, i.e. the participant observation, the unstructured interviews and the Delphi Method, enriched with any other necessary information are combined, analysed and discussed.

It is evident that most schemes are not delivering to the degree to which they should. For instance, the horizontal en-route flight efficiency (shorter routes) of the last filed flight plan trajectory improved slightly in 2013, but this was not enough to meet the target profile. The results from 2014 (4.9%), measured in deviations of the flight plan trajectory from the great circle distance and summed over all IFR (instrument flights rules) in the European Union, indicate that the RP1 target of 4.67% was not achieved.

8.1 Aviation Governance

Governance is the process by which decisions are implemented or not implemented. Governance in Europe is multi-level where 'supranational, national, regional, and local governments are enmeshed in territorially overarching policy networks' (Marks, 1993: 402). There is a growing interdependence between governments operating at different territorial levels. This makes the arrangements complex for taking decisions in increasingly dense networks of public and private, individual and collective actors. In the aviation industry mainly due to its international nature, governance is a very important element. In addition to the multi-level aviation governance, there is also multi-stakeholder governance which is the approach followed in this PhD thesis. The multi-stakeholder governance approach considers the different states as stakeholders. The main issues that are important with respect to EU ETS and SES reforms are the readiness of the states, the incentive mechanism (associated with the willingness to take action) and the trade-offs between the different areas. Governance has emerged as an approach to understanding the dynamic inter-relationship within and between different levels and groups of stakeholders.

8.1.1 Member States Readiness

The interviewees N.02, N.05 and N.04 discussed at length the differences in the countries. They mentioned that not all countries are ready for the reforms or at least progress at the same rate as others. This was also noted by the researcher in the participant observation and in the meeting held with the different member states. Not all the states are in the same position neither do they have the capability to deliver results at the same level. To prove that not all the states are the same the Global Competitiveness Report prepared by the World Economic Forum (2015) is used to assess the readiness of each state involved in EU ETS and SES. To undertake structural changes. The examples of Greece and The Netherlands will be used to shed further light in this context.

The Global Competitiveness Report is used because it gives a Growth Competitiveness Index, which is based on three broad components: macroeconomic environment; quality of public institutions; and technology. Within each component are major subcomponents, for example, the macroeconomic environment consists of macroeconomic stability, government waste, and country credit rating. Furthermore, this report gives an insight on the willingness/openness of a country to the reforms by taking into consideration the openness of the economy to trade and finance; the role of the government budget and regulation; the development of financial markets; the quality of infrastructure; the quality of technology; the quality of business management; the labour market flexibility; and the quality of judicial and political institutions.

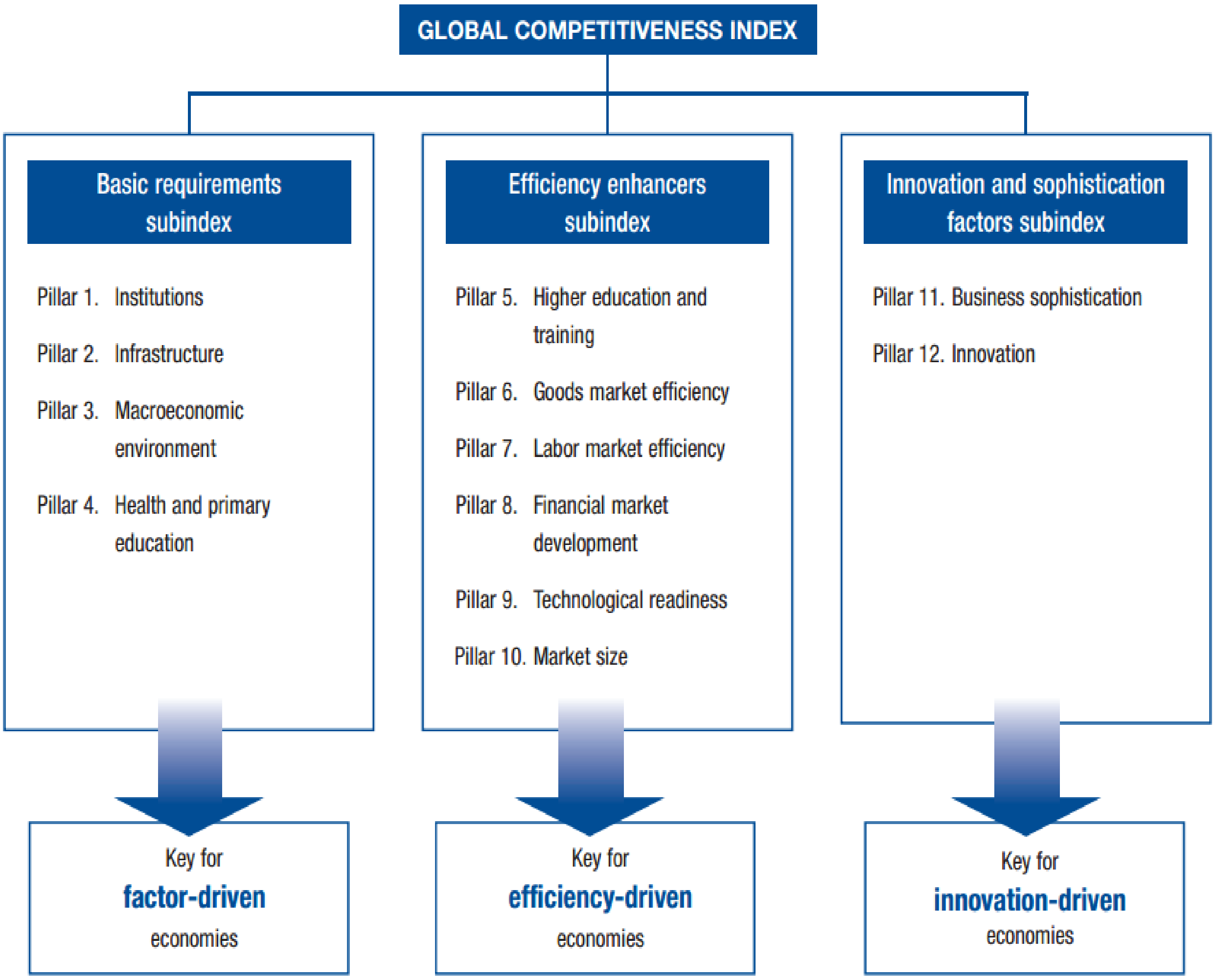


Figure 32: The Global Competitiveness Index framework (WEF, 2015)

Table 59 focuses on the sustainable growth and the Global Competitiveness Index (GCI). The sustainable growth sub-index is measuring the extent to which the natural environment is contributing to overall national competitiveness and the preservation of a pollution-free environment (WEF, 2014).

Table 59: Sustainable Growth Sub-index in the 2014 Edition and Global Competitiveness Index 2015–2016 (based on WEF, 2014; WEF, 2015)

Country	GCI 2015-2016 Score (1–7)	Environmental sustainability 2014 Score (1–7)
Austria	5.12	5.43
Belgium	5.20	4.62
Bulgaria	4.32	3.94
Croatia	4.07	4.67

Country	GCI 2015-2016 Score (1–7)	Environmental sustainability 2014 Score (1–7)
Cyprus	4.23	3.96
Czech Republic	4.69	4.18
Denmark	5.33	5.27
Estonia	4.74	4.67
Finland	5.45	5.75
France	5.13	5.03
Germany	5.53	5.18
Greece	4.02	4.27
Hungary	4.25	3.59
Ireland	5.11	4.42
Italy	4.46	4.36
Latvia	4.45	5.48
Lithuania	4.55	4.93
Luxembourg	5.20	4.68
Malta	4.39	3.89
Netherlands	5.50	4.77
Poland	4.49	4.07
Portugal	4.52	5.06
Romania	4.32	3.94
Slovak Republic	4.22	4.34
Slovenia	4.28	5.17
Spain	4.59	4.86
Sweden	5.43	5.83
United Kingdom	5.43	4.77

8.1.1.1 Readiness issue: The case of Greece vs The Netherlands

The Dutch economy remains one of the most sophisticated and innovative in the world. Its GDP per capita is 51,373 US$. The Netherlands' Global Competitiveness Index is 5.5/7. The 1st Pillar of Global Competitiveness Report (GCR) is institutions. With regard to the institutions, the country received a score of 6/7. The infrastructure was ranked 3rd out of the 140 participating countries with a score of 6.3. In particular, the Quality of air transport infrastructure received 6.4/7 and was ranked 4/140. The macroeconomic environment received 5.7/7, the financial market development got 4.4 and the technological readiness got 6.1/7 position the Netherlands in the 10th position out of 140.

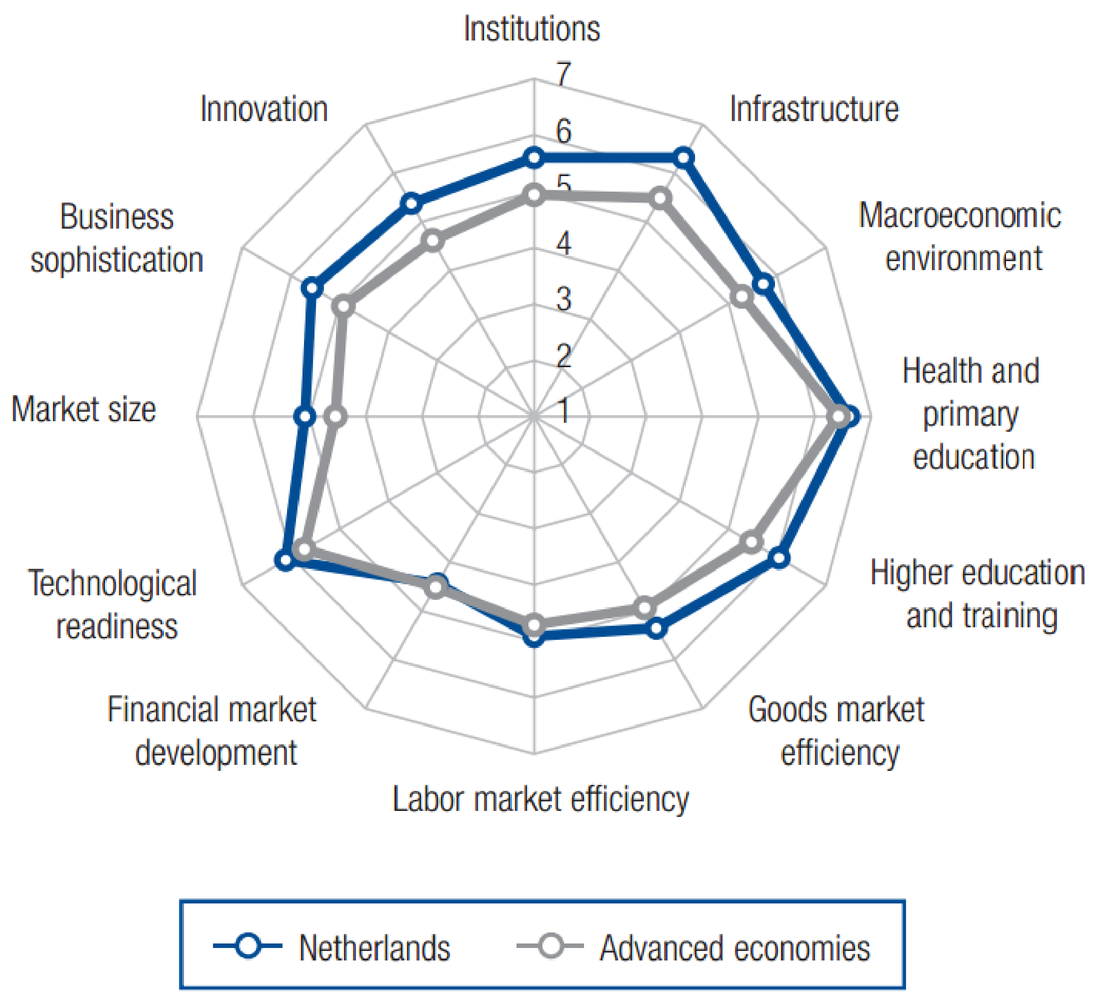


Figure 33: Comparison of the Netherlands with the advanced economies in the 12 pillars of GCI (1: low score and 7: high score) (WEF, 2015: 276)

The figure above shows the comparison of the Netherlands with other advanced economies. The Dutch economy is quite strong. It has risen from 8th to 5th place in the Global Competitiveness Report due to its excellent school system, efficient infrastructure, reliable public administration and permanent focus on innovation.

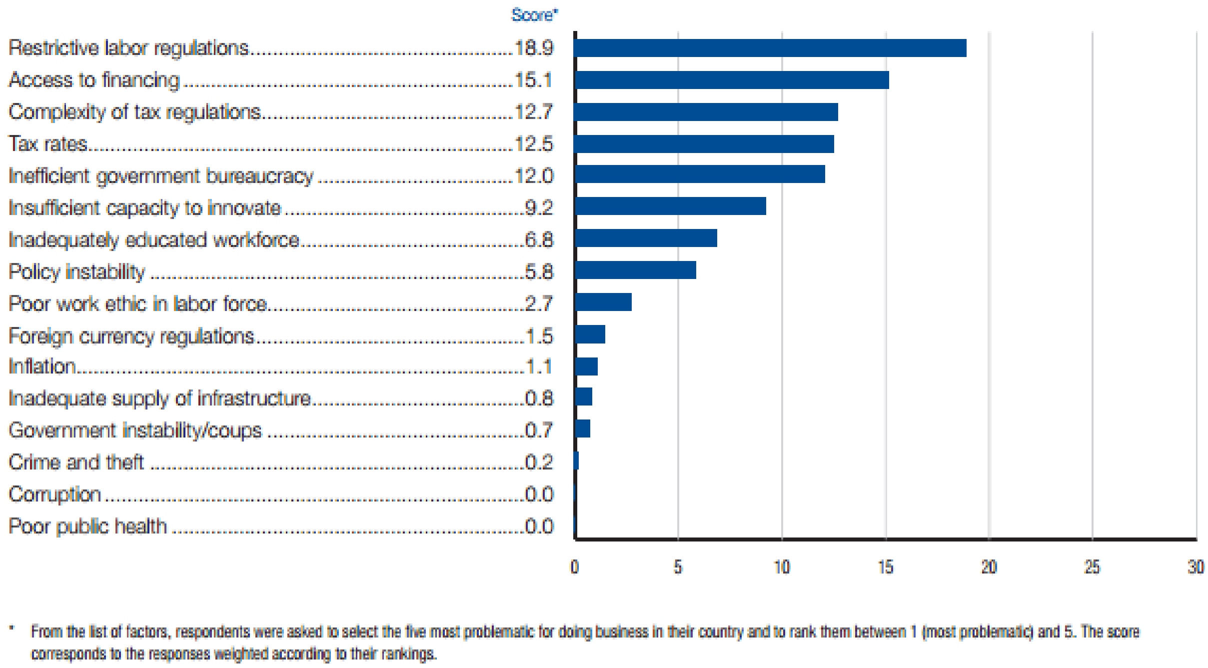


Figure 34: The most problematic factors for doing business in the Netherlands (WEF, 2015)

In the Netherlands, 52% of the flights are overflights, 46% are international departures and arrivals and 2% are domestic flights. Based on NM archived data, traffic in the Netherlands increased by 2.9% during summer 2015 (May to October), when compared to summer 2014. The average en-route delay per flight slightly decreased from 0.17 minutes per flight during summer 2014 to 0.13 minutes per flight in summer 2015. 46% of the delays were due to ATC Capacity, and 28% because of Weather (LSSIP the Netherlands, 2015). The main National Stakeholders involved in ATM in the Netherlands are the following:

- The Ministry of Infrastructure and the Environment (MoI&M, "Ministerie van Infrastructuur en Milieu"); - The Human Environment and Transport Inspectorate (ILT (CAA-NL), "Inspectie Leefomgeving en Transport");
- The Ministry of Defence (MoD, "Ministerie van Defensie") / Military Aviation Authority (MAA, "Militaire Luchtvaart Autoriteit");
- Air Traffic Control The Netherlands (LVNL, "Luchtverkeersleiding Nederland");
- Royal Netherlands Air Force (RNLAF, "Koninklijke Nederlandse Luchtmacht");

- The Netherlands Air Traffic Committee (LVC, “Luchtverkeerscommissie);
- The EUROCONTROL Maastricht Upper Area Centre (Maastricht UAC).

Their activities are detailed in the following subchapters and their relationships are shown in the diagram below (Figure 35).

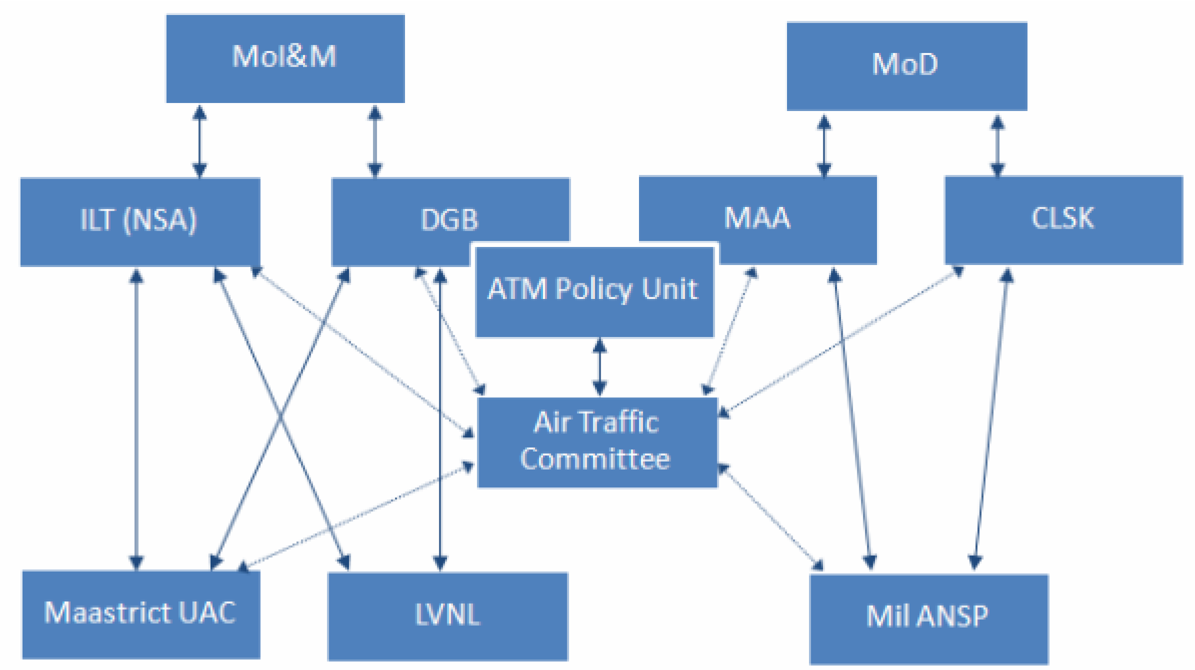
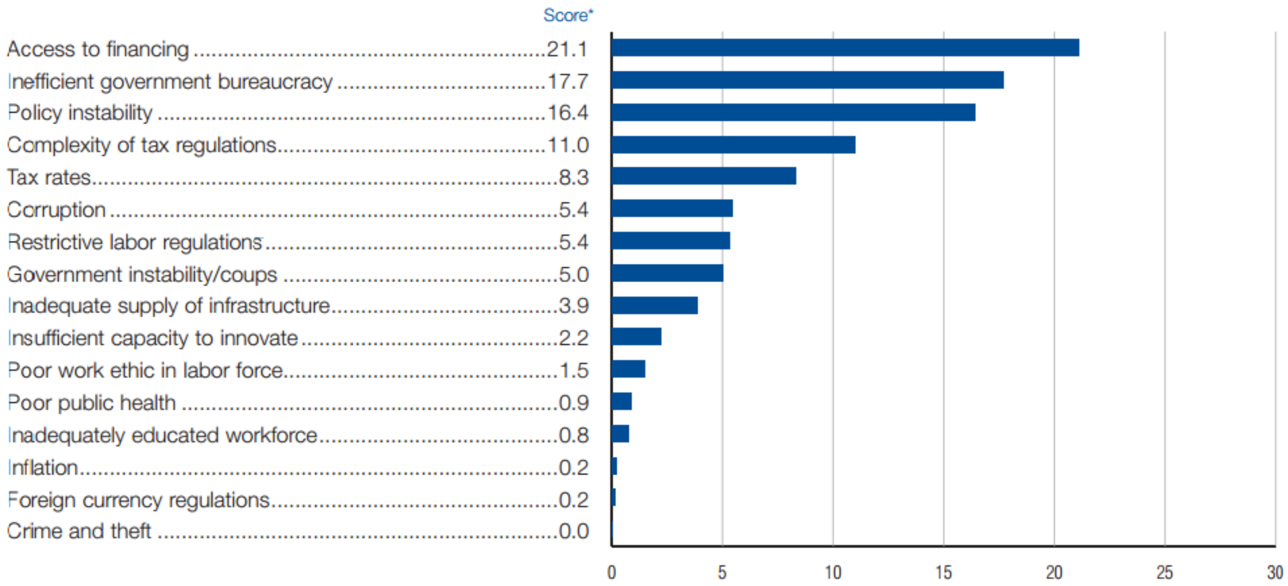


Figure 35: The main National Stakeholders involved in ATM in the Netherlands (LSSIP the Netherlands, 2015)

On the other hand, Greece has GDP per capita 21,653 US$. The GCI score for 2015-2016 is 4/7 which puts Greece in 81st position out of 140. The first pillar of GCR, i.e. Institutions received 3.7/7 points. In terms of infrastructure Greece was ranked 34th out of 140 with a score of 4.8/7. The quality of air transport infrastructure received 5.1/7 points putting Greece in the 37th position. The macroeconomic environment is quite hectic with a score 3.3/7 positioning Greece in the 132nd position out the 140 participating countries. The technological readiness received 4.9/7 points. According to the WEF report the most problematic factors for doing business in Greece is the access to financing, the inefficient government bureaucracy, the political instability and the corruption.



* From the list of factors, respondents were asked to select the five most problematic for doing business in their country and to rank them between 1 (most problematic) and 5. The score corresponds to the responses weighted according to their rankings.

Figure 36: The most problematic factors for doing business in Greece (WEF, 2015)

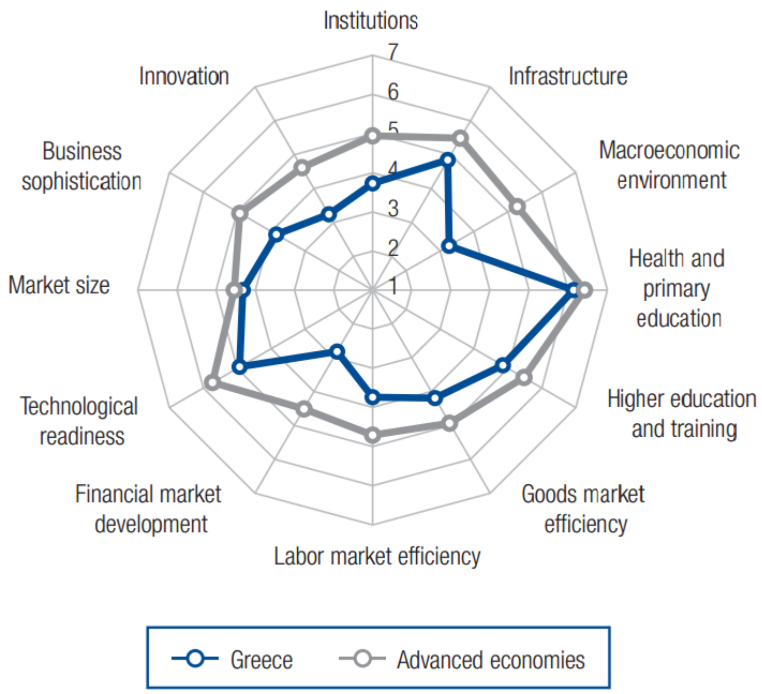


Figure 37: Comparison of Greece with the advanced economies in the 12 pillars of GCI (1: low score and 7: high score) (WEF, 2015: 276)

Greece has one ANSP. In 2014 48% of the flights were overflights, 37% were international departures/arrivals and the remaining 14% was domestic flights (LSSIP Greece, 2015). In Athinai ACC the average en-route delay per flight increased from 0.67 minutes per flight in summer 2014 to 1.46 minutes per flight in summer 2015. 60% of delays were due to ATC capacity and 39% because of ATC staffing. In Macedonia ACC the average en-route delay increased from 0.24 minutes per flight in summer 2014 to 0.75 minutes per flight in summer 2015. 62% of delays were due to ATC staffing, and 37% because of ATC capacity.

In the Local Single Sky ImPlementation (LSSIP) GREECE report of 2015 (2015:23) it is stated that:

> *'The main reasons for shortfalls in the Greek ANS system are the economic and social problems prevailing in Greece in the recent years. That has resulted in lack of investments in ANS infrastructure and lack of personnel. New approaches to allow timely developments and implementation of operational plans including staff availability/recruitment are expected to be put in place.'*

The main National Stakeholders involved in ATM in Greece (LSSIP Greece, 2015) are the following:

- Ministry of Infrastructure, Transport & Networks (MITaN)
- Ministry of National Defence (MND)
- Hellenic Air Force (HAF)
- Hellenic Air Navigation Service Provider (HANSP) – Air Navigation Services Provider
- Hellenic Military Air Navigation Services Oversight Division (H-MANSOD)
- Hellenic Air Force- Search and Rescue Service (HAF/SAR)
- Air Accident Investigation and Aviation Safety Board (AAIASB)
- Hellenic National Meteorological Service (HNMS) – Meteorological Service Provider
- Hellenic Air Navigation Supervisory Authority (HANSA) – National Supervisory Authority
- Hellenic Civil Aviation Authority (HCAA) – Civil Aviation Regulator
    - Regional Services (HCAA/REGS) – Airports Operator

- Civil Aviation Training Centre

Their relationships are shown in Figure 38.

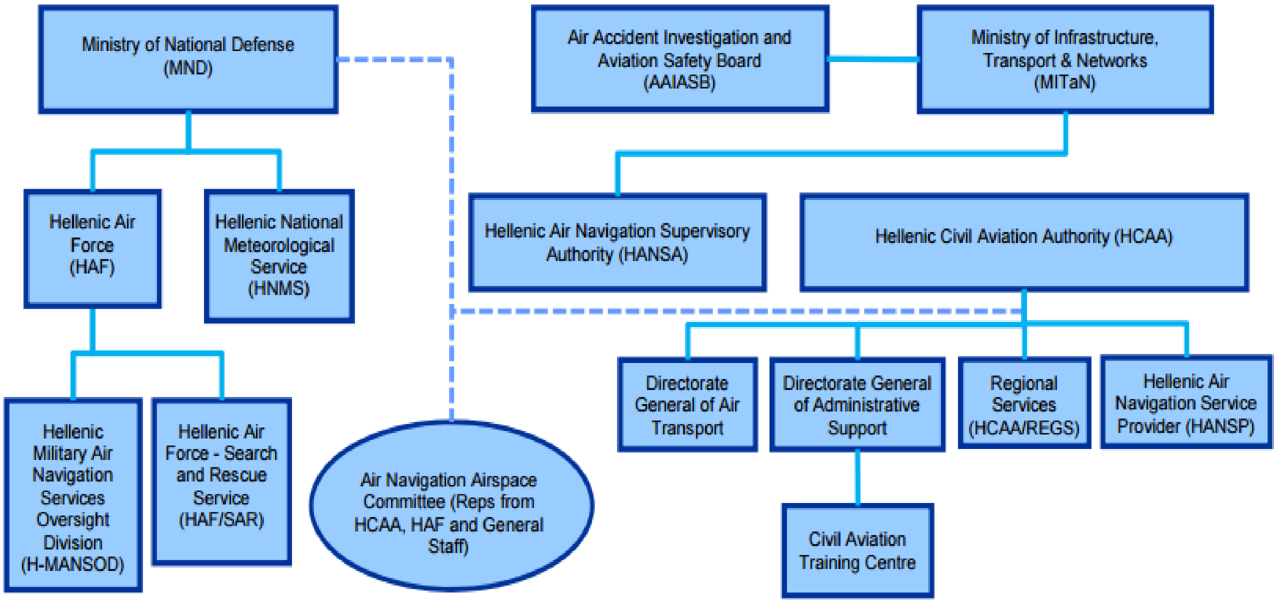


Figure 38: The main National Stakeholders involved in ATM in Greece (LSSIP Greece, 2015)

If we had to compare Greece and the Netherlands, based on the competitiveness of the countries, the Netherlands is far more advanced than Greece. Figure 39 shows the differences of the two countries in the 12 pillars that demonstrate their competitiveness. Therefore, the two countries cannot progress at the same rate.

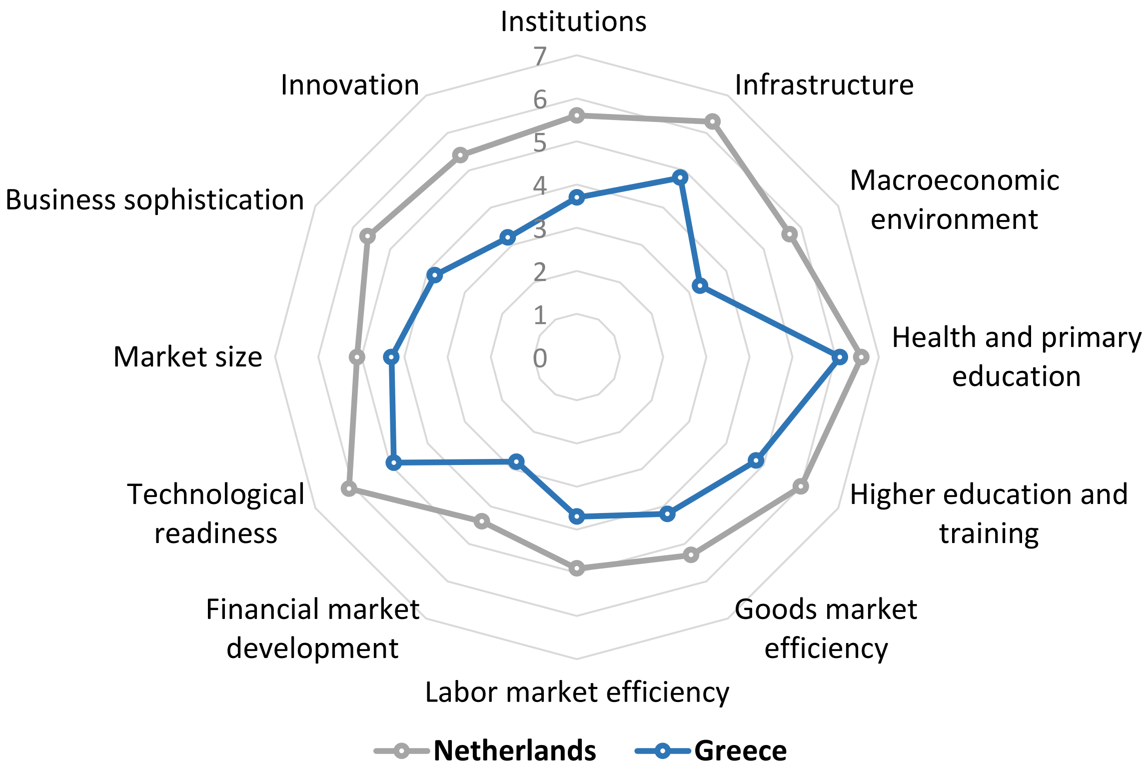


Figure 39: Comparison of Greece and The Netherlands(1: low score and 7: high score) (created by the author based on WEF, 2015)

In terms of what is expected from the Countries/FABs for the Performance Scheme every FAB and every country has a different target. In the example below (Table 60), Blue Med for the period 01 January 2015 till 31 December 2015 the KEP was 5.17% whereas FABEC was 6.14%. Regarding the KEA, the target for 2015 was 3.3% for FABEC and 2.78% for Blue Med. The EU Wide KEP target was 4.78% (Actual KEP=4.84%) and KEA target was 2.96% (actual KEA=2.83%).

Table 60: Environment KPI #1: Horizontal en-route flight efficiency [%] (NM, 2016)

Entity (based on FIR)	KEP [2015]	KEA [PP tgt. 2015]	KEA [2015]	Dif.
Baltic FAB	3.17%	1.50%	1.62%	0.12%
BLUE MED FAB	**5.17%**	**2.78%**	**2.83%**	**0.05%**
DANUBE FAB	3.16%	1.55%	1.29%	-0.26%

Entity (based on FIR)	KEP [2015]	KEA [PP tgt. 2015]	KEA [2015]	Dif.
DK-SE FAB	2.55%	1.20%	1.22%	0.02%
FAB CE	3.42%	1.99%	1.93%	-0.06%
FABEC	**6.14%**	**3.30%**	**3.36%**	**0.06%**
NEFAB	2.07%	1.35%	1.44%	0.09%
SW FAB	4.13%	3.85%	3.41%	-0.44%
UK-Ireland FAB	5.94%	3.36%	3.50%	0.14%
SES Area (RP2)	**4.84%**	**2.96%**	**2.83%**	**-0.13%**

Hence, there are different targets for the countries based on their historic performance. It should also be highlighted that the Netherlands have both LVNL and Maastricht UAC offering ATC to the country. MUAC is a very sophisticated and efficient provider hence the Netherlands have a strong advantage. Greece on the other hand is lacking economic resources, faces serious staffing shortages and it should be noted that in terms of education there are no aeronautical or airspace engineering schools in the country. Some should also evaluate the supporting industry behind the aviation industry. Greece is located quite far from the strong economic centres of Europe and its relations with the supporting mechanism (e.g. CANSO, EC) are not as strong as those of the Netherlands. Hence, different targets might have been established based on the up that time performance, but the current and future situation of the countries has not been evaluated as well as their readiness for the reform. This statement has also been supported by the interviewees N.04 and N.01.

8.1.2 Incentive Scheme

Air Navigation Service Providers are given incentives by the EC to enhance their compliance and efficiency to the Performance Regulation. The risk-sharing mechanism of the charging scheme, i.e. the sharing of the financial risk between Member States/ANSPs and airspace users, is seen as a meaningful economic incentive for ANSPs to be more cost–efficient taking advantage of good management, economies of scale and productivity gains. According to Crespo and Mendes De Leon (2011: 161) 'this creates a regime close to a cost capping in a multi-annual framework'. According to article 12 of Reg. 390/2013 with a link to Commission Implementing Regulation (EU) No. 391/2013, the incentives shall be part of the regulatory environment known ex ante by all stakeholders and be applicable during the entire reference period. Moreover, the incentives on environment and capacity shall be financial and the NSA should enforce corrective actions if necessary. Safety is a KPA that does not have any incentives mechanisms due to it uncompromising nature. The maximum number of aggregate bonuses and the maximum amount of aggregate penalties shall not exceed 1% of the revenue from air navigation services in year n.

The Performance Plan of DANUBE in the Appendix 3 section 4.1 has a general description for the KPA environment and it is not an effective incentive. For the Capacity KPA the incentive is financial for both ANSPs, i.e. ROMATSA and BULATSA and it was decided to have bonuses or penalties equal to 0.1% of revenue from en route air navigation services (see Appendix 3 section 4.1).

According to IATA, the Association of European Airlines, and the European Regions Airline Association (2013) 'the targets and financial incentives set must cascade through the entire ATM supply chain with binding mechanisms between the states and their various air navigation services providers issued on a limited and regularly reviewed term with binding performance obligations'. All the interviewees highlighted the importance of incentive mechanisms for the implementation and success of both SES and EU ETS.

8.1.3 Trade-offs between the KPAs

Flight efficiency always involves trade-offs between the different areas (interviewees N.01, N.02, N.03, N.04, N.05, N.06, N.07), for instance safety versus capacity, fuel cost versus time cost, ground versus airborne delay, noise versus emissions, etc. Excess fuel burn in the Air Traffic Management system is primarily characterized by flight delay costs and flight efficiency costs. Flight delays occur when an airport or airspace resource (runway, gate, taxiway, or airspace sector) has greater demand than the available capacity. Flight delays tend to grow exponentially with increased levels of traffic. Flight efficiency is measured as the increased flight time, distance, and fuel compared to an "ideal" flight trajectory.

As per the DANUBE FAB Performance Plan section 3.3 - Description of KPAs interdependencies and trade-offs:

> *"Safety*
>
> *Safety KPA establishes mandatory requirements in ATM operations and represents the key element of ANS. No safety compromises should be made in order to improve other KPAs especially the cost-efficiency. The Performance Scheme Regulation and corresponding targets for RP2 are more oriented on cost-effectiveness while focusing less on the safety key performance area. Thus, for the second reference period and the next to come the biggest challenge for States and FABs will be to keep focusing on safety while trying to achieve the targets in different KPAs.*
>
> *Capacity*
>
> *The very good performance of ATFM delays recorded by the DANUBE FAB in the last five years and for RP2 implies extra cost through investments, staff and corresponding procedures. DANUBE FAB RP2 capacity targets followed the PRB expectations and indicative figures while contributing to the very challenging cost-efficiency objectives. We appreciate that having one of the most reduced FAB*

determined unit cost and ATFM delays represent a very challenging objective and should be carefully assessed.

Environment

Similarly, to the capacity targets the flight efficiency requires extras cost through investments, staff and corresponding procedures that are requested for reaching the targets. "

8.1.3.1 Example of Environment Vs Unit Rate Cost

The flight Milano- Brindisi can follow different routes. In Figure 40 two different routes are given. The green flight path is sorely within Italy, whereas the red path is passing through Croatia. The Great Distance Cycle (GDC) are the dashed lines in the map. For the red flight path, i.e. the one passing from Croatia the GDC is calculated firstly from Milano to the border of the FIR and then within Croatia for the other intersections of the flight plan with the charging zone and then to Brindisi. Compared to the flight plan contained entirely within Italy, the route through Croatia implies a reduction of 430 km in Italy and an increase of 477 km in Croatia.

For an aircraft weighing 80 metric tonnes, the price (for the unit rate) per kilometre (July 2013) is €1.00 in Italy and €0.53 in Croatia. The longer route (through Croatia) is therefore €177.19 cheaper (430km x €1.00 – 477km x €0.53). The reason for this significant difference in cost is the different Unit Rate in the two charging zones. The airplane might burn additional fuel by a longer distance but the total savings are higher if the plane flies through Croatian airspace. In this specific example, the additional distance is 47km for the plan through Croatia. It is cheaper for the airspace user to file (and fly) the longer flight plan as long as its operating costs per kilometre are less than €3.77 (€177.19 / 47km).

According to PRB Annual Monitoring Report 2012 (2013: 21) ‘such a situation exposes the risk of possible unintended consequences of the current rules. They might constitute an incentive for airspace users to file longer routes with a detrimental effect on the horizontal flight efficiency indicator (KEP). They might create cost competition based on Unit Rates, in order to attract traffic'.

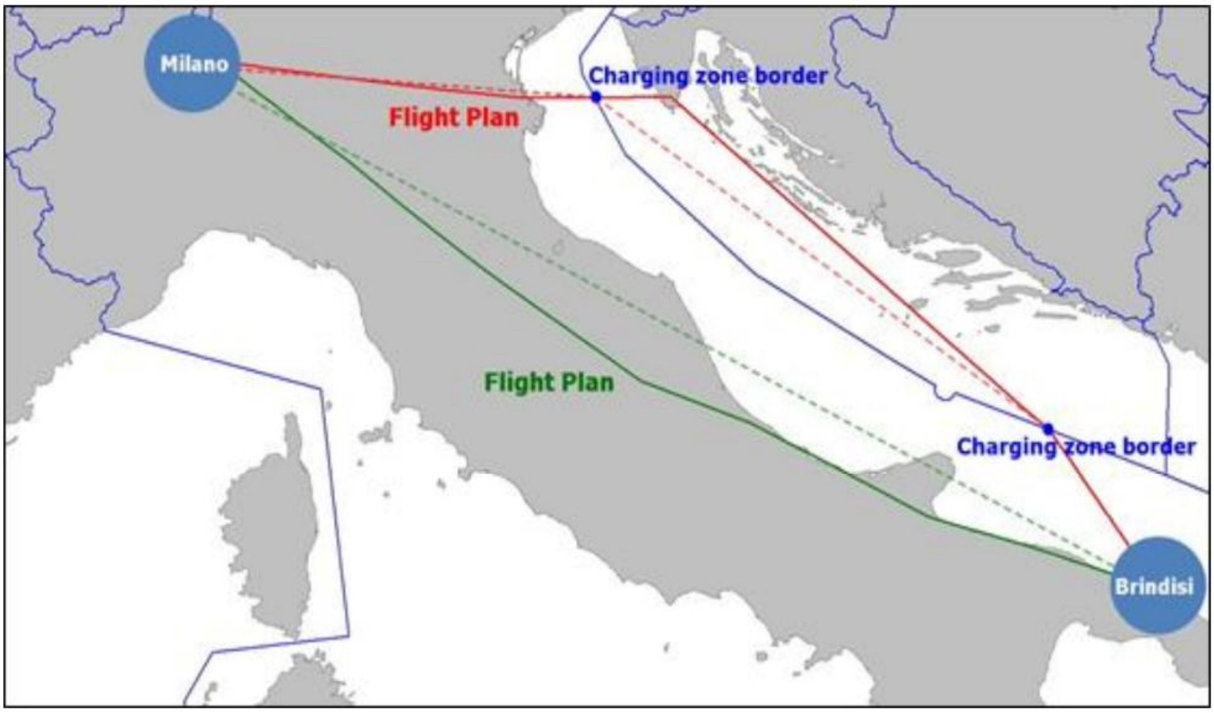


Figure 40: Two alternative routes between Milan and Brindisi

Avoiding expensive unit rates and asking for direct routing may have negative impacts on safety due to sector overloads and on capacity due to ACC under and overload. This is the argument that is used for the implementation of single unit rate per FAB, an action that is quite complex given the diverse local financial arrangements.

8.2 Multi-Stakeholder Governance in Aviation

In SES, there are three main levels of governance. There is the political level (EC), the management level (Deploy manager) and the Implementation level (Project managers). Hence, the multi-stakeholder governance theory will be applied to better understand the underlying issues in SES and EU ETS implementation as well as the possible solutions for the different stakeholders' points of view. Schwab developed a stakeholder theory of management of industrial manufacturing firms in the 1960s. Schwab argued that in order to be effective in maximizing a firm's potential, managers should consider the interests of all the stakeholders in the firm, i.e. shareholders, customers and clients, employees, but also the broader interests of the communities within which the firm is situated, including neighbours in the immediate proximity of the firm, governments, and fellow users of the environment in which the firm operates. Governments can be counted as stakeholders since they certainly affect organisations and groups through their regulatory policies (Moloney, 2006). In the aviation industry and especially when considering the SES and EU ETS governments are one of the most 'strong' stakeholders. Moreover, within governments as a group there are specific governments with even stronger power of influence (Interviewee N.02).

The stakeholders can be primary players, for instance the airlines, or secondary players, for instance education and training providers. The different stakeholders are different types of groups or entities that do not represent themselves and communicate to other bodies in the same way hence the Multi-Stakeholder Governance (MSG) approach and problem solving become more complex as it was realised during the participant observation.

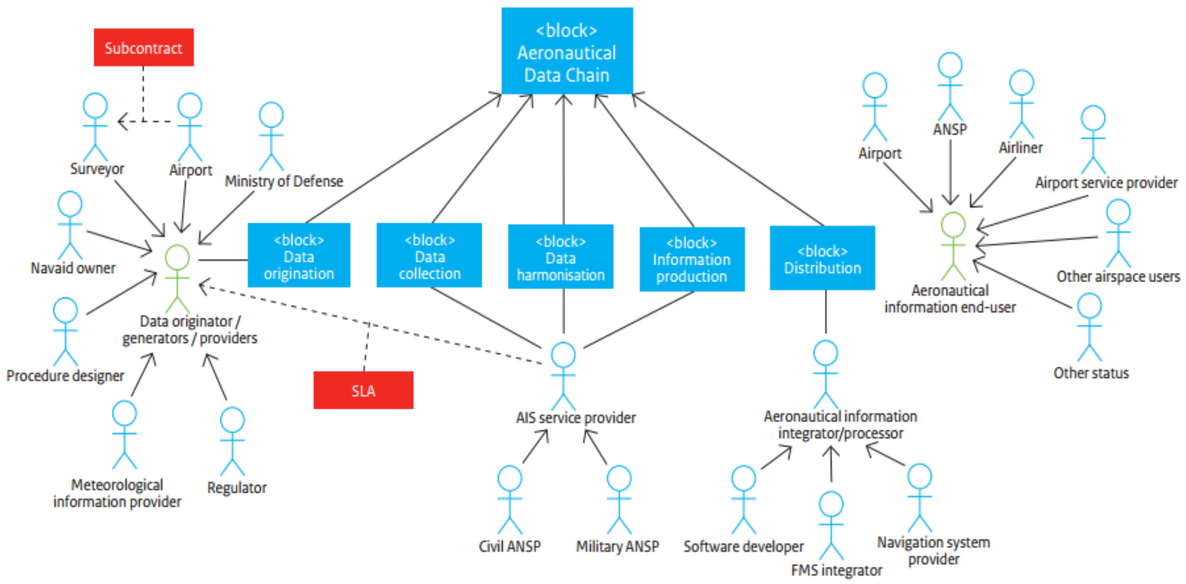


Figure 41: Aeronautical data chain stakeholders (Dutch Ministry of Infrastructure and the Environment, 2013:7)

The graph above shows the overview of the aeronautical data chain elements and the relationships with the different stakeholders in The Netherlands. It is evident that for Aeronautical Information Services there are a lot of stakeholders to manage and their communication can be complex.

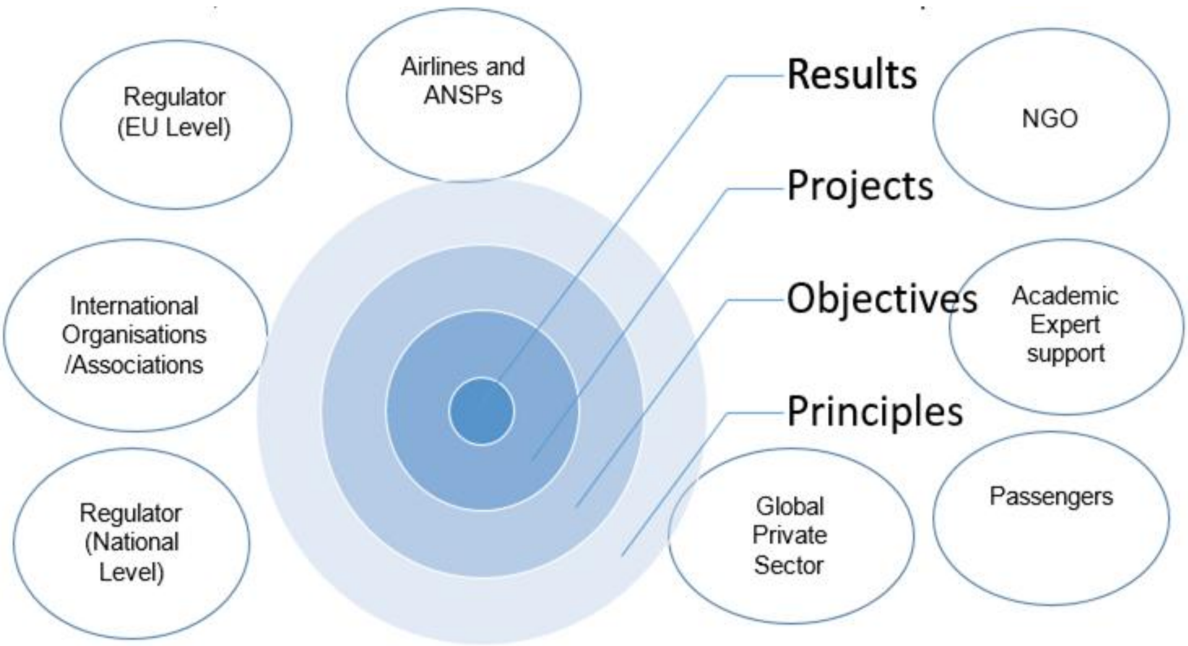


Figure 42: Multi-stakeholder theory of governance in aviation (based on Schwab and WEF, 2007)

The stakeholders as stated in a previous chapter face four major attributes, 1) the stakeholders' position on the reform issue, i.e. SES and EU ETS; 2) the level of influence (negotiation power) they hold; 3) the level of interest they have in SES and/or EU ETS; and 4) the group/coalition to which they belong or can reasonably be associated with. These attributes are identified through various data collection methods, including interviews with experts and with the actual stakeholders directly, as well as from literature review and public announcements.

8.2.1 The Positions of the Stakeholders

Based on a creative amalgamation of the participant observation and the unstructured interviews, the positions of the SES and EU ETS stakeholders are stated in the following subsections. According to interviewees N.01, N.06 and N.07 it is of critical importance to understand who are the stakeholders and their positions in order to manage them. The main stakeholders in the EU ETS and SES reforms are the European Commission, European Parliament and National Governments, the airspace users, the organizations and institutions and the Air Navigation Service Providers. In this section their positions, as interpreted from the participant observation and the semi-structure interviews, will be presented.

8.2.1.1 European Commission, European Parliament, and National Governments

The European Parliament (EP) is the final decisions maker of the reforms. The European Parliament may approve or reject a legislative proposal, or propose amendments to it. The EP recognises that it has a duty to make a positive contribution to welfare and sustainable development as a long-term goal, both through its political and legislative role. The Parliament mentions in the website that it has always been keen on removing the obstacles of the SES implementation following a pragmatic approach. The EP is working closely with the European Commission in this matter. The European Commission's position is the same with the European Parliament's position (interviewee N.02). As per EP website (europarl.europa.eu, 2016):

> *'Given that the major objectives of the Single European Sky are still to be achieved, Parliament is now calling on the Commission to switch from a 'bottom-up' to a 'top-down' approach, in order to overcome remaining reticence and to speed up the implementation of the initiative, notably with respect to the SESAR programme and the functional airspace blocks.'*

Moreover, the Industry Consultation Body was established under Article 6 of Regulation 549/2004 which was formed after the Parliament proposed it. It should be noted that the Members of the European Parliament are directly elected by voters in all Member States to represent people's interests with regard to EU law-making and to make sure other EU institutions are working democratically. It is implied that the EP is affected many times from the industry bodies in terms of policy making. As the British politician Shirley Williams (from Van der Brug and De Vreese, 2016:79) remarked:

> *The "democratic deficit" is the gap between the powers transferred to the Community level and the control of the elected [European] Parliament over them, a gap filled by national civil servants operating as European experts…and to some extent by organized lobbies, mainly representing businesses.*

The PRB white paper on RP3 Performance Objectives (2016) states that the regulation and oversight is quite weak. It also argued that the Member States and their ANSPs have a 'vested interest' in maintaining monopolies and lack of competition as they benefit from this. PRB (2016: 8) also mentioned that *'Unhelpful behaviours and gaming are observed. Not only in the regulated community but also in the operational elements of the legislation'*.

Since most of the ANSPs are government owned and the charging scheme is such that the ANSP cannot make a loss, the national governments have a strong incentive to preserve the situation as it is in terms of ownership and competition. Thus, Ministries retain control of the infrastructure and manage the interaction within its regulating bodies leaving clear conflicts of interests (PRB, 2016). Hence, the independence and credibility of the regulator is a function of the political economy that creates the regulator, sets its goals and instruments, and is always in a position to subsequently change the rules.

8.2.1.2 Airspace Users

The term airspace users refer to aircraft operators and especially airlines. Most of the airlines are private owned. Their main objective to increase their revenues and to decrease their costs. The costs of airlines are: fuel; cost of operations; pax services; airport and ANS charges; distribution; aircraft ownership; and maintenance. SES is affecting the cost of fuel and the navigation charges. Due to SES, the routes will be shorter, thus more fuel efficient and the navigation cost is decreasing through the performance scheme KPA Cost Efficiency. Hence airlines are in favour of the SES reform of ATM. Depending on the business model (LCC or FSNC), the direct cost for ANS represents between 6 and 20% of the total operating costs (TOC), excluding fuel. In addition, there are additional costs for delays and flight inefficiencies (due to longer routes and more fuel consumption) (EC, 2015).

Regarding the EU ETS it needs to be highlighted that this a regulation for the airlines. Since most of the airlines are private, they try to be as cost efficient as possible. Fuel is considered the second or the third highest cost (depending on the fuel price). Airlines try to consume as much as possible. The fuel consumption is directly related to carbon emissions, thus by minimising its consumption airlines are minimising their carbon footprint. However, in order for the minimum consumption of fuel to be achieved, airlines need to invest in airplanes, new technologies, trainings of pilots and other measures. Thus, the EU ETS regulation causes stress to many airlines. The majority of airlines oppose the inclusion of aviation in EU ETS. On the other hand, there are some airlines that are already following a more environmentally friendly approach and are investing a lot of capital to the environmental improvement of their operations. Thus, those airlines embrace the EU ETS principles and concepts. Another condition that influences the position of the airline towards EU ETS is the size of the airline and the ownership. Airlines that have a small fleet and few operations, the time and effort that they invest in EU ETS exceeds the benefits they will get back. Moreover, airlines that are government owned need to have the approval of the ministry in order to do radical changes in the fleet or the management of the operations. Finally, it is also a matter of available expertise and mentality. Small airlines lack the necessary expertise in order to follow fuel-efficient strategies and operate sophisticated software for fuel planning operations.

8.2.1.3 Organisations and Institutions

The Institutions/Organisations related to SES are EUROCONTROL; the International Air Transport Association (IATA); the Association of European Airlines (AEA); and the

European Low Fares Airline Association (ELFAA); the Trade Unions, in particular the European Transport Workers' Federation (EFT) and 'Air Traffic Controllers European Union Coordination' (ATCEUC); and CANSO. In terms of EU ETS, the trade unions and CANSO are not an important stakeholder.

EUROCONTROL is an independent organisation and does not have a position on the reforms. It supports and follows the regulations promoting the efficiency and effectiveness of the aviation systems for all its 41 Members States equally. IATA on the other hand has the mission to represent, lead, and serve the airline industry. As per IATA's website (IATA.org, 2016c) 'Advocating for the interests of airlines across the globe, we challenge unreasonable rules and charges, hold regulators and governments to account, and strive for sensible regulation'.

The airlines are following the developments on SES and they want the aviation system both in terms of charges and in terms of operations to be more efficient. AEA promotes the reduction of emissions and environmental impact, but claims that due to the stop the clock the EU ETS has a negative impact on airlines operating on European routes and is looking forward to the reassessment of ETS following the outcome of the 2016 ICAO assembly. ELFAA's mission statement is 'to ensure that European policy and legislation promote free and equal competition to enable the continued growth and development of low fares into the future, allowing a greater number of people to travel by air. John Hanlon (2013), Secretary General of ELFAA said:

> *'ELFAA has consistently supported the inclusion of aviation in EU ETS. ELFAA renews its call for the reinstatement of full scope EU ETS, to restore environmental effectiveness and remove the unfair discriminatory burden of a limited scope'.*

The Trade Unions of ATCOs are opposing the way the SES is designed and is implemented due to the insecurity they feel for their jobs and salaries. One of the main targets of SES is to reduce the charges for airlines and the charges is related to the

ATCOs salaries. In addition, programs like the Remote and Virtual Tower (RVT), is a risk for the demand of ATCOs. Hence, they are opposing to some elements of SES. In terms of EU ETS, they have a neutral position.

8.2.1.4 Air Navigation Service Providers

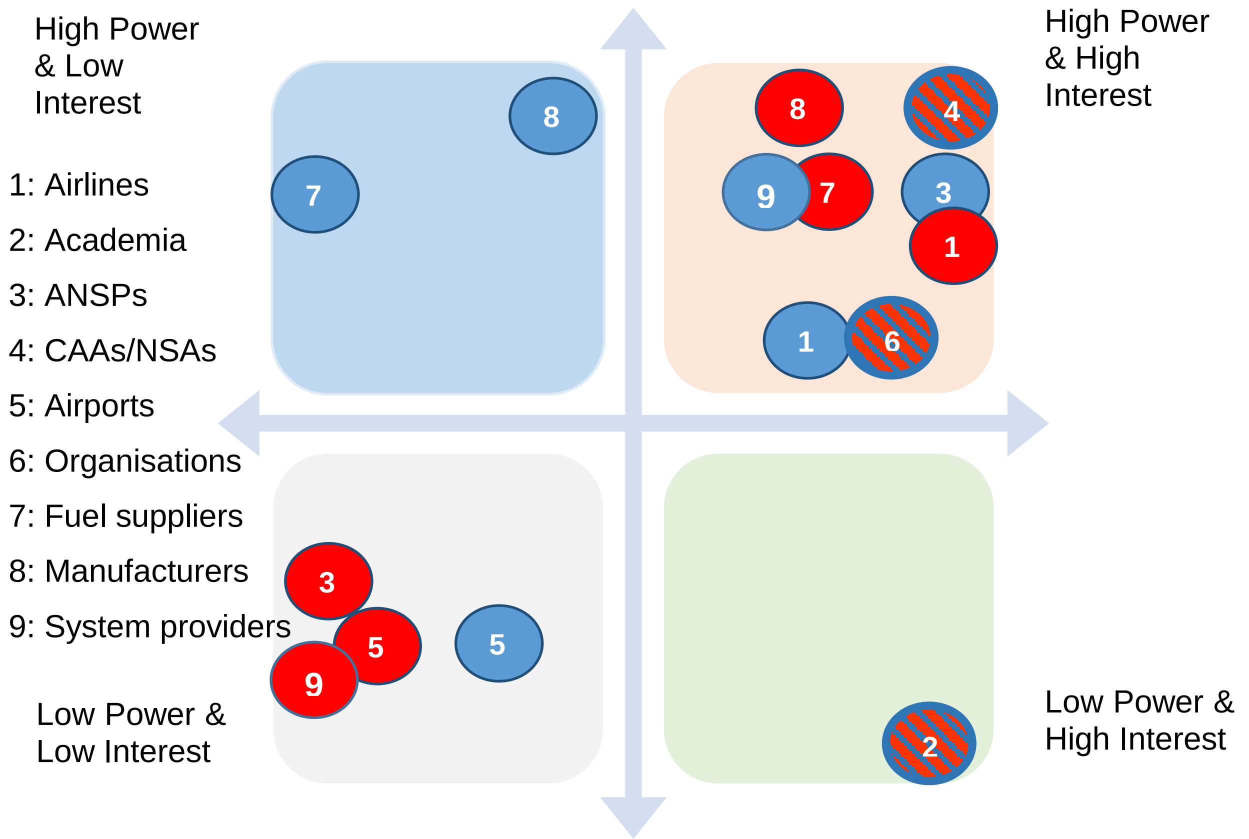
ANSPs have two diverse positions for the SES and neutral position for EU ETS. Those ANSPs that are state enterprises/bodies, i.e. owned by the state follow the position of the state, i.e. preservation of the natural monopoly. Other ANSPs, that are more profit orientated like NATS, might be in favour of the reforms in order to be given the opportunity to overtake services provided by other ANSPs. Those services are mostly Terminal Control (TWR) or Approach Control (APP). With the current national regulations, there is the requirement/limitation that the ATCOs speak the country's language especially in APP and TWR control. Moreover, to comply with the Performance Scheme rapid and drastic changes in the operations need to be done and many times the ANSPs personnel are not willing to adapt. Finally, the SES requires investments in the infrastructures that the ANSPs budget may not be sufficient.

8.2.2 The level of influence and interest

The effective power of the industry, i.e. the degree of power the stakeholder holds over other groups in relation to a reform of the aviation environment, is very strong. In Table 61, a general overview of the power and interest is depicted as it was identified by the participant observation and the unstructured interviews. The blue and red coloured bubbles represent the SES reform and the EU ETS respectively. Bubble number 1 represents the airlines that have high power and high interest. Bubble number 2 represents the academic community that has low power, but high interest. Bubble number three is the ANSPs that have high interest in the SES reform and quite high power too (due to strong Trade Unions and natural monopolistic power). The bubble number 4 in

Table 61, is the regulator either in the form of CAA/NSA or in the form of EC or EP. The 4th bubble has the highest power and the highest interest in the reform. Bubble number 5 is the airports. The airports, concerning the SES, benefit in terms of on ground ATC improvements, but their role is more as an observer than as an active participant. The sixth bubble represents the organisations/associations and institutions like IATA and EUROCONTROL. Bubble number 7 in Table 61is the fuel suppliers. The fuel suppliers have high power but low interest in SES. The 8th bubble represents the manufacturers. The manufacturers have higher power than fuel suppliers do, but lower interest compared to airports or airlines. The ninth bullet is the system providers. They have high power and high interest in SES.

Table 61: Power-Interest Matrix of SES (blue bubbles) and EU ETS (red bubbles) (source: own elaboration)



Regarding the EU ETS, the red bubbles depict the power and interest of the different players. The airlines, which consider EU ETS, i.e. bubble number 1, have high interest and relatively high power over the reforms (see example about 'stop the clock'). Bubble 2 represents the academic society, which has high interest on EU ETS, but low power. The ANSPs (bubble 3) have no interest and little power over the EU ETS. The regulators, i.e. bubble number 4, have the same interest and power as in the SES. Bubble number 5, i.e. the airports, have low power and low interest in EU ETS reforms. The 6^{th} bubble is in the exact position as the SES. Institutions and Associations as an entity have the same interest and power over the 2 reforms. The fuel suppliers, i.e. bubble number 7, have quite high power due to their oligopolistic power, and high interest regarding the environmental targets set to airlines. The manufacturers (bubble 8) have high power and high interest on EU ETS performance due to the possible change in the demands of the airlines. Finally, the system providers, i.e. red bubble 9 have low interest and low power over EU ETS.

Based on Chinyio and Olomolaiye's (2010:8) seven (7) principles of stakeholder management, the regulators should:

1. 'Acknowledge and actively monitor the concerns of all legitimate stakeholders, and take their interests appropriately into account in decision-making and operations.
2. Listen and openly communicate with stakeholders about the latter's respective concerns and contributions, and about the risks that the regulators assume because of their involvement with the corporation.
3. Adopt processes and modes of behaviour that are sensitive to the concerns and capabilities of each stakeholder's constituency.
4. Recognise the interdependence of efforts and rewards among stakeholders, and attempt to achieve a fair distribution of the benefits and burdens of corporate activity among them, taking into account the stakeholders' respective risks and vulnerabilities.

5. Work cooperatively with other entities, both public and private, to ensure that risks and harms arising from corporate activities are minimised and, where they cannot be avoided, appropriately compensated.
6. Avoid altogether activities that might jeopardise inalienable human rights (e.g. the right to life) or give rise to risks that, if clearly understood, would be patently unacceptable to relevant stakeholders.
7. Acknowledge the potential conflicts between (a) their known roles as corporate stakeholders and (b) their legal and moral responsibilities for the interests of stakeholders, and address such conflicts through open communication, appropriate reporting, incentive systems and, where necessary, third-party review.'

The players that have high power and high interest need to be managed closely, because they are key players for the success of the schemes. The players that have high power and low interest need to kept satisfied. The stakeholders with low power and high interest need to be kept satisfied but also informed. Finally, for those stakeholders with low power and low interest, minimal effort can be provided; however, action must be taken by the policymakers when necessary. It needs to be highlighted that the Network Manager has strong power over the airspace users and minimum power over the ANSPs. The industry is also represented by the SESAR JU. There are numerous examples proving this power. The stakeholders can lead to amendments or changes in the reforms under consideration due to their interests and due to their power. The most important example with major effects on the aviation reform related to the reactions of many airlines against the scope of the EU ETS.

8.2.2.1 Reactions to the Implementation of European Union Emissions Trading Scheme in Aviation

The United States of America (USA) disagreed with the implementation of EU ETS in international civil aviation. Representatives of the USA and other government bodies of other states claimed that the onside implementation of EU ETS to non-European carriers violates the Chicago Convection of 1947 for the international civil aviation and its bilateral agreements and that the issue should be resolved by ICAO (Havel and Sanchez, 2012). ICAO supports the cooperation of its Member States (MS) for the non-binding standards and recommended practices for safety, environmental protection and other issues affecting civil aviation. The United States is a signatory MS to the Chicago Convention and is one of the current 190 Member States of ICAO. While the European Union (EU) is not a signatory to the Chicago Convention, it is represented by its 28 Member States in the ICAO. But the EU has observer status in ICAO (Leggett et al, 2012:3).

Since 1997 (Kyoto Protocol) ICAO has published technical information and a range of different volunteering options and recommendations relating to the limitation of greenhouse gas emissions from aviation. In 2004, ICAO ruled out the option of a global emissions trading system for aviation. Instead, it has established guidelines for the Member States which should include international aviation into their own emissions trading schemes. ICAO requested the introduction to be a "mutual agreement" and non-discriminatory. Member states are requested to produce Action Plans presenting how they handle environment issues related to aviation (Leggett et al, 2012: 3).

The US response is particularly strong. Some American airlines and Airlines of America (A4A) appealed to the European Court. But the Court of Justice of the European Union (CJEU) concluded that the EU ETS did not contravene the Chicago Convention, the Kyoto Protocol or the US EU Open Skies Agreement. The Court ruled that application of the EU

ETS to aircraft operators infringes neither the principle of territoriality nor the sovereignty of third party State (Court of Justice of the European Union, 2011).

The US government, China and some other countries have requested exemptions for the airlines from the emissions trading system (Malina et al, 2012). Europe's representatives responded by saying that the regulation is not contradictory to the Chicago Convention and that the consent of the other countries is not required (American Society of International Law, 2008). This policy of the European Union has raised many controversies among the stakeholders. On the one hand, there are countries such as the USA and China that actively react to this policy, because they believe it could have a negative impact on their carriers' profitability. On the other hand, there are some countries, that are positive to EU ETS full scheme, because they have developed the biofuels industry. Brazil is one of them since Boeing and Embraer opened in 2015 a Joint Aviation Biofuel Research Centre in Brazil (Embraer, 2015).

This example illustrates that within the category of the stakeholder, there are subgroups that are either supportive or against the regulation according to their interests. Hence countries that are biofuels producers supported the full scope of the EU ETS whereas fast developing countries like China were opposed. Nevertheless, some international airlines complied with the full, original, scope of the scheme including: Korean Air; Fed Ex; Nippon Air and Lufthansa Cargo (Sandbag, 2013). The reason for such a decision was that they considered it financially advantageous to receive the generous number of free allowances. According to Sandbag (2013) Ryanair publicly announced an ETS charge of €0.25 per passenger per flight, and had €8 million windfall profits since their actual ETS cost was €0.13 in 2012.

8.2.3 The group/coalition of stakeholders

The stakeholders come closer and start forming groups with common goals and aims, i.e. coalitions. The ANSPs have developed coalitions due to SES, but the airlines haven't developed coalitions due to EU ETS. The airlines are using the established groups, for instance IATA, ELFAA or AEA. The ANSPs formed COOPANS that included a system supplier. COOPeration between Air Navigation Services providers-COOPANS is an international partnership between the IAA and the air navigations service providers (ANSPs) of Austria, Croatia, Denmark and Sweden and system supplier, Thales. COOPANS has structured the development and deployment process around joint activities such as common specification, operational documentation, validation, training materials and generic safety cases.

The overarching aim of COOPANS is to achieve financial savings and reduced investment risks by harmonising and standardising technical solutions and operational procedures. COOPANS also meets the EU requirements concerning future harmonisation of ATM systems in Europe. The business partners share the development costs. In total, the cooperation is expected to cut system development costs by approximately 30 per cent compared with the costs each partner would incur if it had to develop the technology independently. Using COOPANS capability, the Irish Aviation Authority (IAA) has enabled Free Route Airspace within the Rathlin West sector (RATHE), which allows airlines to reduce fuel uplift and gives them greater flexibility in how they route.

Furthermore, the five biggest ANSPs plus PANSA (Poland) formed an alliance called A6 alliance. Apart from A6 there is COOPANS Alliance consisting of the ANSPs of Austria, Croatia, Denmark, Ireland and Sweden that works with A6. Moreover, B4 Consortium consists of the ANSPs of the Czech Republic, Lithuania, Poland and Slovakia and is member of A6 on work associated with the Deployment Manager and SESAR 2020.

Noracon - representing the ANSPs of Austria (Austro Control), Denmark (Naviair), Estonia (EANS), Finland (Finavia), Ireland (IAA) Norway (AVINOR) and Sweden (LFV) at the end of 2016 - will no longer be a member of the A6 Alliance. The A6 aims to modernise of the European ATM network within the SESAR programme creating synergies between the ANSP members of the SESAR JU to maximise customer and network benefits as well as promoting leadership at a European level in critical technical and strategic areas. The practice of forming alliances that was followed by the airlines is now applied to the ANSPs as a result of SES regulatory framework.

There are also some attempts from FABS. Functional and efficient cooperation arrangement with neighbouring states and FAB´s are of strategic importance for FABs. The FAIR STREAM (FABEC ANSPs and AIRlines in SESAR TRials for Enhanced Arrival Management) consortium involving major European airlines, ANPSPs and suppliers has started the concrete work on flight trials to improve predictability and flight efficiency towards major European airports. The project is launched by the SESAR. DK-SE FAB is cooperating with the ANSPs in NEFAB to increase the opportunities for establishing Free Route Airspace, so the airlines can determine their own routes throughout the entire Nordic airspace.

In 2011, Irish IAA, Swedish LFV, UK NATS and Naviair established the so-called FAB 4 project (IAA, 2013). The project is exploring the possibilities of closer cooperation on ATM in the airspace over Denmark, Sweden, the UK and Ireland. The aim is to enhance ATM efficiency in this area. The possibility of combining the only two European FABs to date – the Danish-Swedish and the UK-Irish FABs – forms part of the project analysis. A preliminary study already completed has shown that genuine cost reductions and enhanced efficiency would be possible in cooperation.

Significant improvements have been done in terms of the Inter- FAB Coordination, explicitly by creating `Borealis Alliance`, where ANSPs of Norway, Finland, Estonia, Latvia (NEFAB States), Sweden and Denmark (DK-SE FAB States), and UK and Ireland (UK-IR FAB States) cooperates to enable better performance for stakeholders through business collaboration. Borealis Alliance focuses on strategic business cooperation between the member ANSPs, seeking economies of scale and projects that can be achieved on a commercial basis, complementing the work of the northern European Functional Airspace Blocks (FABs) but without the need for regulatory or State involvement.

8.3 Summary

The four major attributes, 1) the stakeholders' position on the reform issue, i.e. SES and EU ETS; 2) the level of influence (negotiation power) they hold; 3) the level of interest they have in SES and/or EU ETS; and 4) the group/coalition to which they belong or can reasonably be associated with, determine the capability the stakeholder has to block, amend or promote regulations either alone or in collaboration with other stakeholders. Hence, Stakeholder Analysis offers a detailed understanding of the aviation game taking into consideration political, economic, and social elements that affect the groups' positions, the hierarchy of authority, but also the power among different groups.

There are big differences among the stakeholders, but also within the stakeholders. For instance, the ANSPs in Europe operate in very diverse environments, both in terms of operational conditions (e.g. traffic complexity and traffic variability) and socio-economic conditions (e.g. cost of living, labour laws). There are also significant differences in terms of size across the ANSPs since the five largest bear 57% of the total Pan-European ATM/CNS provision costs while the five smallest represent less than 1% of the costs.

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9 Conclusion

This chapter is dedicated to the summarised conclusions of the research, but most importantly to the contribution of the thesis to the body of existing knowledge. Moreover, recommendations for the Single European Sky and the European Union Emissions Trading Scheme will be given. Finally, a holistic/systemic approach for handling environmental regulations in the aviation sector will be presented.

9.1 Conclusion for EU ETS and SES

The aviation sector has been included in the EU ETS since 2012. The provisional cap of aviation emissions has been set at a constant level of 210,349,264 aviation allowances per year which represents 95% of the historical aviation emissions. The allocation of allowances was done by free allocation (based on benchmarks and expressed at CO_2 per tonne-kilometre) or via auctioning (15%).

The EU Emissions Trading Scheme is the biggest ETS in scale and size in the world. The impact of Emissions Trading (ET) in aviation affects companies of all size and from various industrial sectors. For instance, the EU ETS in aviation affects the system suppliers in terms of implementing the element of the EU ETS in the Operation Control Centres software for choosing flight paths. The biomass producers are directly affected by the EU ETS. The carbon offsetting schemes in countries outside the EU are also linked to the ETS. Even consumers are affected by the way the trading scheme is set. If the biofuels do not comply with sustainability criteria and if they are produced in land used for food production, food prices are affected. Moreover, if the land is important for biodiversity, the ecosystem is affected. Therefore, the EU ETS not only affects the industries or the countries that it regulates, but it also affects every one of us directly or indirectly.

Aircraft operators are requested to surrender a number of allowances to the Competent Authority. When it comes to compliance with the EU ETS, there are different options.

These options might be short-term (e.g. optimised use of the given technologies) or long-term (e.g. investment in technical progress and new technologies).

In order to achieve successful implementation of stakeholder management within an organisation, the following factors should be considered: a) the effort of the implementation must be aligned with the organisations' readiness, i.e. the maturity of the organisations to comply with the reform, and b) the implementation must be treated as a change programme (Bourne, 2009).

The concept of 'organisational maturity' for measuring the organisation's performance in specific areas and benchmark their existing practices aiming at improvements is essential. The level of readiness of an organisation is closely related to the organisational willingness to engage proactively in developing and improving the processes. Therefore, the readiness of the stakeholders is of critical importance for the implementation and success of both the EU ETS and the SES. If and when the regulator understands the level of readiness an organisation is closer to, the management can define the starting point for improvements in stakeholder relationship management. We should note that the EU ETS and the SES are reform projects for many countries and they involve different stakeholders both in terms of nationality and in terms of nature. On that account, the regulatory authorities (EC, European Parliament, CAAs etc.) should first evaluate the readiness of the involved stakeholders and then proceed to stakeholders' management in order to better support aviation reforms. The challenge is to keep Transaction Costs low enough to ensure that cost-effective reductions of GHGs can be achieved. In addition, the role of the institutions is very important as they are needed in order to make the results believable, enforce contracts, disseminate information and resolve disputes.

9.2 Contribution of the PhD thesis to the body of existing knowledge

The current state of knowledge in the field of Air Transport Management is limited and the most abundant mass of studies concerns airspace engineering and environmental sciences. Most studies focus on the specific and limited topic of research, without linking areas or topics. Moreover, most of the comparative studies in policies refer to individual companies or entities in a single- or cross-country context rather than groups/stakeholders as part of two or more systems at the same time. However, an important contribution of this study is its synthetic nature. The study examined the interaction of the individuals in both reform programmes taking into consideration at the same time more than just the environmental sector.

This PhD thesis contributes to the limited academic literature that is available on the topic of the Single European sky and the environmental regulation of climate change due to aviation operations. At the same time, it contributes by generating empirical evidence on the relationship of reforms to ANSPs and Airlines in terms of environmental performance and operations. To the knowledge of the researcher, no such research had been carried out previously. The contribution is in line with the literature review and the comments of the interviewees and therefore some citations and interviews statements are used to reinforce and support the recommendations.

Different models have been built to measure the carbon footprint of aviation operations and its environmental consequences in general. Other studies have evaluated the welfare effect of environmental problems. There are plenty of studies regarding noise pollution and local air quality in the proximity of airports and their consequences to the health and well-being of the communities living there. Other studies concern the models that evaluate the impacts of the implemented operational solution to civil aviation with regards to environmental performance. This research follows a different approach, focusing on the management perspective and the governance issues related to the implementation of SES and EU ETS. Ultimately, it will be the task of aviation managers to implement policies for the environment.

Furthermore, studies have been carried out about the implementation of the EU ETS in other industries, and research has been conducted concerning the inclusion of aviation in the area of environmental studies focusing on the emission reduction measurements due to EU ETS. As far as SES is concerned, research has been conducted in the engineering part, i.e. approached design, minimum separation criteria and avionics, as well as some studies by EUROCONTROL or the European Commission. However, all these studies were controlled or were conducted on behalf of the European Commission.

Finally, transaction cost economic theory is applied widely in the environmental economics and especially in Emissions Trading Scheme, but it was never applied in the air transport management reforms and so to Single European Sky. It proved very topical to implement transaction costs to Single European Sky. Many participants in the Delphi method commented that they spend a lot of effort on ‘figuring out what is happening and how to handle the reform’. Moreover, all the interviewees reported that all the stakeholders apart from the direct economic cost of handling the reform, they spent and are spending a lot of time and consequently time to develop policies, evaluate the policies, think of strategies, monitor progress, i.e. a cost that is not taken under consideration and is not always obvious. When dealing with reforms implemented within one company or even within one country, the transaction costs are quite low, compared to the cost of the technical changes. However, when the reforms are for the entire aviation system, then the transaction costs and the complexity of implementation and monitoring can be extremely high.

9.2.1 Contribution to the policy makers and the aviation practitioners

From an aviation policy point of view, the findings of the research could assist the relevant decision-and-policy makers with assessing the impact of regulatory reforms to the environmental performance of the sector as well as with evaluating possible corrective measures. The researcher focused on governance issues that obstruct the implementation and effectiveness of the policy reforms. The multi-stakeholders approach in implementing reforms can be a realistic solution to empower the reforms.

9.2.1.1 Recommendations for EU ETS

This section presents the recommendations for the European Union Emissions Trading Scheme. These recommendations focus on the Monitoring, Reporting and Verification processes, the revenue from auctions and penalties, the balance of allowances demand and supply, as well as the interaction with the Global Market Based Measure developed by ICAO.

9.2.1.1.1 More simple MRV process and further environmental training

A major difficulty in the Monitoring, Reporting and Verification of emissions is the verification of biofuels. This issue was brought up by the researcher during a workshop about the MRV and biofuels that was held in June 2016 in Brussels. Many airlines, verifiers and fuel suppliers expressed concerns about the process of MRV and discussed extensively the role of alternative fuels on the emissions reduction.

The central EU regulation for alternative fuels is the RED Directive 2009/28/EC. The EU agreed on a Directive (2009/28/EC) on the promotion of the use of energy from renewable sources (RED). Some Member States have a large share of aviation in their gross final consumption of energy due to specific characteristics. For instance, Cyprus and Malta, due to their insular and peripheral character, have a gross final consumption of energy in national air transport that is more than three times the Community average in 2005. Since these places rely largely on aviation, the exemption should cover the amount by which they exceed the Community average gross final consumption of energy in aviation in 2005, as assessed by Eurostat (Directive 2009/28/EC).

The EU has set sustainability criteria (Directive 2009/28/EC, article 17) to ensure that the carbon savings from biofuels are real and that biodiversity is protected. Biofuels that are not produced according to these criteria do not count towards the environmental targets. According to DG Energy, biofuels cannot be produced either in areas converted from land with previously high carbon stock (such as wetlands or forests) or from raw materials obtained from land with high biodiversity (such as primary forests or highly biodiverse grasslands).

In the renewable energy directive (2009/28/EC: "RED") the European Union, in order to encourage the diversification of feedstocks used to produce biofuels, i.e. biofuels produced from wastes, residues and lignocellulosic, counts for double their real energy value in terms of their contribution to the national EU mandates. The double counting gives an economic value to some biofuel pathways (advanced biofuels) and it can increase their chances of being selected by airlines.

One key issue that airspace users are facing is the complexity in monitoring, reporting and verifying allowances. For instance, reporting the use of biofuels is an especially complicated process. Biofuels are difficult to track when they are blended with the standard aviation fuel. In some airports some airlines have dedicated fuel tank farms. In case the airlines do not have one, the purchased blend of biofuel ends up in the common tank that supplies all the airlines. For instance, if Airline A buys 50% blend of bio-kerosene and this ends up in the common tank farm, it blends with the Fossil Jet A1 fuel that is paid by other airlines. As a result, everyone ends up with a blend of the blend and Airline A is not using what they paid for. In this case, the physical tracing of bio-kerosene is almost impossible. A mathematical fuel balance is used to estimate the use of bio-kerosene. However, the verifier of biofuel has no knowledge about whether or not other airlines purchased bio-kerosene, which imposes the risk of double counting of biofuel and credits. Furthermore, we cannot verify whether the bio-kerosene is used for flights within the EU or for international flights.

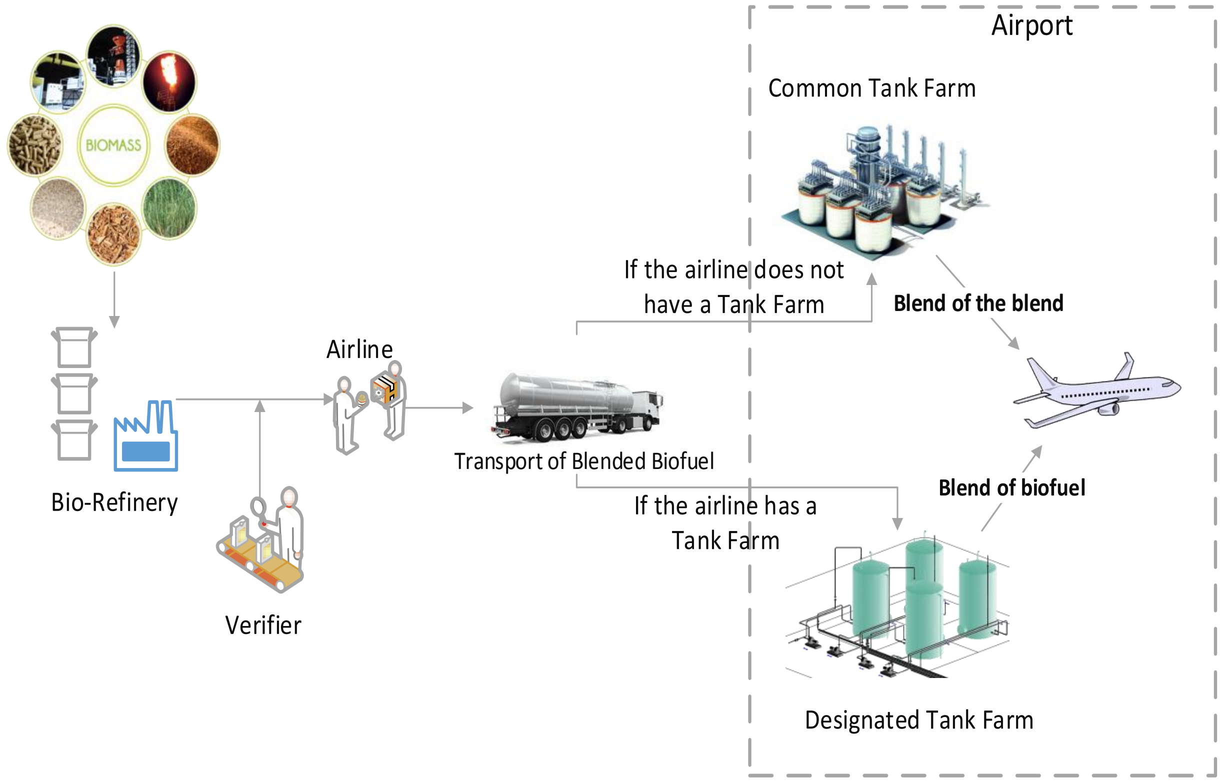


Figure 43: The biofuel journey from production to consumption (Source: own elaboration)

The above described practical problem could be resolved in different ways. For instance, we could claim that every airline should have its designated tank farm in every airport where it buys fuel. This might solve the problem with the use of the biofuel blend but, on the other hand, it would increase the cost of infrastructure and it would create land use problems. Building biofuel tank farms could be a solution, which could become a reality as soon as more airlines purchase biofuels.

A solution would be to virtually assign the credits of biofuels to airlines and to take for granted that the biofuel is used for EU flights. We could then count the total use of biofuels vs fossil fuel and this would make the process much easier and faster, which would encourage airlines to start reporting their use of biofuels. The airlines avoid reporting the use of biofuels blend because the process is too complex and the use of biofuels is limited to a small amount of flights. The interviewees N.05 and N.06 also mentioned this.

Moreover, the physical tracing of biofuels is not possible. The airlines use an intermediate company that purchases the biofuels for them. This company, the verifier, is responsible for the logistics and documentation of the biofuels. The airline and the verifier use national databases to document the biofuel blend use. In these databases, such as the German Nabisy, there is the rule of 'no information' on the supply chain of the biofuel supplier. This ensures that the airline will not bypass the intermediate company and, instead, it will buy directly from the biofuel supplier. This process might protect the intermediate company but, on the other hand, it makes the physical tracing of the biofuel more difficult and it increases the risk of double counting.

Aircraft operators, the MRV authorities as well as everyone involved in the documentation and administration of the EU ETS should first undergo training by the same organisation or training agency in order to have the same level of information as well as reference point for questions and answers. This training will, first of all, help to raise the environmental awareness of the involved members and, secondly, it can ensure a better administration and handling of the EU ETS. The implementation of simpler MRV processes and environmental training is an easy and inexpensive procedure.

9.2.1.1.2 Revenue from auctions and penalties

The Emissions Trading Scheme involves transactions from which Member States can create revenues. The Member States (MS) make revenues by selling allowances in the stock market and from the penalties that are imposed to aircraft operators. The MS according to article 10 (3) of the EU ETS Directive are obliged to use at least 50% of auction revenues in order to combat climate change in the EU and third countries. However, since the MS do not have any obligation to publish relevant information, it is often unknown where exactly the revenues go. Of course, this raises ethical issues for the scheme and it became a main discussion topic in some workshops that the researcher attended.

Regarding the penalties, the MS and the CA in particular are responsible for imposing them. According to Carbon Market Report 2015, the application of the 'excess emissions penalty' in 2014 was reported for a low number of cases (ca. 0.1% of installations) in 6 Member States (DE, ES, PL, PT, RO, UK). As provided for by the Directive, Member States should increase the penalty in accordance with the European index of consumer prices. The range of different penalties varies substantially across MS; in certain cases the minimum can be a few hundred euros and the maximum €75,000, whereas in other cases the imposed penalties might range from €5,000 to €15 million. Seven Member States reported potential penalties in the form of imprisonment.

Another important element is the transaction cost of the EU ETS. The issue here is the existing inconsistency in this respect, as some Member States charge the airlines administrative fees, whereas others do not. According to Carbon Market Report 2015 (EC, COM (2015) 576) there are 16 countries that do not charge any fees to operators. However, six EU countries collect an annual subsistence fee from operators or aircraft operators. These fees range from 671€ to 5250€ per year per operator. In two reported cases, they are expressed as an amount (0.02€ to 0.07€) per allowance. Seventeen Member States reported that they collect fees for various services, such as the approval or update of monitoring plans or permits. Those fees vary significantly, starting from below

100€ up to above 3,000€ for a new monitoring plan approval. That being said, it seems that some member states recover their transaction cost, whereas others do not. The inconsistency that is created, however, is unfair both to the member states administration offices and the aircraft operators.

The situation calls for a standardisation of the processes; penalties should be given by a central agency following the same criteria and methods for all the operators in all countries. The CA should be responsible for MRV and not for imposing penalties in questionable ways. It is also proposed that the MS publish information about the revenue investments. Moreover, the MS should monitor the progress of the carbon offsetting schemes or the environmental improvements projects. Since climate change is a global phenomenon, all the money, i.e. 100% of the gathered revenues, should be assigned to environmental improvements. In order for this recommendation to be implemented, consensus needs to be reached among member states and this is not always an easy thing to achieve. .

9.2.1.1.3 Balance of the allowances market

The EU ETS is a virtual market based on shadow prices and requires that wisely set factors are applied to all aircraft operators in all EU countries. As a virtual market, it allows the ideal setting of the factors, which contributes to the achievement of the EU ETS target, i.e. the decrease of the negative environmental externalities. Since it is a market, all the rules of demand and supply apply to the scheme. As discussed in the literature review, it is evident that there is no balance between the supply and the demand of the allowances. The interviewees N.04 and N.05 expressed their concerns on this lack of balance. A mechanism is thus required in order to accommodate this need for balance in the market.

There are numerous trials to project CO_2 emissions. Different scenarios are applied in order to capture the interaction of the different policies, reforms, changes. However, the problem arises when the different scenarios do not develop according to plan and, in that case, amendment or corrective measures should be taken by the regulator to adapt to the new standards and situations.

According to the EC, there is a surplus of allowances leading to lower carbon prices and weaker incentives to reduce emissions. The surplus amounted to around 2 billion allowances at the start of phase 3 and it increased further to more than 2.1 billion in 2013. In 2015, it was reduced to around 1.78 billion as a consequence of back-loading. Without this, the surplus would have been almost 40% higher at the end of 2015 (EC, 2016). This massive oversupply of allowances has hugely devalued the carbon price.

The surplus is a big issue for the position of aviation in the EU ETS and the existence of a surplus is proven by the allowances price in EEX. The surplus can be either due to a generous cap or an excess supply. According to the result of the Delphi analysis, the CAAs/NSAs (40%), some individual experts (29%) and other governmental bodies (60%) believe that the cap of the EU ETS is too generous. On the other hand, IATA (66%), the airlines (57%) and the ANSPs (100%) believe that the cap was not generous. The fundamental issue faced by the ETS is the absolutely fixed nature of the cap (SSE, n.d.).

Companies that have been given enough free allowances to cover their emissions have an economic incentive to sell any offsets they do not actually need, since they are significantly cheaper than EU carbon allowances, giving them the option to make a profit. According to SSE (nd), the linear reduction factor does not align with expected targets. This phenomenon is mostly for energy industries, but it affects the supply of allowances for the aviation industry, too. This difference in the supply and demand of allowances makes the EU ETS vulnerable and increases the risks for stakeholders and especially investors.

The supply of allowances needs to be controlled for the market to start working. A Supply Adjustment Mechanism (SAM) would allow the supply of allowances to respond to the demand. To control the market, allowances that are considered surplus could be placed into a strategic reserve which can be used only when the demand is much higher than the supply. In the area of aviation, the EC, in an effort to control supply and demand, postponed the auctions and created some kind of scarcity in the market. This was an ad hoc measure with limited but not sufficient results for market stability. A more organised strategy like the SAM would be more beneficial for the virtual market of the EU ETS. The SAM can be used when additional schemes affect the availability of the allowances. For instance, the SES reform through the optimisation of the airspace provided aircraft users with shorter routes and, consequently, fewer emissions, saving in allowance usage. Technological improvements in the aircraft and the engines have the same effect. As a consequence, the supply of allowances becomes higher than the demand and the emissions market becomes vulnerable.

The surplus of allowances can be identified in the auction markets or the banking reserves of the airlines. Airlines are allowed to bank the allowances that they have not used. SchleichI et al (2006:36) claimed that ‘banning the transfer of allowances increases the overall compliance costs because cost savings cannot be traded over time’. After their simulations, they also concluded that a generous allocation of allowances in the first phase results in the collapse of market prices towards the end of the first commitment period and a sharp increase afterwards when targets become stricter. However, reality proved that either the targets did not become strict enough after 10 years or what the simulation was suggesting was wrong. In both cases, the EU ETS needs to change. If the supply of allowances needs to be controlled, the banking of allowances rule should change or the free allowances given for next year need to be reduced. The simplest market rule says that, if the supply is much higher than the demand, the prices fall. Consequently, the aircraft operators will no longer have an incentive to cut emissions or even auction excess allowances.

The Market Stability Reserve (MSR) is a rule-based mechanism that allows the supply of allowances to respond to the changes in demand, maintaining the balance in the EU ETS carbon market. To put it simply, the MSR adjusts the auction volumes. By using the total number of allowances in the market as an indicator, market imbalances due to unexpected shocks that impact demand, such as the economic crisis, can be addressed. This allows the EU ETS to maintain its objective for emission reduction in a cost-effective and economically efficient manner, even under unexpected circumstances.

Another way of offering stability and credibility to the market could be a price minimum cap, a price floor, for the auctioned allowances. This might improve the stability of the allowances markets but it will not serve the target as effectively as the control of the allowances supply. The minimum price for purchase of allowances will increase, ensuring minimum revenues from the auctions, but this does not mean that the oversupply is under control or that the market is functioning. Undoubtedly, it is a measure that can be implemented easier than the ban of banking or further reduction of free allocated allowances and its implementation is recommended, but only as a complement to SAM.

9.2.1.1.4 EU ETS vs Global Measures

The emissions trading scheme in the EU is the largest ETS in the world in scale as well as in scope. Aviation was recently included in it and so far only CO_2 emissions are regulated. At the same time, there are discussions on how global measures will be adopted to address climate change as far as aviation emissions are concerned.

The states were asked to voluntarily prepare the report 'ICAO Action Plan on Emissions Reduction' where they state the measures/actions they take to handle emissions from aviation operations. The states reported on their ATM reforms, i.e. the SES/FABs, the research and development actions like the Clean Sky Joint Undertaking (JU) which is a Joint Technology Initiative (JTI) involving the industry. Moreover, they reported on biofuels with reference to the Renewable Energy Directive (RED) and SWAFEA (Sustainable Ways for Alternative Fuels and Energy for Aviation). This research actively contributed to the development of the “ICAO Action Plan on Emissions Reduction - Republic of Bulgaria” as part of a team from the Directorate General of Civil Aviation Administration - Republic of Bulgaria. These reports are the basis to understanding the similarities and differences among the different policies and actions. To clarify, the EU ETS regulates the airlines. The Clean Sky JU conducts research on the possible technological improvements in the engines and airframes of airplanes and helicopters contributing to environmental performance. The SES regulates ANSPs and the RED regulates the fuel provision.

Carbon offsetting schemes, voluntary or not, do not provide an effective solution to climate change. The funded emission reduction projects enhance the clean technology and support developing countries. Carbon offsetting projects contribute to opening a path to a low carbon economy. However, these projects do not provide a solution to climate change as the problem is not actually resolved, but rather transferred to another industry or region causing carbon leakage. A multi-layered approach with different schemes working in conjunction is needed.

The strong points of the EU ETS is the safeguarding systems to address environmental and social risks as well as the sustainable development criteria. Emitters can buy carbon offsetting only up to a certain extent, avoiding thus leakage phenomena. There are three main MBM: voluntary offsetting, mandatory offsetting with revenue and the emissions trading scheme. The administration of a carbon offsetting scheme is much easier since it can be handled by a centralised database/accounting system. According to ICAO Doc 10018 (2013), the main difference between ETS and carbon offsetting schemes is the use of tradable emissions allowances in the ETS, which would create additional responsibilities and opportunities for the participants as emissions allowances are similar to financial assets.

Climate change is a global phenomenon and, for this reason, it should be addressed at a global level. The EC does not have the regulatory power to impose rules to non-EU countries and carriers. The International Civil Aviation Organization (ICAO) is a UN specialized agency to manage the administration and governance of the Convention on International Civil Aviation (Chicago Convention). ICAO has 191 Member States and it is the most appropriate organization to deal with a global issue. ICAO proposed the implementation of a Global Market Based Measures (GMBM) handling CO_2 emissions worldwide. The decision regarding this was taken during the 39th Session of the Assembly (October 2016). The ICAO GMBMs is the Carbon Offsetting Scheme for International Aviation (COSIA) aiming at addressing any annual increase in total CO_2 emissions above the 2020 levels, taking into account special circumstances and respective capabilities.

Offsetting in COSIA is accomplished through the purchase of emissions units that certify emission reductions in other locations or sectors. The global MBM scheme uses emissions units that are available through carbon markets. This global scheme does not generate any emission reduction credits. According to ICAO, the aircraft operator will be required to offset n tonnes of CO_2. The operator acquires a number of emissions units equivalent to this obligation in the carbon market; each emissions unit corresponds to one tonne of CO_2 that was reduced by another project/program. The aircraft operator surrenders these emissions units to the regulatory authority. The regulatory authority records that the operator surrendered these emissions units, thereby fulfilling its obligation (ICAO, 2016). The decision on the implementation of GMBM was taken during the 39th ICAO Assembly (27/09/2016-07/10/2016) and until the 40th ICAO Assembly in 2019 there will be actions for the implementation of GMBM, which is expected to be implemented by 2020. The first

Compliance cycle will be in 2021-2023, the second compliance cycle concerns the period 2024-2026 and finally the third period will be in 2027-2029. The quantity to be offset by each operator is calculated using a formula that takes into account the average percentage increase in the sector's emissions, the operator's individual percentage increase in emissions, as well as adjustments for fast growers and early movers.

One important element of CORSIA is that it takes into consideration the fast growers, new entrants, de minimis thresholds and the early movers. The new entrant is exempted from the application of the CORSIA for three years or until the year in which its annual emissions exceed 0.1 per cent of total emissions in 2020, whichever occurs earlier (ICAO, 2016). Due to high transaction costs such as administrative costs, the smaller entities of both airlines and aircraft are exempted. Fast growers, i.e. individual airlines predominantly serving increasingly growing routes, will have fewer offset obligations than airlines serving more mature routes, in order to support those routes. There is a number of airlines that have invested in more fuel-efficient airplanes and/or have improved their operations resulting in fewer emissions. For those airlines the allocation of offset obligations will be made based on a historic performance benchmark (European Parliament, 2016).

It is evident from both the ICAO Action Plans and the Delphi research undertaken in this thesis that one measure cannot on its own lead to carbon neutral growth. The COSIA initiative is a carbon-offsetting scheme that does not reduce emissions and climate change. It gives the opportunity to aircraft operators to transfer their emissions somewhere else without actually cutting them and without leading to carbon leakage. The initial name of the GMBM was COSIA, which stands for Carbon Offsetting Scheme in Aviation, and ICAO renamed it to CORSIA, i.e. Carbon Offsetting and Reduction Scheme in Aviation. This is indicative of the change of the scheme's aim making it maybe more vulnerable to carbon leakage. A fuller set of measures can achieve a better outcome. The ICAO Basket of measures reducing aviation emissions is definitely a better solution to handle climate change. Individual efforts cannot lead to carbon neutral growth. The schemes should act complementarily to achieve the maximum outcome.

9.2.1.2 Recommendations for SES

This section presents the recommendation to improve the performance of the SES. The recommendations focus on raising the environmental awareness of ANSPs and CAAs, the use of navigation charges as incentives for better environmental performance, the consolidation of ANSPs and the ideal regulatory system for the better implementation of Performance Scheme. These are considered in turn.

9.2.1.2.1 Environmental awareness of ANSPs and CAAs

The KPA of Environment in the Performance Regulation is not exactly a separate target, but someone could argue that it benefits from improvements in the other areas. The creation of FAB and the implementation of FUA and FRA, the improvements in the communication and data sharing or the decrease of the en-route delays have positive consequences to the environmental performance. The targets set in the Performance regulation assist in measuring the benefits, but also in promoting the mentality of protecting the environment.

Environmentally-friendly attitude and behaviour is not common across all the ANSPs and countries and this was noted during the participant's observation. As discussed in the literature review, some of the ANSPs have implemented additional measures to protect the environment, hence they prove a more environmentally friendly behaviour. On the other hand, some ANSPs prioritise the other KPAs and the environment is not among their priorities (supported also by Interviewee N.01). In order to promote consistency among ANSPs and handle the global problem of climate change, a change of mentality is deemed necessary.

The most effective action to increase environmental awareness is to change the mentality of ATCOs, ANSPs employees and CAAs employees. Public Environmental Awareness and Education could be applied either by each state or centrally by the EC or NM. Should the training be developed and delivered from the CAAs/NSAs or Ministries of Transport, the implementation is expected to be self-defeating. The reason is that the educators most probably share the same mentality and do not have the mentality of environmental protection and sustainable development. They also need to be trained and educated. If the training was organised by a central authority like the EC or EUROCONTROL, there would be fewer transaction costs due to economies of scale. The researcher attended 'the Aviation and the Environment' training course offered by IANS/EUROCONTROL and believes that, if it was more adapted to SES and if some practical elements were introduced, it could become an effective solution.

In addition, airspace users are not making the best from SES. There are conditional routes available that the airlines do not use either due to the short notice or due to the difficulty from the AOC to change the flight plans as a system. The airlines should also be informed about the implemented solutions regarding the CDRs and a better communication channel should be developed to make the change of routes a reality. The implementation of this recommendation is considered very important and necessary. The main advantage of its implementation is the low cost, the acceptance by the stakeholders and the radical effects it will bring to the environmental protection mentality.

9.2.1.2.2 Charges Scheme as Incentive mechanism

In terms of mitigating Climate change in the en-route level from an operational perspective, the main stakeholders are the Airlines and the ANSPs. The Airlines have an incentive to reduce their emissions based on the principle that excess fuel consumption costs them money. The ANSPs have no incentive to be more environmentally friendly (Interviewee N.03).

The airlines behaviour depends a lot on fuel prices. Fossil fuels are much cheaper than biofuels. Therefore, the price is the main parameter for its use. Secondly, the availability of biofuel is another important element as the airlines often have difficulties in finding biofuels. Finally, the certification and verification of biofuel use as explained above in the EU ETS process can be quite complicated. The question that arises is whether airlines need another incentive for using biofuel.

One way to enhance the use of biofuels by airlines would be a discount in the en-route or terminal charges. All countries would benefit from the use of biofuel, regardless of whether the flight is taking place in their airspace. Should the discount be in the en-route phase, it would mean that all ANSPs should offer a discount to that airline proportionally to the airway use. If the discount was in terminal charges, that would bring extra benefits for the airports. Some airports, Heathrow for instance, face problems with the Local Air Quality (LAQ) and, if the airlines had a financial incentive to use biofuels, those airports would improve their LAQ and bring benefits to the local society. Biofuels though would be used during the whole phase of the flight contribution to climate change mitigation.

The discount in the en-route charges for biofuel users might be a solution that needs to be accepted by all ANSPs, but some might bring objections to that. Discount to terminal charges in some selective airports that have a problem with LAQ because it might be a constraint for their expansion, is something that could be implemented more easily. Airports and local communities have adopted, or tried to adopt, measures to regulate airlines operations with regard to LAQ by implementing Pigouvian taxes, like the Catalonian NOx tax as discussed earlier. The taxes are not well received by airlines and the airlines often threaten airport authorities that they would move their operations to other airports (Interviewee N.02). A discount could be a solution and it would be well received by the airlines, it would improve the LAQ and it would help an airport expand, as it would comply with the environmental regulations.

The practical difficulty in this solution is the administration of biofuel use. When the airline does not possess a dedicated fuel tank, it is unknown whether the specific airline is using the biofuel. This solution can work for big airlines when they operate for flight connecting their base/hub with another big airport, but not in the connections among regional airports. Heathrow airport is capped to 480,000 ATMs per annum and hosts on average 670 flights per day. The fuel demand in 2008 was forecast to be 8 mil litres, but BAA and BA demand forecasts show fuel doubling by 2030 (IATA, 2008b). In 2008 there were two fuel tank farms and fuel was delivered to aircraft via hydrant systems. The analysis conducted by British Airways stated that LHR needs four additional tanks to accommodate fuel demand. Should the expansion of LHR be a reality and given the need for fuel storage, BA -as the dominant airline at Heathrow- should have a dedicated farm tank that could facilitate biofuel use and tracking.

As far as route availability is concerned, the organisation of auctions regarding the routes that are closer to GDC could be a possible scenario. The ANSP could modify the charging scheme and charge by route. Routes identical or almost identical to GDC could be auctioned to airlines that are willing to contribute more for the use of these routes. The principles of slot trading could be implemented to this mechanism. For the time being this scenario looks unrealistic, but it could be an effective solution in case the nature of ANSPs changes and consolidation is achieved or in case ANSP alliances are reinforced and promoted.

The ANSPs could be reshaped to have a centralised en-route level, or at least one handled by a single company or authority, as well as a terminal level handled by the national authority/company. This would promote consistency among the different sectors, reduce the number of sectors and improve data sharing leading to improved, more direct routes. Other than that, the existing performance regulation includes economic incentives when the ANSP performance is above the expected targets. The implementation of this recommendation can be time-consuming and bears many bureaucratic procedures, but it is a very effective way to encourage an environmentally friendly behaviour.

9.2.1.2.3 Consolidation and financing

As discussed in previous chapters, the economic situation and the readiness of the countries are not at the same level. The performance targets are set at national/FAB level and at EU-wide level. Nevertheless, it is not very clear how these targets are set. They can be set at individual rate, at sectoral rate or a combination of both. The hybrid option could balance the pros and cons of the individual rate and sectoral rate options. It could be one level ahead of the existing regulation, offering flexibility and accommodating the needs of fast growers, new entrants and early movers so as to make the implementation of the regulation fairer for all the players. In case some ANSPs face problems that might make the achievement of the targets extremely difficult, the possibility to freeze the targets should be available.

Some ANSPs have already taken action before the implementation of the Performance Scheme to improve and make their operations more efficient. From a fairness perspective, those early birds should be rewarded but they would be ignored if the targets were allocated based on the sectoral rate. Moreover, with regard to capacity and environment, the efficiency of ANSPs in ECAC is affected by the efficiency of other ANSPs that are not based in ECAC, but that handle traffic entering the ECAC airspace. Therefore, the scope of SES and the performance scheme could be extended to capture the actions of the neighbouring ANSPs.

The current aviation system in terms of ANS provision is based on the natural monopolies or, in the best case, on the oligopolies of ANSPs. The cost of infrastructure as well as the cost of service provision is very high which results in high charges for both the airlines and the passengers. Furthermore, some ANSPs cannot increase their CAPEX due to financial problems. The Greek ANSPs' revenues from the charges are not necessarily reinvested to the ANSP thus contributing to infrastructure improvements, but they may be allocated to other sectors, such as healthcare or education. Consequently, there might be inefficiencies in the aviation systems affecting all the other ECAC members. If a special financing system from the EU is implemented to economically support those ANSPs for technological improvements, this might be unfair for other countries.

Most of the ANSPs handle a small share of movements, but they still need all the infrastructure. Traffic movements are concentrated in 4-5 countries, i.e. 4-5 ANSPs. Nevertheless, this does not necessarily mean that only those 4-5 ANSPs are needed to provide ANS. Services could be provided from the most efficient and effective ones (one or two) with regard to safety, capacity, environment and cost efficiency factors. The system could be more efficient if the number of ANSPs was reduced or if some of the ANS were centrally provided by a separate entity. This recommendation is quite controversial and it can create a series of reactions from the trade unions. However, due to increased competition among the ANSPs, it will be a reality in the coming future and it is better to organise and control this transition.

9.2.1.2.4 Independent regulator

The Single European Sky (SES) reform is a necessity in order to respond to the contemporary needs of civil aviation. The European Parliament and the Council vote on the regulations, whereas the European Commission drafts the regulations with the help of some agencies. In order to monitor the performance plans of the Functional Airspace

Blocks (FABs), the Civil Aviation Authority (CAA) was separated from the Air Navigation Service Provider (ANSP). The National Supervisory Authority (NSA), which is usually part of the CAA, is responsible for monitoring the performance of the ANSP that is offering the services to the state. This separation was made in order to gain credibility and transparency in the monitoring process as well as in the proposal of corrective actions. The CAA/NSA is responsible for proposing penalties or financial awards to the ANSP. The question that arises is the independence of the CAA/NSA from the ANSP.

A more independent regulator for the ANSP is proposed. The regulator can be the CAA of X country regulating and monitoring the ANSP of Y country. This might lead to mutual forbearance, as the CAAs of X country are less likely to act aggressively if needed when they perceive that the CAA of Y country can counterattack the ANSP of X country. This is related to the ownership of the ANSPs. Should the ANSPs be private entities, the mutual forbearance would be an unlikely hypothesis. In order to avoid this case, it should be ensured that the X country's ANSP is not monitored by the Y country. This would enable the existence of a more binding mechanism for the FAB/State and the ANSP allowing the targets set to be cascaded.

The Monitoring, Reporting and Verification practice of the EU ETS could be applied to the SES, too. This would either enhance the efficiency of the ANSP or create frictions between the ANSPs and the CAAs/NSAs. ANSPs could claim that, due to safety issues and the confidentiality of the operations of Military aviation, they do not wish to share specific information with foreign countries.

Currently, there are many agencies and bodies involved with a rather unclear role, leading most probably to duplications of the tasks and efforts without contributing to the overall efficiency of the system. The role of EASA regarding the SES is not clarified enough (Interviewee N.07 and N.04) and, according to IATA, AEA and ERA (2013), the NM should be empowered with new responsibilities and functions concerning airspace architecture. The position of the Performance Review Body and the Performance Review Commission should be further clarified since the PRB and PRC almost consist of the same members holding different positions.

Another way of regulating the ANSPs more effectively could be the establishment of a body with the power to impose fines and actually enforce the regulation. PRC or PRB should be re-established and enrich the body with industry members, such as representatives of IATA, EUROCONTROL, CANSO and NCP. If the PRB/PRC consisted of all the main stakeholders, the regulation could be more effective as the consultation would be realistic and the views of the different stakeholders would actually be taken into consideration. The role of the new, reshaped PRB would not only be to monitor, but also to establish the performance scheme, to monitor and enforce the targets to the member states.

9.2.1.3 Policies interaction and systemic approach

Engine manufacturers are obliged to meet the noise certification standards adopted by the Council of ICAO that are included in Annex 16 — Environmental Protection, Volume I. The engine emissions principles and standards for the airplanes are also included in Annex 16. The EC implemented the Directive 2002/49/EC and the Regulation (EU) No 598/2014 on the procedures concerning the introduction of noise-related operating restrictions. The Framework Directive 96/62/EC and the Directive 2008/50/EC refers to the ambient air quality and cleaner air for Europe. Apart from global policies and EC regulations, there are also national regulations regarding noise levels and the LAQ. Pigouvian taxes can be imposed at national or local level. Those taxes are directly imposed to the airlines in combination with ICAO standards to manufacturers and EC regulations to airports.

With regards to climate change, engine manufacturers are regulated by Annex 16 of ICAO. Airports refer to local level only, and, thus, there is no regulation for climate change regarding aircraft operations. Airlines are regulated by the EU ETS and ANSPs are regulated by the performance regulation of SES. The passenger is the key point for air transportation, but since the passenger is the consumer and not the producer, there are no binding regulations for the passenger.

Apart from the regulations, the players can take additional actions to mitigate or compensate their emissions. Once example is the Clean Sky Joint Undertaking focusing on technological improvements in the engines and airframes of the airplanes. The European Advanced Biofuels Flightpath aims at putting sustainably produced biofuels to the market faster through the construction of advanced biofuel production plants and at convincing the aviation industry to use 2 million tonnes of biofuels by 2020. Oslo airport is the first airport in Europe offering biofuels to all airlines. AirBP, the Norwegian airport operator Avinor and biofuel specialist SkyNRG work together to provide airlines at Gardermoen Airport with biofuel for jets. Finally, ICAO also introduced a balanced approach according to which airplanes should be quieter, the land around airports should be managed in a sustainable way, operational procedures to reduce the ground noise should be implemented and operating restrictions should be adopted.

Figure 44 depicts the interaction of the EU ETS with operations and technology policies according to four scenarios. The first scenario is business as scheduled. In order to achieve carbon neutral growth, operational and technology policies (grey bars) are needed in combination with the EU ETS (blue bar). The EU ETS is represented by the blue bar, whereas the operational and technology policies are the grey bars. The blue line represents traffic growth. In the first three scenarios, the traffic growth is positive and as expected. The second scenario is capturing the case of failing operations and technology policies. If those two policies underachieve their targets, more emphasis should be given to the EU ETS. By imposing stricter EU ETS requirements, the carbon prices will increase. According to the third scenario, if the supplementary policies achieve more than expected, the EU ETS requirements will become less strict leading to lower carbon prices. Finally, the last scenario suggests that traffic is reduced and, subsequently, the emissions as well. Should this be the case, the EU ETS will not be necessary for carbon neutral growth. It should be highlighted that the aim of the policies is environmental improvements and not overregulating the market without bringing benefit to the social welfare.

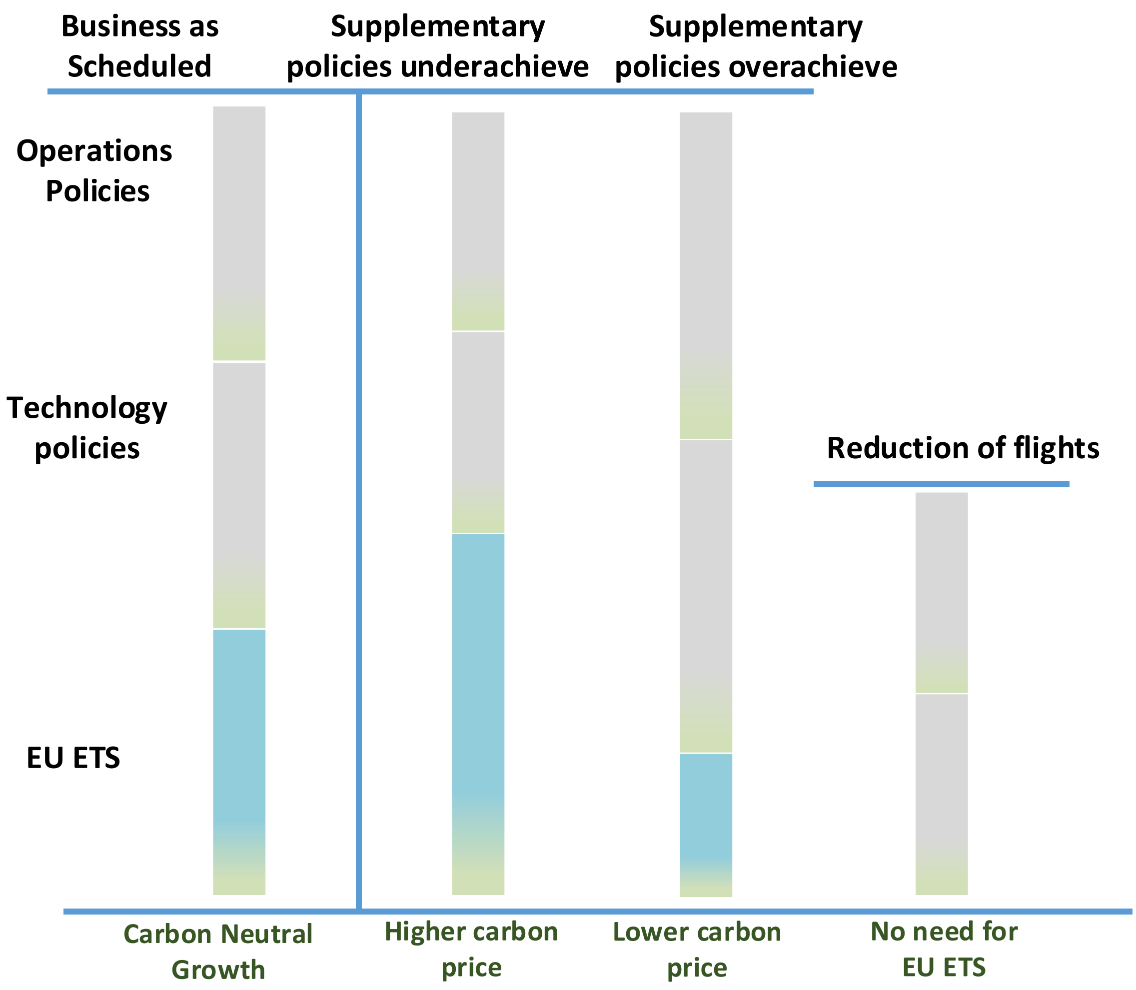


Figure 44: EU ETS and other policies for carbon neutral growth (source: own elaboration)

The environmental issues should be addressed holistically according to the unstructured interviews and as identified by the Delphi method and the participant observation.

Regarding the operational aspect of aviation, the problems of the air transport industry (orange boxes in Figure 45) are the high cost of ATM service provision, the delays and related costs, safety issues and the climate change caused by excess fuel burn and emissions. Those problems are caused by the fragmentation of the ATM sector, labour and social issues, economic difficulties faced by the States, outdated technology and lack of airspace capacity (blue boxes in Figure 45). The reforms (red boxes in Figure 45) currently implemented are the EU ETS for the aircraft operators, the SES for the ANSPs and the Clean Sky JU for the manufacturers. The supply chain, mainly the manufacturers, are not forced to implement the technological solutions developed by Clean Sky JU, but they contribute to the Research & Development (R&D) cost of Clean Sky.

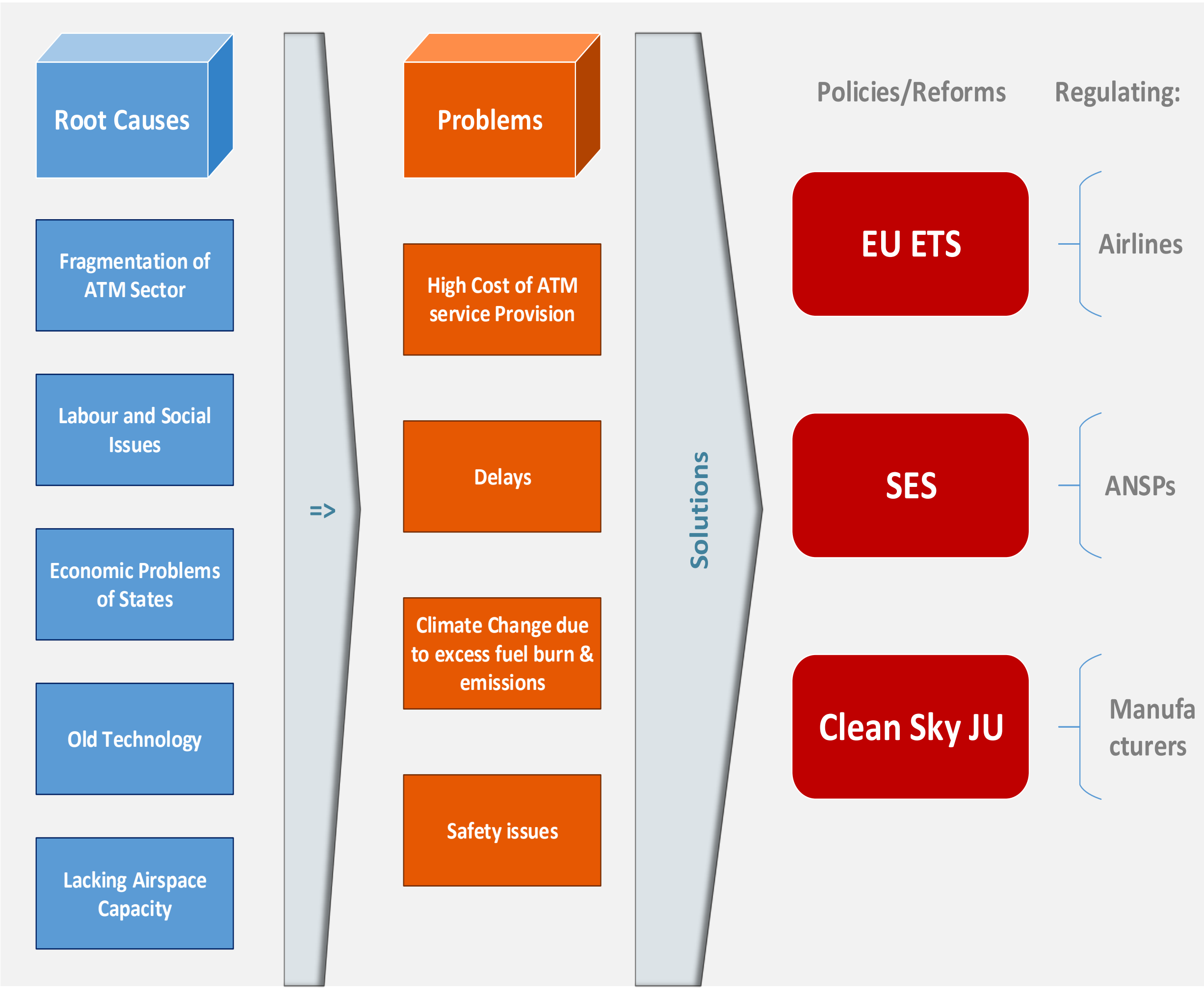


Figure 45: Problems and recent interventions in aviation (source: own elaboration)

In conclusion, there are two aviation stakeholders that are regulated (Airlines and ANSPs) and one that is self-regulated (manufacturers). The airlines operate under competition and in a global environment, the ANSPs are natural monopolies or oligopolies and operate in a national/local or ECAC environment, whereas the manufacturers are under oligopoly selling their products worldwide. The EC cannot impose a regulation to the manufacturers due to the fact that not all manufacturers are obliged to comply with EC rules and regulations. The only solution in ECAC level would be to intensify the existing environmental regulations and ensure their effective implementation.

On the other hand, should ICAO implement the GMBM in all airlines, there will be no need for the EU ETS to continue in aviation; it can focus on other industries. The policy makers should approach this option taking into consideration all the industries and addressing climate change holistically. The lack of collaboration and coordination in R&D at regional and multi-national levels, within one industry and cross-industries should be eliminated.

The environmental aspects of aviation should be looked into in parallel with the economic situation of the airlines, ANSPs and states, and societal needs. Moreover, Research and Development is a very costly sector and, when developing environmental policies in aviation (like the use of biofuels), the needs and policies for the other means of transportation should be interlinked. The links should be formed within Europe but also with the rest of the world.

Finally, managing the stakeholders is one of the most critical points in order to achieve an effective reform. The interests of the different airlines, airports, ANSPs, States, CAAs, fuel suppliers, manufacturers and policy consultants should be taken into consideration when designing environmental policies. The next step is to develop more platforms, apart from the NSA Coordination Platform, and move beyond the consultation documents. The NSA have reported that they find the NSA Coordination Platform (NCP) very useful as it is the only established official platform where they can gather and discuss related matters in person promoting the exchange of information and lesson learning. Similar platforms could be developed encouraging each group to meet separately or with other groups and contribute their ideas or express their concerns to the regulators.

The processes should be adapted to the needs and capabilities of the stakeholders in all states or send experts as secondments to help the groups perform their obligations. Apart from that recognition of efforts, the communication of benefits and burdens as well as the fair distribution of benefits should be a priority for policy makers. When policy makers work together with the stakeholders, the can be more easily identified and solutions can be found with less difficulty. Improved communication, monitoring and reporting, incentive systems and third party review are key elements for the sustainable development of aviation through SES and EU ETS. In this way, potential conflicts between airlines, airports, ANSPs, CAAs, suppliers, policy advisers and makers will be identified and addressed. The connection and linking among the different schemes, rather than their individual function, can bring operational cost savings. However, the linking should be done only if there is consistency among the schemes in question.

9.2.1.4 Concluding remarks of recommendations

Since Climate change is a reality with tremendous impacts to human well-being, it needs to be regulated. Both EU ETS and SES can contribute to the mitigation of emissions. Both reforms face many problems in terms of their effective implementation because, even though they have been implemented, they do not deliver to the expected extent.

- A common solution would be to change the mind-set and mentality towards the environmental performance of civil aviation. The transparency and credibility of the SES and EU ETS can be enhanced by putting in place an independent regulator that is able to balance the influences by the industry, airlines, ANSPs, governments and all the stakeholders.

- In addition, the financial aspect can be a useful tool towards achieving the targets. The ETS bonus to the use of biofuels can enhance their use and economic incentives to ANSPs can enhance the offer of flight efficiency measures taken by the ANSPs. Climate change is a global issue which requires a global solution. ICAO is an organisation with power all over the world. The Market-Based Measure that will be implemented by ICAO should focus on the reduction of the actual emissions and it should not lead to carbon leakage.
- Finally, the central point of the recommendations is the holistic approach of the environmental regulations. The regulator should consider all the policies and their interrelation in order not to have underachieving or overachieving schemes that are under-regulating or over-regulating the aviation system.

9.2.2 Contribution to the methodology theory

The originality of the proposed thesis is also based on its methodology. The Delphi method that was applied is usually conducted with one questionnaire (in which questions can be added) in 1, 2, 3, n rounds. In this research, two sets of questionnaires were used. One questionnaire (EU ETS Questionnaire) was addressed to airline orientated experts, and a second questionnaire (SES questionnaire) was addressed to air navigation experts. Both sets of questionnaires were focusing on the same issue, i.e. environmental performance and governance issues, but from different perspectives. The questionnaires had some common questions and few experts participated in both surveys since they had expertise in both areas. This can prove very helpful for future research that combines complex and multidisciplinary topics.

Finally, the study contributes to the body of knowledge of secondary research and the industry by creating a conceptual framework for the systemic environmental performance of the air transportation sector. The comprehensive overview of the Single European Sky with emphasis on the environment under the perspective of the management stream is one of the few such overviews. On the other hand, the EU Emissions Trading Scheme in aviation and the connection of operational improvements, i.e. SES, is a very different undertaking.

9.3 Conclusions for the Research Questions

The main reason for endeavouring on this research path was the unanswered question why aviation is not as regulated as the other industries in terms of the negative environmental externalities. The reason was the airlines were traditionally owned by the state and regulating them via a tax or via MBMs would not make any sense in the context of vertical governance. There has been little academic discourse on the management aspect of aviation regulation and especially in the area of ANSPs. In the current PhD thesis, the research focused on the area of governance issues in civil aviation related to the implementation of the SES and EU ETS reforms. The SES reform focuses on restructuring the airspace system and reshaping the ANSP sector. The EU ETS aims at regulating civil aviation operations and at internalising external negative economies that are related to climate change.

In order to understand the interactions of the policies, the general picture of the environmental problem and the reforms should first be explained. The environmental issues constitute a real problem. The environmental issues originate from natural causes and human causes. Natural causes, such as changes in volcanic activity, solar output or the Earth's orbit around the sun, cannot be controlled or mitigated. Human causes, such as the burning of fossil fuels and the conversion of land for forestry and agriculture, were intensified after the industrial revolution. The human-induced enhancement of the greenhouse effect should be regulated to handle the negative externalities and achieve sustainable development.

The main environmental issues in Europe are Local Air Quality, Noise Pollution and Climate change. Those issues are addressed at a local level, at EU level and at global level. Since climate change is a global problem, any solutions implemented locally are less effective than solutions implemented globally. Global warming is primarily attributed to the increase of the natural greenhouse gas effect. Without appropriate action, climate change endangers both the environment and the people. Temperatures are rising, upsetting the balance of the ecosystems, plants and animals. Landscapes are changing, rising seas threaten airports, and intensified storms affect aircraft operations. All the above put communities at risks and have a high economic impact.

Carbon dioxide is the main cause of human-induced climate change and it is a very long-lived gas contributing to the greenhouse effect. Increases in CO_2 are due primarily to fossil fuel use, with additional contribution from the change in the use of land. Risks from climate change depend on cumulative CO_2 emissions and, according to IPCC, there is fair scientific understanding regarding the behaviour of CO_2 concerning climate change. Consequently, CO_2 is the element that is regulated. The main sectors that contribute to climate change and CO_2 emissions according to CAIT (2015) are: energy-electricity/heat (33%); Energy/transport (16%); Energy-manufacturing/construction (14%); agriculture (12%); energy-other fuel combustion (9%); industrial processes (6%); energy-fugitive emissions (6%); and waste (3%).

According to IPCC (1999), airplanes emit gases and particles which alter the atmospheric concentration of greenhouse gases, trigger the formation of condensation trails and may increase cirrus cloudiness, all of which contribute to climate change; airplanes are estimated to contribute about 3.5% of the total radiative forcing (a measure of change in climate) by all human activities and that this percentage, which excludes the effects of possible changes in cirrus clouds, was projected to grow. The main players involved in air transportation are manufacturers, airports, airlines, the ANSPs and passengers. Figure 46 depicts the different policies that each player is obliged to comply with.

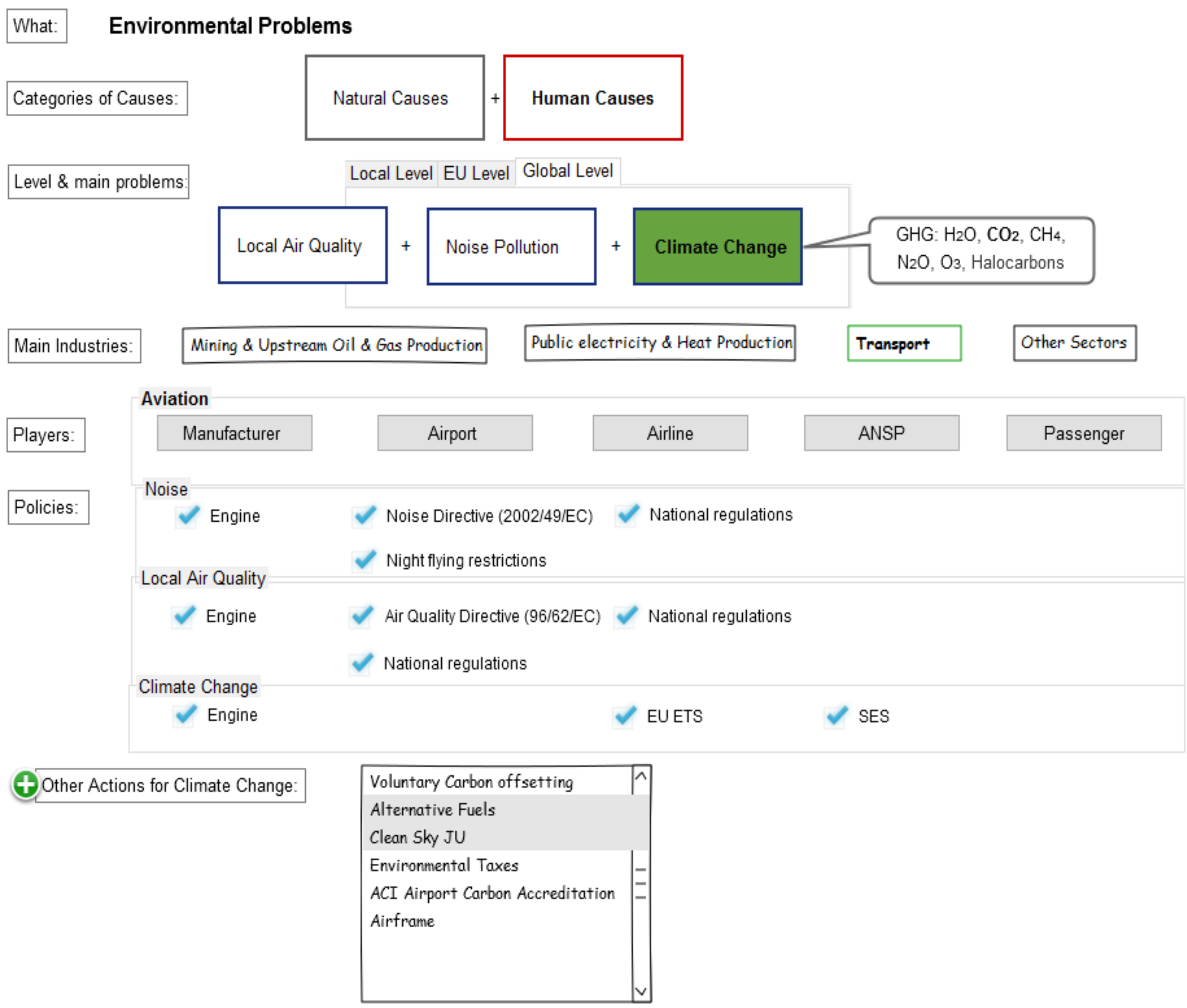


Figure 46: Aviation Policies for Environment (source: own elaboration)

The aim of the PhD thesis was to analyse the aviation governance concerning environmental regulation of aircraft emissions. The thesis used Single European Sky and EU Emissions Trading Scheme as its major schemes of study and looked into their interaction and implementation having as main target to identify any areas in need of improvement and make suitable recommendations for policy makers.

In order to achieve this aim, the PhD thesis addressed the following research questions (as identified in chapter 1):

Research Question 1: Are airline operations environmentally sustainable and what are the factors leading to sustainable growth?

The three pillars of sustainable development as discussed in chapter 2 are a) the economic pillar, b) the social pillar and c) the environmental pillar. Aviation offers connectivity to remoted or isolated regions, supports 63 million jobs and $2.4 trillion in economic activity. A third of all global trade by value is shipped by air. Despite the fact that aviation is a valuable driver for the economic development and the society in general, it damages the environment.

Airport operations, aircraft manufacturing, construction of infrastructure, etc., produce harmful emissions and damage the natural environment and the social welfare. Emissions of nitrogen oxides (NOx), carbon monoxide (CO), unburned hydrocarbons (UHC) and particulate matter (PM) contribute to local air quality deterioration, resulting in negative human health and welfare impacts. Air pollution has been linked to diseases like cancer, asthma, stroke and heart disease, diabetes, obesity, and dementia. Those negative externalities do not have a direct cost for the one that creates them.

In the context of airlines, burned fuel produces the aircraft's emissions. The airline industry's fuel bill is estimated to $181 billion in 2015 and accounts for the 27% of operating expenses at $55/barrel (IATA, 2016b). In 2003 when the oil price was at $28.8 per barrel (13.6% of operational cost), the airlines focused on reduction strategies of other costs (IATA, 2016b). When the price per barrel of crude oil is high, the airlines focus on ways to reduce their fuel costs. Strategies for fuel reduction, apart from hedging, are the use of environmentally friendly aircraft/engines or operational improvements. By reducing the fuel consumption, airlines also reduce their emissions. Hence, airlines for example in comparison to airport operators or ANSPSs, have a direct economic incentive to emit less.

Based on the literature review discussed in this thesis, in order to have sustainable development in aviation, all three dimensions, i.e. environmental, social and economic dimension, should be balanced. As discussed in chapter 2, this is not the case for contemporary aviation where the environmental pillar was not taken seriously under consideration until the introduction of EU ETS, SES and other environmental schemes. On these grounds, aviation growth is not regarded as sustainable for the time being. Should the environmental aspect be incorporated better in the aviation operation, then aviation will have a more sustainable growth.

Research Question 2: How does the market environment and structure, in which the Single European Sky (SES) and the European Union Emissions Trading Scheme (EU ETS) are implemented, affect the efficiency of the schemes?

The market environment of airlines is very different from the ANSPs market environment. Therefore, the implementation process and associated issues of SES and EU ETS are very different too. The airline environment in Europe is quite competitive with many private companies with different business models. The EU ETS as discussed in chapter 3 is a reform scheme for different sectors and it included aviation in 2012. The airlines according to the regulatory framework may take actions to reduce their emissions, leading to excess allowances that they can bank or sell. Moreover, the carriers can purchase allowances from auctions (either from other airlines or other industries) or from carbon offsetting schemes. Therefore, the EU ETS market environment is primarily affected by the competitive environment of airlines (game theory can explain the airlines' behaviour) and the other industries to a lesser degree. European airlines could not obstruct the implementation of EU ETS, but the non-EU airlines managed to ‘stop the clock’ and amend the regulatory framework.

On the other hand, the ANSPs environment as analysed in chapter 4, is characterised as natural monopoly, where almost every country has its own national ANSP. This practice is slowly changing where few ANSPs in spite of being state-owned developed a profit orientation. For instance, Belgocontrol offers training modules to individuals about safety, capacity, economic and environmental efficiency.

Few ANSPs (e.g. NATs) offer services to other states and established cooperation or even alliances, leading to an oligopolistic market. For instance, DFS (a state-owned Limited Liability Company) offers ATC services at Gatwick airport. A6 alliance, Noracon and COOPANS are the first alliances of ANSPs. Those alliances are concentrated around the biggest ANSPs, i.e. NATS, DFS, ENAIRE, ENAV, DSNA, PANSA and the northern countries. ANSPs like Croatia Control and MATS find it difficult to follow the ‘giants’.

The fact that ANSPs are still the leading players within their national borders (for both terminal and en-route control) means that there is still a monopolistic market that moves towards oligopoly. Due to this monopolistic/oligopolistic market, the full implementation of the SES is obstructed by the ANSPs unwillingness to liberalise the market.

Research Question 3: Can the inclusion of aviation in the European Union Emissions Trading Scheme and/or Single European Sky lead to carbon-neutral growth?

In chapter 3 and 4, it was made evident that both the EU ETS and the SES contribute to environmental improvements. The main aim of EU ETS is CO_2 reduction. European Commission set the cap at 210,465,788 allowances per year. 82% is granted for free and

15% are auction (3% are held in a special reserve). There is only a 5% decrease to the allowances. It should be noted that the 15% of the 5% might be coming from the flexible mechanisms of Kyoto that does not necessary mean carbon emissions reduction. As analysed in chapter 7, the Delphi participants were asked to share 100 points to the factors that lead to carbon neutral growth and none of them gave 100 points to one factor. All of them split the points to two or even nine factors, the most important of which were flight efficiency and ETS. As a conclusion, the EU ETS alone (when 82% of the allowances based on the initial base year are for free) is not sufficient to achieve carbon neutral growth.

On the other hand, the Single European Sky never aimed to carbon neutral growth. SES has the following high - level goals: a) to enable a 3-fold increase in capacity which will also reduce delays both on the ground and in the air, b) to improve safety by a factor of 10, c) to enable a 10% reduction in the effects flights have on the environment and d) to provide ATM services to the airspace users at a cost of at least 50% or less. As discussed in Chapter 7, the Delphi participants were asked if the route optimisation is sufficient enough to lead to carbon neutral growth; the majority of the participants stated that it is not enough (mean=1.77 where 1 is strongly disagree). The KPA of environment as understood in the participatory observation and the unstructured interviews is more like a 'fortunate', positive side-effect of the operational changes in the ATM system that aimed to improve capacity and safety and has positive externalities to the environment area. Therefore, and although the Delphi participants agreed that FABs lead to reduction of emissions, the SES alone cannot lead to carbon neutral growth.

Research Question 4: Can the effective implementation of SES render the EU ETS redundant and are the environmental targets overlapping?

The SES general target is to reduce the effects flights have on the environment by 10%. According to the performance scheme (RP2) the EU - wide targets are to reduce the average horizontal en route flight inefficiency for the last filed flight plan trajectory to 4.1% and for the actual trajectory to 2.6 %. The targets of SES are related only to ATM structure and in some parts to the airline's decision to use the possibilities offered by the ANSPs (e.g. CDRs) as identified by the participatory observation at EUROCONTROL. Therefore, there is no overlapping between the targets of SES in relation to EU ETS. SES was implemented after the baseline calculations for EU ETS had been set. Therefore, the environmental benefits of SES are not taken under consideration to the allocated allowances for EU ETS.

The EU ETS is an environmental regulatory framework and it included aviation in 2012 in the third phase. In 2012 the cap was 97% and from 2013-2020 the cap is 95% of the baseline (average annual emissions of 2004-2006). The EU ETS target is easier to achieve because the business environment of aviation operations was very different in 2004-2006. Therefore, the environmental target is made redundant and the scheme in spite of not underperforming according to the target, it is not delivering the emissions reduction that it could. This was concluded after the long discussions and interviews with the 7 experts that belong to different groups. Nowadays, the technological state-of-the-art as well as the ATM structure and procedures are of higher standards compared to 2004-2006. It would be much better if the cap were applied based on the previous year operations.

Research Question 5: What do the research findings reveal about any issues that the SES and the EU ETS reforms are facing and how can these findings be used to improve the aviation environmental performance and achieve a more sustainable growth?

The SES and EU ETS do not deliver to the extend they could. The main reasons, as identified in the primary research and discussed in chapter 8, are the following:

- Different readiness/capabilities of the air carriers (for the EU ETS) and the states/ANSPs (for SES);
- Insufficient incentive mechanism;
- Different positions and the (political) willingness to take actions; and
- Trade-offs and interactions among the different areas.

The most significant contribution of this PhD thesis is the synthetic discussion of the SES and EU ETS issues and the recommendations made to address currently underperforming areas. The identification of the problem and its root is part of the solution. Therefore, the recommendations for EU ETS as discussed earlier in this final chapter of the Thesis are:

- Simpler Monitoring, Reporting and Verification Process and further environmental training;
- Standardised process in the revenue use form auctions and processes;
- Balance of the allowances market; and
- Development of an ambitious and realistic global environmental scheme for aviation operations.

The recommendations for Single European Sky as explained above are:

- Increase the Environmental awareness of ANSPs and CAAs
- Use the charging scheme as incentive mechanism to improve the environmental performance
- Restructure the ANSP market and make them more efficient in their operations and services
- Use an independent regulator that has the political willingness to take actions

The EU ETS, the SES and any other environmental reform/regulatory framework should not be treated separately, but it should be designed as part of a system of regulations.

Only then can the reform prove sufficiently effective to improve the environmental performance of aviation to the maximum possible extent.

9.4 Limitations of the PhD Thesis

The central point of this research is the policies about environmental performance in aviation. The SES and EU ETS reforms were used as case studies to evaluate the governance issues around the regulation of the European aviation system. The use of more cases would bring more added value to the findings. Moreover, comparisons between national and EU attempts to tackle environmental problems were not carried out.

The Delphi study focused on the participants' opinions on the SES and EU ETS reforms, but also on other options for the reduction of carbon emissions and the adoption of carbon neutral growth. A major limitation of this research was the fact that the focus is on carbon emissions, not on other harmful gases. The regulation focuses on carbon emissions due to the lack of scientific knowledge about other gases that contribute to Climate Change. The management approach would be more guiding and beneficial for the actual mitigation of negative externalities to the environment if further research is conducted in both physics and chemistry, in combination with the evaluation of the technological improvements in the aircraft. Due to the lack of consistent and reliable statistical data on aircraft emissions and their contribution to climate change, this topic is highlighted as an important one, requiring further research. The contribution of aviation reforms to carbon neutral growth can be accurately assessed provided that the emissions are researched and fully understood.

Finally, the Delphi research gathered opinions from different stakeholders. The European Commission, EUROCONTROL, IATA, CAAs and NSAs, European airlines, ANSPs, individual aviation experts and experts from Ministries of Transports expressed their views about the SES and EU ETS reforms in relation to the main issues they face and their contribution to environmental performance. A major limitation is the omission of system and fuel suppliers, the absence of manufacturers and non-European airlines. The reason for this absence is the difficulty to find experts that are familiar with the reforms and that are willing to participate in the research. If those groups were represented, the research would be more holistic and representative of the situation.

9.5 Directions for further research

The aim of this research was achieved. The PhD Thesis gives insight into the environmental problems caused by aviation operations and the key factors that can lead to carbon neutral growth. The areas of the Single European Sky and the European Union Emissions Trading Scheme reforms and their associated issues were extensively researched; it has been found that they face implementation problems and recommendations have been given. Finally, the interaction of the aviation reforms, i.e. SES and EU ETS, were identified and a common approach was proposed.

An area that is very interesting for further study is the route choice based on the trade-off between the environment and the economic cost of a flight. A conceptual model that arose from the PhD research takes into consideration the fact that the cost factor needs to be minimised and flight efficiency needs to be maximised. The model may prove extremely helpful for the Operational Control Centres of airlines and for the Capacity Flow Management.

The airlines want to reduce fuel costs, spill costs, the time based cost and overflight costs. Those costs are subject to aircraft performance, weather conditions, the allowed route, altitude structure and any schedule and operational constraints. It should be noted that the route (the ground track), the profile (altitudes along route), the speed (possibly varying along the route) and the departure fuel vary. The Aircraft Price Index and Aircraft utilisation parameter are important elements for the model.

As far as environmental aspects are concerned, the en-route flight efficiency is affected by a number of factors. The most important are the following: the route network design (existing route network), route availability (utilisation of civil military structures), flight planning capabilities (use of software, repetitive flight planning), user preferences (time, cost, fuel), the tactical ATC routings and special events such as severe weather or ATC strikes.

The reduction of emissions depends on the aircraft, the flight operations, technical optimisation and the network-ground relation. For the aircraft factor, the aircraft weight and size, the speed, the tanking and the balance-optimal centre for gravity in cargo should be considered. Flight operations are related to the SES scheme and especially to the Conditional routes and the airspace re-design. As for the technical optimisation factor, aerodynamics, the engines, alternative fuels, the 4D trajectory management algorithms (G, A), the advanced Communication: Datalink (G-A), the advanced Navigation: P-RNAV (A) and the advanced Surveillance: ADS-B (G ,A), these can actually affect carbon emissions. The Network/Ground factor concerns local air quality and, to a lesser extent, the climate change.

The main parameters of the model are identified, but the weighing factors need to be set. The model will improve airline decision-making for routes selection and will incorporate the negative externalities towards the environment as well as the trade-offs with other areas of aviation. The model could be initially a theoretical model and it may afterwards be tested to historical data and different scenarios.

Reference List

1. Abdi, H. (2010) Coefficient of Variation. In Salkind, N. *Encyclopaedia of Research Design*, Thousand Oaks, CA: Sage.
2. Adler, N., Forsyth, P., Mueller, J. and Niemeier, H.M. (2015) An economic assessment of airport incentive regulation, *Transport Policy*, 41, 5-15.
3. Allen, W.B., Weigelt, K., Doherty, N.A and Mansfield, E. (2012). *Managerial Economics, Theory, Applications and Cases (8th ed.)*. New York: Norton & Company Inc.
4. Amadae, S.M (2016) *Prisoners of Reason: Game Theory and Neoliberal Political Economy*. UK: Cambridge University Press.
5. American Society of International Law (2008) Possible Looming Conflict with EU Regulation of Greenhouse Gas Emissions from Civil Aviation; United States Prefers ICAO Action, The American Journal of International Law, 102 (1), 171-173.
6. Anger, A. and Kohler, J. (2010) Including aviation emissions in the EU ETS: much ado about nothing? A review. *Transport Policy*, 17, 38-46.
7. Anger, A., 2010. Including aviation in the European emissions trading scheme: impacts on the industry, CO 2 emissions and macroeconomic activity in the EU. Journal of Air Transport Management, 16(2), pp.100–105.
8. Antimiani, A., Costantini, V., Martini, C., Salvatici , L., & Tommasino, M. (2013) Assessing alternative solutions to carbon leakage. *Energy Economics*,13, 299-311.
9. Archer, D. (2011) *Global Warming: Understanding the Forecast* (2nd Edition). USA: Wiley.
10. Armstrong, M. and Sappington, E.E.M. (2007) Recent Developments in the Theory of Regulation. In Armstrong, M. and Porter, R. Handbook of Industrial Organization, Volume 3. North Holland.
11. ATAG (2014). *Aviation Benefits beyond Borders*. Geneva: ATAG.
12. ATAG, (2005). The economic & social benefits of air transport, Geneva: ATAG.
13. ATWonline. Com (2016) *ICAO seals aviation emissions deal*. Available from: http://atwonline.com/eco-aviation/icao-seals-aviation-emissions-deal?NL=ATW-04&Issue=ATW-04_20161006_ATW-04_859&sfvc4enews=42&cl=article_1&utm_rid=CPEN1000000425477&utm_campaign=7267&utm_medium=email&elq2=6ac59fa75c624f3e8241aa9f909b8cbe [Accessed 10 October 2016].

14. Baldwin, M. (2013). Air Transport Liberalisation - the EU Perspective. ECAC News, The European Civil Aviation Conference Magazine: 7.
15. Baldwin, R., Cave, M. and Lodge, M. (2013) *Understanding Regulation* (2^{nd} ed.). Oxford: Oxford University Press.
16. Ballantyne, R., Hughes, K. & Bond, N. (2016). Using a Delphi approach to identify managers' preferences for visitor interpretation at Canterbury Cathedral World Heritage Site. *Tourism Management* 54, 72-80.
17. Banner, S. (2008). *Who Owns the Sky? The struggle to control airspace from the Wright brothers on*. Harvard University Press.
18. Barbot, C. et al., 2014. Trade-offs between environmental regulation and market competition: Airlines, emission trading systems and entry deterrence. Transport Policy, 33(C), pp.65–72.
19. Barker, T., Junankar, S., Pollitt, H. & Summerton, P. (2007) Carbon leakage from unilateral Environmental Tax Reforms in Europe, 1995-2005. *Energy Policy*, 35, 6281-6292.
20. Barrett, S. (2009) Climate Treaties and the Imperative of Enforcement. In Helm, D. and Hepburn, C. (2009) *The economics and politics of climate change.* NY: Oxford University Press.
21. Barthwal, R. R. (2004). *Industrial Economics, an introductory textbook*. 2nd edition. New Delhi: New Age International.
22. Baumgartner, M. & Finger, M., 2014. European air transport liberalization: Possible ways out of the single European sky gridlock. Utilities policy, 30, pp.29–40.
23. Baumgartner, M. & Finger, M., 2014. The Single European Sky gridlock: A difficult 10 year reform process. Utilities Policy, 31, pp.289–301.
24. Beesley, M. (1997) *Privatization, Regulation and Deregulation* (2nd Ed). Routledge.
25. Beins, C. B., and McCarthy A. M. (2012). *Research methods and statistics*. USA: Pearson.
26. Bel, G. and Fageda, X., (2010) Privatization, regulation and airport pricing: An empirical analysis for Europe, *Journal of Regulatory Economics*, 37(2), 142–61.
27. Bernard, H.R., Wutich, A.Y. and Ryan, G.W. (2016) *Analyzing qualitative data: Systemic approaches.* California: SAGE.
28. Besanko, D. & Braeutigam, R. R. (2011). *Microeconomics 4th edition*. USA: John Wiley & Sons.
29. Biedermann, M. (2015) Aviation Biofuels. Curse or Cure for Green Aviation? Germany: Grin Verlag Gmbh.

30. Biggar, D., 2012. Why Regulate Airports?
 A Re-examination of the Rationale for Airport Regulation. *Journal of Transport Economics and Policy (JTEP)*, 46(3), pp.367–380.
31. Boeing, 2016. Current Market Outlook 2016-2035. Seattle: Boeing.
32. Bogdan, R.C. & Biklen, S. K. (2006). *Qualitative research for education: An introductory to theory and methods*. (5th ed.). Needham Heights, MA: Allyn and Bacon.
33. Bourne, L., (2009). *Stakeholder Relationship Management, a Maturity Model for Organisational Implementation*. Surrey: Gower Publishing Limited.
34. Bozarth, C. (2016). *Introduction to Operations and Supply Chain Management* (Global Edition). UK: Pearson.
35. Bradley, T. H., Moffitt, B. A., Parekh, D. E. and Mavris, D. N. (2007) Flight Test Results for a Fuel Cell Unmanned Aerial Vehicle," in45th AIAA Aerospace Sciences Meeting and Exhibit, 8 - 11 January 2007, Reno, Nevada.
36. Brasseur, G.P., Gupta, M., Anderson, B.E., Balasubramanian, S., Barrett, S., Duda, D., Fleming, G., Forster, P.M., Fuglestvedt, J., Gettelman, A., et al. (2016) Impact of Aviation on Climate: FAA’s Aviation Climate Change Research Initiative (ACCRI) Phase II. DOI: http://dx.doi.org/10.1175/BAMS-D-13-00089.1 .
37. Brunner, s. and Enting, K. (2013) Climate finance: A transaction cost perspective on the structure of state-to-state transfers. *Global Environmental Change*, 27, 138-143.
38. Bunge, M. (1993) Realism and Antirealism in Social Science. *Theory and Decision*, 35(3), 207-235.
39. Button, K. & Neiva, R., 2013. Single European Sky and the functional airspace blocks: Will they improve economic efficiency? Journal of Air Transport Management, 33(C), pp.73–80.
40. CAA (2016) Aviation's impact on air quality. Available from: https://www.caa.co.uk/Environment/Environmental-information/Information-by-environmental-impact/Aviation-s-impact-on-air-quality/ [Accessed on 01 July 2016].
41. CAA CAP 1119 (2013) *Environmental charging – Review of impact of noise and NOx landing charges.* London: CAA.
42. Cacho, O.J., Lipper, L. and Moss J. (2013) Transaction costs of carbon offset projects: A comparative study. *Ecological Economics*, 88, 232-243.
43. CAIT Climate Data Explorer (2015) World Resources Institute. Available from: http://cait.wri.org. [Accessed on 28 July 2016].

44. Calleja Crespo D. & Mendes de Leon P.M.J. (2011), Achieving the Single European Sky: Goals and Challenges. Alphen aan de Rijn: Kluwer law International.

45. CE (2005) Giving wings to emission trading: Inclusion of aviation under the European emission trading system (ETS): design and impacts. The Netherlands: CE.

46. Chadwick, B. P. (2006) Transaction costs and the clean development mechanism. *Natural Resources Forum*, 30, 256-271.

47. Chevallier, J. (2012). *Econometric Analysis of Carbon Markets*. 1st Edition ed. S.l.:Springer.

48. Chinyio, E. and Olomolaiye, P. (2010) *Construction Stakeholder Management.* Wiley-Blackwell

49. Chuck, C. (2016) Biofuels for Aviation Feedstocks, Technology and Implementation. Elsevier

50. Clo, S. (2010) Grandfathering, auctioning and Carbon Leakage: Assessing the inconsistencies of the new ETS Directive. *Energy Policy*, 38, 2420-2430.

51. Coady, D.Gillingham, R., Ossowski, R., Piotrowski, J., Tareq, S. and Tyson, J. (2010) Petroleum product subsidies: Costly, inequitable and rising; International Monetary Fund Staff Position Note. Available from: http://www.imf.org/external/pubs/ft/spn/2010/spn1005.pdf [Accessed on 28 July 2016].

52. Coase, R.H. (1960) The Problem of Social Cost, *Journal of Law and Economics*, 3, 1-43.

53. Coglianese, C., Nash, J. and Olmstead, T. (2002) Performance-Based Regulation: Prospects and Limitations in Health, Safety, and Environmental Protection, Regulatory Policy Program Report No. RPP-03. Available from: http://www.ksg.harvard.edu/m-rcbg/Events/Papers/RPPREPORT3.pdf [Accessed 19 September 2014].

54. Committee on Radiative Forcing Effects on Climate, Climate Research Committee, Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies and National Research Council (2005) *Radiative Forcing of Climate Change: Expanding the Concept and Addressing Uncertainties.* USA: National Academies Press

55. Cong, R.-G. & Wei, Y.-M. (2012) Experimental comparison of impact of auction format on carbon allowance market. *Renewable and Sustainable Energy Reviews*, 16(6), 4148-4156.

56. Court of Justice of the European Union (2011) The directive including aviation activities in the EU's emissions trading scheme is valid. Luxembourg: CJEU.

57. Creswell, J. W. (2008). *Educational Research: Planning, conducting, and evaluating quantitative and qualitative research* (3rd ed.). Upper Saddle River: Pearson.

58. Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches,* 4th Ed. Sage Publications.

59. Creswell, J.W. (2012). *Qualitative inquiry & research design: Choosing among five approaches,* 3rd Ed. Sage Publications.

60. Crubb, M. (2009). Linking Emissions Trading Schemes. *Climate Policy*, 9, 339-340.

61. Cui, Q., Wei, Y.M. and Li, Y. (2016) Exploring the impacts of the EU ETS emission limits on airline performance via the Dynamic Environmental DEA approach. *Applied Energy*, 183, 984-994.

62. Czerny, AI., Guiomard, C. and Zhang, A. (2016) Single-Till versus Dual-Till Regulation of Airports: Where Do Academics and Regulators (Dis)Agree? Available at SSRN: https://ssrn.com/abstract=2734643 or http://dx.doi.org/10.2139/ssrn.2734643 [Accessed 08 February 2017].

63. De Bruyn, S., Nelissen, D. & Koopman, M. (2013). Carbon leakage and the future of the EU ETS market Impact of recent developments in the EU ETS on the list of sectors deemed to be exposed to carbon leakage. [Online] Available from: http://www.cedelft.eu/art/uploads/CE_Delft_7917_Carbon_leakage_future_EU_ETS_market_Final.pdf [Accessed 19 September 2013].

64. De Laporte, A.V., Weersink, A.J. and McKenney, D.W. (2016) Effects of supply chain structure and biomass prices on bioenergy feedstock supply*, Applied Energy*, 183, 1053-1064.

65. DECISION No 377/2013/EU on derogating temporarily from Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community.

66. DEHSt (2012) *Auctioning of Emission Allowances in Germany Periodical Report: Early Auctions and Auctioning in Aviation 2012.* Available from: http://www.dehst.de/SharedDocs/Downloads/EN/Auctioning/2012_report_early-auctions.pdf?__blob=publicationFile [Accessed 19 April 2013].

67. Department of energy and climate change (2013). Call for evidence EU ETS: Carbon leakage review data request. [Online] Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/1442

32/call_for_evidence_euets_carbon_leakage_review_data_request.pdf [Accessed 19 September 2013].

68. Department of Transportation (DoT) / Bureau of Transport Statistics of the (2016). National Transportation Statistics. Available from: http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/index.html#chapter_1 [Accessed 10 October 2016].

69. DIRECTIVE 2008/101/EC on amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community

70. DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

71. Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

72. Directive 2009/29/EC of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community.

73. EASA, EEA and EUROCONTROL (2016) *European Aviation Environmental Report 2016*. Available from: http://ec.europa.eu/transport/sites/transport/files/modes/air/aviation-strategy/documents/european-aviation-environmental-report-2016-72dpi.pdf [Accessed 3 October 2016].

74. EC (2012) Guidance Document: The Accreditation and Verification Regulation Verification Guidance for EU ETS Aviation. Brussels, EC. Available from: http://ec.europa.eu/clima/policies/ets/monitoring/docs/gd_iii_aviation_verification_guidance_en.pdf [Accessed 03 February 2015].

75. EC (2013). *Impact Assessment* Available from: http://ec.europa.eu/clima/policies/transport/aviation/docs/swd_2013_430_en.pdf [Accessed 23 February 2015].

76. EC (2014) Opinion of the European Economic and Social Committee on the Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in view of the implementation by 2020 of

an international agreement applying a single global market-based measure to international aviation emissions. Available from: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52013AE7943 [Accessed 03 February 2015].
77. EC (2015). Evaluation of the Single European Sky (SES) performance and charging schemes. Available from: http://ec.europa.eu/smart-regulation/roadmaps/docs/2016_move_015_evaluation_single_european_sky_performance_en.pdf [Accessed 03 June 2016].
78. EC (2016) *Structural reform of the EU ETS*. Available from: http://ec.europa.eu/clima/policies/ets/reform/index_en.htm [Accessed 01 July 2016]
79. EC (n.d.) EU ETS Handbook. Available at http://ec.europa.eu/clima/publications/docs/ets_handbook_en.pdf [Accessed 01 July 2016].
80. EC 2015/340 on laying down technical requirements and administrative procedures relating to air traffic controllers' licences and certificates pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council, amending Commission Implementing Regulation (EU) No 923/2012 and repealing Commission Regulation (EU) No 805/2011.
81. EC COM (2015) 576 final *CARBON MARKET REPORT 2015.* Available from: http://ec.europa.eu/clima/policies/strategies/progress/docs/com_2015_576_annex_1_en.pdf
82. EC DG ENER (2014). *Study on actual GHG data for diesel, petrol, kerosene and natural gas (Interim Report).* Brussels, EC.
83. EC No 100/2014 amending Regulation (EC) No 748/2009 on the list of aircraft operators that performed an aviation activity listed in Annex I to directive 2003/87/EC of the European Parliament and of the Council on or after 1 January 2006 specifying the administering Member State for each aircraft operator.
84. EC No 1031/2010 on the timing, administration and other aspects of auctioning of greenhouse gas emission allowances pursuant to Directive 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowances trading within the Community.
85. EC No 1794/2006 laying down a common charging scheme for air navigation services.
86. EC No 2150/2005 on laying down common rules for the flexible use of airspace.

87. EC No 390/2013 on laying down a performance scheme for air navigation services and network functions.
88. EC No 549/2004 on laying down the framework for the creation of the Single European Sky.
89. EC No 550/2004 on the provision of air navigation services in the Single European Sky.
90. EC No 601/2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council.
91. EC No 691/2010 on laying down a performance scheme for air navigation services and network functions and amending Regulation (EC) No 2096/2005 laying down common requirements for the provision of air navigation services.
92. EC No 94/69: Council Decision of 15 December 1993 concerning the conclusion of the United Nations Framework Convention on Climate Change.
93. Ecofys (2014). *Greenhouse gas impact of marginal fossil fuel use*. Netherlands, Ecofys.
94. Ecosystem Marketplace (2014) *Ecosystem Marketplace*. Available from: http://www.ecosystemmarketplace.com/pages/dynamic/web.page.php?section=carbon_market&page_name=otc_market [Accessed 20 February 2014].
95. EEX (2012) *Auctioning of Emission Allowances in EU ETS Phase III, Guidance for Bidders*. Available from: http://cdn.eex.com/document/129131/EEX_PIIIAuctions_Guidance.pdf [Accessed 19 April 2013].
96. EEX (2013) EEX. Available from: http://www.eex.com/en/Auction [Accessed 19 April 2013].
97. EEX (2016) Emission Spot Primary Market Auction Report 2016. Available from: https://www.eex.com/en/products/environmental-markets/emissions-auctions [Accessed 19 August 2016].
98. Efthymiou, M., Arvanitis, P. & Papatheodorou, A. (2016) *Institutional Changes and Dynamics in the European Aviation Sector: Implications for Tourism*. In Pappas N. & Bregoli, I. (eds) Global Dynamics in Travel, Tourism and Hospitality. Hershey Pennsylvania: IGI Global.
99. Embraer (2015) Boeing and Embraer Open Joint Aviation Biofuel Research Center in Brazil. Available from: http://www.embraer.com/en-us/imprensaeventos/press-releases/noticias/pages/boeing-e-embraer-inauguram-centro-de-pesquisa-em-biocombustiveis-no-brasil.aspx [Accessed 28 June 2016].

100. EUROCONTROL (2008) *Evaluation of Functional Airspace Block (FAB) initiatives and their contribution to Performance improvement.* Brussels: EUROCONTROL. Available from: http://www.eurocontrol.int/sites/default/files/publication/files/prc-evaluation-of-fabs-high-quality-graphics.pdf [Accessed 3 October 2016].

101. EUROCONTROL (2010) EUROCONTROL History Book. Brussels: EUROCONTROL. Available from https://www.eurocontrol.int/sites/default/files/publication/files/2011-history-book.pdf [Accessed 21 April 2016].

102. EUROCONTROL (2011a) Continuous Descent: A guide to implementing Continuous Descent. Brussels: EUROCONTROL. Available from: https://www.eurocontrol.int/sites/default/files/publication/files/2011-cd-brochure-web.pdf [Accessed 3 October 2016].

103. EUROCONTROL (2011b) Free Route Airspace in high-density airspace enters new phase – direct routes available to aircraft operators for longer time period. Available from: http://www.eurocontrol.int/sites/default/files/pressrelease/june2011-fram2pressrelease.pdf [Accessed 3 October 2016].

104. EUROCONTROL (2012) Report on the Operation of the Route Charges System in 2011. Brussels: EUROCONTROL. Available from: https://www.eurocontrol.int/sites/default/files/article/content/documents/route-charges/operation-reports/system_report_2011.pdf [Accessed 21 April 2016].

105. EUROCONTROL (2014) Report on the Operation of the Route Charges System in 2013. Brussels: EUROCONTROL. Available from: https://www.eurocontrol.int/sites/default/files/content/documents/route-charges/operation-reports/2013-report-on-the-operation-of-the-route-charges-system.pdf [Accessed 21 April 2016].

106. EUROCONTROL (2015a) EUROCONTROL Seven-Year Forecast February 2015: Flight Movements and Service Units 2015 – 2021. Available from: https://www.eurocontrol.int/sites/default/files/content/documents/route-charges/forecast-of-service-units/seven-year-flights-service-units-forecast-2015-2021-feb2015.pdf [Accessed 21 April 2016].

107. EUROCONTROL (2015b) Report on the Operation of the Route Charges System in 2014. Brussels: EUROCONTROL. Available from: https://www.eurocontrol.int/sites/default/files/content/documents/route-charges/operation-reports/2014-report-on-the-operation-of-the-route-charges-system.pdf [Accessed 21 April 2016].

108. EUROCONTROL (2015c) Annual Network Operations Report 2014, June 2015. Available from: https://www.eurocontrol.int/sites/default/files/publication/performance/2014_annual/final/annual_network_operations_report_2014_main_report_final_edition.pdf [Accessed 21 April 2016].

109. EUROCONTROL (2016a) *EUROCONTROL Seven-Year Forecast February 2016: Flight Movements and Service Units 2016-2022*. Available online from: https://www.eurocontrol.int/sites/default/files/content/documents/official-documents/forecasts/seven-year-flights-service-units-forecast-2016-2022-Feb2016.pdf [Accessed 21 April 2016].

110. EUROCONTROL (2016b). *Maastricht Upper Area Control Centre Annual Report 2015*. Maastricht: EUROCONTROL.

111. EUROCONTROL (2016c) Initial Estimates of the Route Charges Cost-Bases and Unit Rates CRCO Overview –Estimated figures –June 2016 (Information Paper). Brussels: EUROCONTROL. Available from: https://www.eurocontrol.int/sites/default/files/content/documents/route-charges/operation-reports/preliminary-estimate-route-charges-2017.pdf [Accessed 3 October 2016].

112. EUROCONTROL and FAA, 2013. *Comparison of ATM-related performance: U.S. – Europe.*

113. EUROCONTROL and University of Westminster (2004) Evaluating the true cost to airlines of one minute of airborne or ground delay. Brussels: EUROCONTROL. Available from: https://www.eurocontrol.int/sites/default/files/content/documents/sesar/business-case/evaluating_true_cost_of_delay_2004.pdf [Accessed 02 June 2015]

114. EUROCONTROL.int (2016a) *Performance Review Unit*. Available from: http://www.eurocontrol.int/articles/performance-review-unit [Accessed 3 October 2016].

115. EUROCONTROL.int (2016b) *Full integration with the Single European Sky.* Available from: http://www.eurocontrol.int/articles/full-integration-single-european-sky [Accessed 3 October 2016].

116. EUROCONTROL.int (2016c) *Establishing route charges*. Available from: http://www.eurocontrol.int/articles/establishing-route-charges [Accessed 3 October 2016].

117. EUROCONTROL.int (2016d) Airspace developments and the Flight Efficiency Plan (FEP). Available from: http://www.eurocontrol.int/articles/airspace-developments-and-flight-efficiency-plan-fep [Accessed 3 October 2016].
118. EUROCONTROL.int (2016e) Conditional Route. Available from: https://ext.eurocontrol.int/lexicon/index.php/Conditional_Route [Accessed 3 October 2016].
119. EUROCONTROL.int (2016f) Flexible use of airspace. Available from: http://www.eurocontrol.int/articles/flexible-use-airspace [Accessed 3 October 2016].
120. EUROCONTROL/Performance Review Commission (2015) Performance Review Report: An Assessment of Air Traffic Management in Europe during the Calendar Year 2014. Brussels: EUROCONTROL. Available from: https://www.eurocontrol.int/sites/default/files/publication/files/prr-2014.PDF [Accessed 3 October 2016].
121. EUROCONTROL/Performance Review Commission (2016) Performance Review Report: An Assessment of Air Traffic Management in Europe during the Calendar Year 2015. Brussels: EUROCONTROL. Available from: http://www.eurocontrol.int/sites/default/files/content/documents/single-sky/pru/publications/other/PRR-2015.pdf [Accessed 3 October 2016].
122. europarl.europa.eu (2016) Air transport: Single European Sky. Available from: http://www.europarl.europa.eu/atyourservice/en/displayFtu.html?ftuId=FTU_5.6.9.html [Accessed 10 October 2016].
123. European Parliament (2016) Main options for a GMBM at ICAO during its High-level Meeting in May 2016. Available from: http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/578983/IPOL_BRI(2016)578983_EN.pdf [Accessed 28 July 2016].
124. FAA (2016) *Continuous Lower Energy, Emissions, and Noise (CLEEN) Program.* Available from: http://www.faa.gov/about/office_org/headquarters_offices/apl/research/aircraft_technology/cleen/ [Accessed 01 October 2016].
125. FAA and EUROCONTROL (2016). 2015 Comparison of ATM-related performance: U.S. –Europe. Available from: https://www.eurocontrol.int/sites/default/files/content/documents/single-sky/pru/publications/other/us-eu-comparison-2015.pdf [Accessed 10 October 2016].

126. FABEC.eu (2016) FABEC Facts & Figures. Available from: http://www.fabec.eu/fabec_homepage/en/About%20FABEC/Facts%20&%20Figures/ [Accessed 21 April 2016].
127. FAO (2011) New tool for weighing pros and cons of bioenergy; FAO Press release, 17th May 2011. Available from: http://www.fao.org/asiapacific/rap/home/news/detail/en/?no_cache=1&news_uid=74658 [Accessed on 10 July 2013].
128. Feilzer, M. Y. (2010). Doing mixed methods research pragmatically: Implications for the rediscovery of pragmatism as a research paradigm. *Journal of Mixed Methods Research*. 4, 6 – 16.
129. Field, B. (1994) *Environmental Economics: An introduction*. Sinapore: McGraw-Hill International Editions.
130. Flachsland, C., Marschinski, R. & Edenhofer, O. (2009) To link or not to link: benefits and disadvantages of linking cap-and-trade systems. *Climate Policy*, 9, 358-372.
131. Flick, U. (2009) *An Introduction to Qualitative Research* 4th Ed. Sage.
132. Forster, P.M. de F., Shine, K.P. & Stuber, N., 2006. It is premature to include non-CO 2 effects of aviation in emission trading schemes. Atmospheric Environment, 40(6), pp.1117–1121.
133. Forsyth, P. (2008) *The Impact of Climate Change Policy on Competition in the Air Transport Industry.* Paris: OECD.
134. Frasch, F. (2007) Transaction Costs of the EU Emissions Trading Scheme in German Companies, *Sustainable Development Law & Policy*, 48-51.
135. Girardet, D. & Spinler, S., 2013. Does the aviation Emission Trading System influence the financial evaluation of new airplanes? An assessment of present values and purchase options. Transportation Research Part D: Transport and Environment, 20, pp.30–39.
136. Glesne, C. & Peshkin, A. (1992) *Becoming qualitative researchers: An introduction.* White Plains, NY: Longman.
137. Goodman, J. C. (2009) *Aviation and the Environment*. 1st ed. New York: Nova Science Publishers.
138. Gössling, S. & Upham, P. (2009) *Climate Change and Aviation, Issues, Challenges and Solutions*. London: Earthscan.
139. Gray, E.D. (2014). *Doing Research in the Real World*. UK: SAGE.

140. GreenAir (2012) *British Airways pledges 10-year offtake agreement as GreenSky project with Solena gathers momentum;* GreenAir Online. Available from: http://www.solenafuels.com/pdfs/BritishAirways_10yrAgreement.pd [Accessed 30 December 2012].
141. Grifiths, P. (2013) SES Performance targets and achievements. Available from: http://www.caa.lv/upload/userfiles/files/SES%20Performance%20targets%20_%20achievements.pdf [Accessed 10 October 2016].
142. Grifiths, P. (2014) SES Performance Scheme: Driving Performance Improvement in European ATM /ANS. Presented at CIPFA Meeting. Available from: www.cipfa.org/~/media/files/.../ses%20performance%20scheme%20cipfa.pptx?la=en [Accessed 10 October 2016].
143. Grodecka, A. and Kuralbayeva, K. (2015) The price vs quantity debate: climate policy and the role of business cycles. Working paper, Centre for Climate Change Economics and Policy and Grantham Research Institute on Climate Change and the Environment.
144. Grubb, M. & Neuhoff, K. (2006) Allocation and competitiveness in the EU emissions trading scheme: policy overview. *Climate Policy*, 6, 7-30.
145. Guba, E. G. (1990) The Alternative Paradigm Dialog. In Guba, E. (Ed) *The Paradigm dialog*. Newbury Park, CA: Sage Publications.
146. Haites, E. (2009) Linking emission trading schemes for international aviation and shipping emissions. *Climate Policy*, 9, 415-430.
147. Han, J., Elgowainy, A., Cai, H. and Wang Q.Q., (2013) Life-cycle analysis of bio-based aviation fuels, *Bioresource Technology,* 15, 447-456.
148. Hanlon, J., (2013) ELFAA Press Release ELFAA urges Parliament to reject Commission proposal to weaken effectiveness of EU ETS Available from: http://www.elfaa.com/131202_ELFAA_PressRelease_ETS.pdf [Accessed 28 June 2016].
149. Harris, J.M and Roach, B. (2016) *Environmental and Natural Resource Economics: A Contemporary Approach* (3rd ed.). London, Routledge
150. Havel, B.F. and Sanchez, G.S. (2012) Toward an international aviation emissions agreement, Harvard Environmental Law Review, 36, 350-385.
151. Heindl, P. (2012), Transaction Costs and Tradable Permits: Empirical Evidence from the EU Emissions Trading Scheme, ZEW Discussion Paper No. 12-021, Mannheim.

152. Helm, D. (2009) Climate-change Policy: Why has so little been achieved? In Helm, D. and Hepburn, C. (2009) *The economics and politics of climate change.* NY: Oxford University Press.

153. Hepburn, C. and Stern, S. (2009) The Global Deal on Climate Change. In Helm, D. and Hepburn, C. (2009) *The economics and politics of climate change.* NY: Oxford University Press.

154. Hicks, J. R. (1935) A Suggestion for Simplifying the Theory of Money. *Economica (New Series*), 2(5), 1-19.

155. Hogan, J., Dolan, P., Donnelly, P. (2011) *Approaches to Qualitative Research: Theory and Its Practical Application*. Cork: Oak Tree Press.

156. Hsu, C.C and Sandford, B.A. (2007) The Delphi Technique: Making Sense Of Consensus, *Practical Assessment, Research & Evaluation*, 12(10), 1-8.

157. Huet, F. (2011) The Regulation of Air Navigation Charges. In Crespo, D.C. and Mendes de Leon, P. *Achieving the Single European Sky: Goals and Challenges*, The Netherlands: Kluwer Law International.

158. IAA and NATS (2012) UK-Ireland FAB Cost-Benefit Analysis. Available from: http://ec.europa.eu/transport/modes/air/single_european_sky/doc/2012_04_17_appendix_i_fab_cba_final_9_jan_2012.pdf [Accessed 13 August 2013].

159. IAA, 2013. FAB 4 Project, IAA. Available from: https://www.iaa.ie/FAB [Accessed 16 August 2013].

160. IATA (2006) *Economics Briefing Impact of the Rise in UK Air Passenger Duty,* Geneva: IATA .

161. IATA (2008a) *Aviation carbon offset programmes IATA guidelines and toolkit*. Montreal: IATA.

162. IATA (2008b) IATA Guidance on Airport Fuel Storage Capacity. Available at https://www.iata.org/policy/Documents/guidance-fuel-storage-may08.pdf [Accessed on 28 July 2016].

163. IATA (2013a) *IATA Economic Briefing Infrastructure Costs*. Montreal: IATA. Available from: https://www.iata.org/whatwedo/Documents/economics/Infrastructure-Cost-March-2013.pdf [Accessed on 28 July 2016].

164. IATA (2013b) *The Cost of the EU Emissions Trading Scheme*. Montreal: IATA. Available from: https://www.iata.org/publications/economics/Documents/EUETS-cost-briefing-march-2013.pdf [Accessed on 28 July 2015].

165. IATA (2014a) *Annual Review 2014*. Montreal: IATA. Available from: https://www.iata.org/about/Documents/iata-annual-review-2014.pdf [Accessed on 28 July 2016].

166. IATA (2015) *Progress Report 2015 and Supporting Airline Industry Achievement of Sustained Financial Health*. Montreal: IATA. Available from: http://www.iata.org/services/finance/Documents/iata-financial-committee-white-paper.pdf [Accessed on 28 July 2016].

167. IATA (2016a). *Fact Sheet: Carbon Offsetting.* Montreal: IATA. Available from: https://www.iata.org/pressroom/facts_figures/fact_sheets/Documents/fact-sheet-carbon-offsetting.pdf [Accessed on 06 October 2016].

168. IATA (2016b) Fact Sheet –Fuel. Montreal: IATA. Available from: https://www.iata.org/pressroom/facts_figures/fact_sheets/Documents/fact-sheet-fuel.pdf [Accessed on 06 October 2016].

169. IATA, AEA and ERA (2013) A Blueprint for the Single European Sky report. Available from: https://www.iata.org/pressroom/pr/Documents/blueprint-single-european-sky.pdf [Accessed on 28 July 2016].

170. IATA, AEA and ERA, (2013) *A Blueprint for the Single European Sky Delivering on safety, environment, capacity and cost-effectiveness*. Available from: https://www.iata.org/pressroom/pr/Documents/blueprint-single-european-sky.pdf [Accessed 29 June 2016].

171. IATA, EUROCONTROL, CANSO (2008) Flight Efficiency Plan: Fuel and emissions savings. Available from: http://www.EUROCONTROL.int/sites/default/files/article/content/documents/nm/reports/flight-efficiency-plan.pdf [Accessed 6 Oct. 2016].

172. IATA.org (2016b) IATA Carbon Offset Program. Available from https://www.iata.org/whatwedo/environment/Pages/carbon-offset.aspx [Accessed 6 Oct. 2016].

173. IATA.org (2016c) Vision and Mission. Available from: http://www.iata.org/about/Pages/mission.aspx [Accessed 6 Oct. 2016].

174. IATA.org. (2016a) *IATA - History - Growth and Development*. Available from: http://www.iata.org/about/Pages/history_3.aspx [Accessed 6 Oct. 2016].

175. ICAO (2003) *Worldwide Air Transport Conference: Challenges and Opportunities of Liberalization* ATConf/5-WP/20. Available from: http://www.icao.int/Meetings/ATConf5/Documents/ATConf5_wp020_en.pdf [Accessed 09 September 2015].

176. ICAO (2010). *ICAO Environmental Report 2010, Aviation and Climate Change.* Montreal: ICAO.

177. ICAO (2012) New ICAO Council High-level Group to Focus on Environmental Policy Challenges. Available from: http://www.icao.int/Newsroom/Pages/new-ICAO-council-high-level-group-to-focus-on-environmental-policy-challenges.aspx [Accessed 09 September 2015].

178. ICAO (2013a) *Present and Future Trends in Aircraft Noise and Emissions. Agenda Item 17: Environmental Protection Assembly — 38th Session Working Paper 26*. Available online at http://www.icao.int/Meetings/a38/Documents/WP/wp026_en.pdf [Accessed 09 April 2016].

179. ICAO (2013b) ICAO Environmental Report 2013. Montreal: ICAO.

180. ICAO (2014a*) Safety report 2014 edition*. Montreal, ICAO. Available from: http://www.icao.int/safety/Documents/ICAO_2014%20Safety%20Report_final_02042014_web.pdf [Accessed 12 July 2016].

181. ICAO (2014b) CAO Carbon Emissions Calculator Version 7. Montreal: ICAO. Available from http://www.icao.int/environmental-protection/CarbonOffset/Documents/Methodology%20ICAO%20Carbon%20Calculator_v7-2014.pdf [Accessed 09 April 2016].

182. ICAO (2016) *High Level Meeting on a Global Market Based Measure Scheme.* Working paper available from http://www.icao.int/Meetings/HLM-MBM/Documents/HLM-GMBM.WP2-Developments_Final.pdf [Accessed 28 July 2016].

183. ICAO Annex 16 (2008) Environmental Protection Volume II Aircraft engine emissions (3rd ed). Montreal: ICAO.

184. ICAO Annex 16 (2011) Environmental Protection Volume I Aircraft Noise (6th ed). Montreal: ICAO.

185. ICAO Doc 030 (2013) *EUR Region Performance Framework Document*. Montreal: ICAO.

186. ICAO Doc 10018 (2013). *Report of the Assessment of Market-based Measures*. Available from: http://www.icao.int/Meetings/GLADs-2015/Documents/10018_cons_en.pdf [Accessed 12 July 2016].

187. ICAO Doc 9082 (2012) *ICAO's Policies on Charges for Airports and Air Navigation Services.* Montreal: ICAO.

188. ICAO Doc 9161 (2013) *Manual on Air Navigation Services Economics*. Available from: http://www.icao.int/publications/Documents/9161_en.pdf [Accessed 12 July 2016].

189. ICAO Doc 9587 (2008) *Policy and Guidance Material on the Economic Regulation of International Air Transport*. Montreal: ICAO.

190. ICAO Doc 9885 (2008) *Guidance on the Use of Emissions Trading for Aviation.* Montreal: ICAO.

191. ICAO Doc 9902 (2007) Assembly Resolutions in Force (as of 28 September 2007). Available from: http://www.icao.int/environmental-protection/Documents/A36_Res22_Prov.pdf [Accessed 09 April 2015].

192. ICAO Doc 9931 (2010) *Continuous Descent Operations (CDO) Manual.* Montreal: ICAO.

193. ICAO Doc 9951 (2011) *Offsetting Emissions from the Aviation Sector*. Montreal: ICAO.

194. ICAO Doc 9980 (2012) *Manual on Privatization in the Provision of Airports and Air Navigation Services*. Montreal: ICAO

195. ICAO Doc 9993 (2013) *Continuous Climb Operations (CCO) Manual.* Montreal: ICAO.

196. ICAP (2014) Emissions Trading Worldwide International Carbon Action Partnership (ICAP) Status Report 2014. Available from: https://icapcarbonaction.com/en/?option=com_attach&task=download&id=349 [Accessed 09 April 2015].

197. ICAP (2016) Canada - Québec Cap-and-Trade System. Available from: https://icapcarbonaction.com/en/?option=com_etsmap&task=export&format=pdf&layout=list&syste [Accessed 09 October 2016].

198. ICCT (2016) Cost assessment of near and mid-term echnologies to improve new aircraft fuel efficiency. USA: ICCT. Available from: http://www.theicct.org/sites/default/files/publications/ICCT%20aircraft%20fuel%20efficiency%20cost%20assessment_final_09272016.pdf [Accessed 10 October 2016].

199. Ihlen, O and Berntzen, O. (2007) When lobbying backfires: Balancing lobby efforts with insights from stakeholder theory. *Journal of Communication Management*, 11(3):235–246.

200. Independent Transport Commission (2016) The sustainability of UK Aviation: Trends in the mitigation of noise and emissions. London: Independent Transport Commission. Available from: http://www.theitc.org.uk/wp-

content/uploads/2016/03/ITC-Aviation-Sustainability-March-2016-complete.pdf [Accessed 12 September 2016].

201. International Energy Agency (IEA) (2015) CO2 Emissions From Fuel Combustion Highlights. Available from https://www.iea.org/publications/freepublications/publication/CO2EmissionsFromFuelCombustionHighlights2015.pdf [Accessed 09 March 2016].

202. IPCC (1999) Aviation and the Global Atmosphere. Geneva:IPCC. Available from: http://www.ipcc.ch/ipccreports/sres/aviation/ [Accessed on 28 July 2016].

203. IPCC (2007) *Climate Change 2007 – The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report*. Available from http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html Accessed 09/04/2016 [Accessed on 28 July 2015].

204. ITF/OECD (2011) Better Economic Regulation: The role of the regulator. Paris: OECD

205. Janes, T.M., Felps, W. and Bigley, G.A. (2007) Ethical theory and stakeholder related decisions: the role of stakeholder culture, *Academy of Management Review*, 22(1), 137-155.

206. Janic, M. (2007) *The Sustainability of Air Transportation: A Quantitative Analysis and Assessment*. UK: Routledge

207. Johnson, G., Scholes, K. and Whittington, R. (2010) *Exploring Corporate Strategy: Texts and Cases* (9th ed). Harlow: Financial Times Prentice-Hall.

208. Johnson, R. B. & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, 33(7), 14-26.

209. Joskow: L. & Rose, N. L. (1989). *The Effects of Economic Regulation. In: Handbook of Industrial Organization*. S.l.:Elsevier Science Publishers B.V.

210. Karakoc, T.H., Ozerdem, M.B., Sogut, M.Z., Colpan, C.O., Altuntas, O. and Acikkalp, E. (2016). *Sustainable Aviation: Energy and Environmental Issues 1st ed.* Germany: Springer.

211. Kantareva, M., Angelova, A., Iliev, L. and Efthymiou, M. (2016). Action Plan of Bulgaria for CO2 Emissions Reduction from Civil Aviation. Bulgaria: Civil Aviation Administration the Republic of Bulgaria.

212. Klemperer, P. (2002) How (not) to run auctions: The European 3G telecom auctions. *European Economic Review,* 46(4-5), 829–845.

213. KLM (2016) KLM to operate biofuel flights out of Los Angeles. Available from: http://news.klm.com/klm-to-operate-biofuel-flights-out-of-los-angeles [Accessed 10 October 2016].
214. Kolk, A. and Pinkse, J. (2006) Stakeholder mismanagement and corporate social responsibility crises. *European Management Journal*, 24(1):59–72.
215. Kollmuss, A., Lazarus, M., Lee, C., LeFranc, M. and Polycarp, C. (2010). *Handbook of Carbon Offset Programs: Trading Systems, Funds, Protocols and Standards (Environmental Market Insights*). UK Routledge.
216. Kopsch, F., 2012. Aviation and the EU Emissions Trading Scheme—Lessons learned from previous emissions trading schemes. Energy Policy, 49(C), pp.770–773.
217. Kousoulidou, M. and Lonza, L. (2016) Biofuels in aviation: Fuel demand and CO2 emissions evolution in Europe toward 2030. *Transportation Research Part D: Transport and Environment,* 46, 166-181.
218. Laffont, J.J. (1977) More on Prices vs. Quantities, *Review of Economic Studies* 44(1): 177–182.
219. Laffont, J.J. (1997) Game theory and empirical economics: The case of auction data. *European Economic Review*, 41, 1-35.
220. Leedy, P. & Ormrod, J. (2012). *Practical research: Planning and design* (10th ed.). UK, Pearson.
221. Linstone, H. A. & Turoff, M. (2002) *The Delphi Method: Techniques and Applications*. S.l.:Addison-Wesley Publishing.
222. LSSIP Greece (2015) Local Single Sky ImPlementation (LSSIP) GREECE Year 2015-Level 1. Available from https://www.eurocontrol.int/sites/default/files/content/documents/official-documents/reports/lssip2015-greece.pdf [Accessed 26 June 2016].
223. LSSIP the Netherlands Local Single Sky ImPlementation (LSSIP) the Netherlands Year 2015-Level 1. Available from https://www.eurocontrol.int/sites/default/files/content/documents/official-documents/reports/2016-lssip2015-netherlands.pdf [Accessed 26 June 2016].
224. Ludwig, B. (1997). Predicting the future: Have you considered using the Delphi methodology? *Journal of Extension*, 35 (5), 1-4.
225. Lufthansa Group (2016). *Environmental Strategy 2020*. Available from: https://www.lufthansagroup.com/en/responsibility/climate-and-environmental-

responsibility/environmental-strategy-and-measures.html [Accessed 3 October 2016].

226. Malavolti, E. and Podesta, M., 2015. Strategic Reactions of Airlines to the European Trading Scheme. Transportation Research Procedia, 8, pp.103-113.

227. Malina, R. et al., 2012. The impact of the European Union Emissions Trading Scheme on US aviation. Journal of Air Transport Management, 19(C), pp.36–41.

228. Malina, R. McConnachie, D., Winchester, N., Wollersheim, C., Paltsev, S. and Waitz, I.A. (2012) The impact of the European Union Emissions Trading Scheme on US aviation, *Journal of Air Transport Management*, 19, 36-41.

229. MARKS, G. (1993) 'Structural Policy and Multilevel Governance in the EC', in A. Cafruny and G. Rosenthal (eds), The State of the European Community Vol. 2: The Maastricht Debates and Beyond (Boulder, CO: Lynne Riener, and Harlow: Longman).

230. McCann, L. (2013) Transaction costs and environmental policy design. *Ecological Economics*, 88, 253-262.

231. Meleo, L., Nava, C.R. and Pozzi, C. (2016). Aviation and the costs of the European Emission Trading Scheme: The case of Italy. *Energy Policy*, 88, 138-147.

232. Meleo, L., Nava, C.R., Pozzi, C., 2016. Aviation and the costs of the European Emission Trading Scheme: The case of Italy, Energy Policy, 88, pp. 138-147.

233. Menezes, F. M. & Monteiro: K. (2008). *An introduction to auction theory*. s.l.:Oxford University Press.

234. Metz, B., Davidson, O.R., Bosch, P.R., Dave, R. and Meyer, L.A. (2007) Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. UK: Cambridge University Press.

235. Miyoshi, C., 2014. Assessing the equity impact of the European Union Emission Trading Scheme on an African airline. Transport Policy, 33(C), pp.56–64.

236. Moloney, K. (2006) *Rethinking Public Relations: PR Propaganda and Democracy* (2nd edn). London: Routledge.

237. Monjon, S. & Quirion, P. (2011). Addressing leakage in the EU ETS: Border adjustment or output-based allocation? *Ecological Economics*, 70: 1957–1971.

238. Morgan, C.W., Katz, M. L. & Rosen, H. S. (2009) *Microeconomics*. UK: McGraw-Hill Higher Education.

239. Morrell, P., 2007. An evaluation of possible EU air transport emissions trading scheme allocation methods. Energy Policy, 35(11), pp.5562–5570.

240. Mott MacDonald (2015) Annual Analyses of the EU Air Transport Market 2013. Available from: http://ec.europa.eu/transport/modes/air/internal_market/observatory_market/doc/annual-2013.pdf [Accessed 07 July 2015].
241. Musante, K. and DeWalt, B.R. (2010) Participant Observation: A Guide for Fieldworkers (2nd Ed.). USA: AltaMira Press.
242. NASA (2009) Biofuels as an Alternative Energy Source for Aviation—A Survey. USA: NASA. Available from: http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20100002886.pdf [Accessed 03 February 2015].
243. Nath, S. K. (1969) Reappraisal of Welfare Economics. NY: Routledge & Kegan Paul PLC.
244. NATS (2014). *3Di inefficiency score*. [Online] Available at: http://www.nats.aero/news/projects/greensky/ [Accessed 05 December 2014].
245. NATS (2015). FerroNATS. Available from http://www.nats.aero/static/ferronats/ [Accessed 05 July 2016].
246. Nava-Gaxiola, C.A. & Barrado, C., 2016. Performance measures of the SESAR Southwest functional airspace block. Journal of Air Transport Management, 50, pp.21–29.
247. Neely, A. (2004). *Business performance measurement, Theory and practice*. UK: Cambridge University Press.
248. NERA (2006) Cost Benchmarking of Air Navigation Service Providers: A Stochastic Frontier Analysis. London, NERA. Available from: http://www.eurocontrol.int/publications/cost-benchmarking-ansps-stochastic-frontier-analysis [Accessed 05 December 2015].
249. Nicholson, W. and Snyder C.M. (2016) *Microeconomic Theory: Basic Principles and Extensions* 12th Edition. USA: Cengage Learning.
250. Niemeier, HM. (2002) Regulation of airports: the case of Hamburg airport—a view from the perspective of regional policy, *Journal of Air Transport Management*, 8(1), 37-48.
251. NM (2015) *European Route Network Improvement Plan: PART 2 European ATS Route Network - Version 2015-2019*. Brussels, EUROCONTROL.
252. North, G. (1992) *The Coase Theorem, a study in economic epistemology*. s.l.:Institute for Christian Economics.

253. O'Connell, J.F. and Warnock-Smith, D. (2013) An investigation into traveler preferences and acceptance levels of airline ancillary revenues, *Journal of Air Transport Management*, 33, 12-21.

254. OECD (2002) Regulatory Policies in OECD Countries: From Interventionism to Regulatory Governance, Paris: OECD

255. Okoli, C. and Pawlowski, S.D. (2004). The Delphi method as a research tool: an example, design considerations and applications*. Information and Management*, 15-29.

256. Olander, S. (2007) Stakeholder impact analysis in construction project management. *Construction Management and Economics*, 25(3):277–287.

257. Owen, A. D. & Hanley, N. (2004). The Economics of Climate Change. London: Routledge.

258. Oxford Economics (2011) Economic Benefits from Air Transport in the UK. Oxford Economics

259. Pacos, T. (1997). Industrial Organization, Business Policies and Performance (in greek). Athens: Papazisi.

260. Parmenter, D. (2015). Key Performance Indicators, Developing, Implementing and Using Winning KPIs. 3rd ed. Canada: John Wiley & Sons, Inc.

261. Pellegrini, P. & Rodriguez, J., 2013. Single European Sky and Single European Railway Area: A system level analysis of air and rail transportation. Transportation Research Part A: Policy and Practice, 57(C), pp.64–86.

262. Piermartini, R. & Rousova, L. (2008) *Liberalization of Air Transport Services and Passenger Traffic.* Available from: http://www.wto.org/english/res_e/reser_e/ersd200806_e.pdf [Accessed 18 September 2013].

263. Pigman, A., G. (2007). *The World Economic Forum, a multi stakeholder approach to global governance*. NY: Routledge.

264. PRB (2013) *PRB Annual monitoring Report 2012, Volume 1, European overview and PRB recommendations*. Brussels: EUROCONTROL. Available from: http://www.EUROCONTROL.int/sites/default/files/content/documents/single-sky/pru/news-related/2013-19-13_prb_monitoring_report_2012_volume_1-_european_overview_and_prb_recommendations.pdf [Accessed 04 October 2013].

265. PRB (2014a) PRB Assessment Report of RP2 FAB Performance Plans Volume 1 - Union-wide view assessment report. Brussels: EC. Available from: http://www.eurocontrol.int/sites/default/files/content/documents/single-

sky/pru/publications/other/RP2-Assessment-Report-Vol-1-Union-wide-view.pdf [Accessed 21 April 2016].

266. PRB (2014b) PRB Annual Monitoring Report 2013 Volume 1 -European overview and PRB recommendations. Brussels: EC. Available from: http://www.eurocontrol.int/sites/default/files/content/documents/single-sky/pru/publications/other/RP1-Annual-Monitoring-Report-2013-Vol1-European-view-Fact-validated-edition.pdf [Accessed 21 April 2016].

267. PRB (2016) PRB White Paper: RP3 Performance Objectives, version 3.6. available from: http://www.eusinglesky.eu/Documents/PRB%20Reports/Reference%20Period%20Three/RP3%20White%20Paper.pdf [Accessed 04 October 2016].

268. Preston, H., Lee, D.S. & Hooper, P.D., 2012. The inclusion of the aviation sector within the European Union's Emissions Trading Scheme: What are the prospects for a more sustainable aviation industry? Environmental Development, 2, pp.48–56.

269. Preston, H., Lee, D.S. and Hooper, P.D. (2012). The inclusion of the aviation sector within the European Union's Emissions Trading Scheme: What are the prospects for a more sustainable aviation industry? *Environmental Development*, 2, 48-56.

270. PRU (2004). *ATM Cost-Effectiveness (ACE) 2002 Benchmarking Report*. Brussels: EUROCONTROL.

271. PRU (2016) ATM Cost-Effectiveness (ACE) 2014 Benchmarking Report with 2015-2019 Outlook. Available from: http://www.eurocontrol.int/sites/default/files/content/documents/single-sky/pru/publications/ace/ACE-2014-Benchmarking-Report.pdf [Accessed 28 June 2016].

272. Quality Assurance Standard (2014). *Quality Assurance Standard*. Available from: http://qascarbonoffsetting.com/airline-carbon-offset-programs/ [Accessed 21 February 2014].

273. Rao, R. K. (2003). *The Economics of Transaction Costs: Theory, Methods, and Applications*. UK: Palgrave Macmillan.

274. Raven, H.P., Hassenzahl, D.M., Hager, M.C., Gift, N.Y. and Berg, L.R. (2015) *Environment,* 9th Edition. USA: Wiley.

275. Regulation (EU) No 598/2014 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach and repealing Directive 2002/30/EC.

276. Remenyi, D., Williams, B., Money, A. and Swartz, E. (1998) *Doing Research in Business and Management: An Introduction to Process and Method.* London, Sage.
277. SAA (2016) Africa's Greenest Flight. Available from: https://www.flysaa.com/us/en/flyingSAA/News/Africas_Greenest_Flight_First_flight_to_operate_with_biofuel_made_from_locally_grown_tobacco_plants.html [Accessed 10 October 2016].
278. Samsonowa, T. (2012). *Industrial Research Performance Management Key Performance Indicators in the ICT Industry*. Berlin: Springer.
279. Sandbag (2013) Aviation and the EU ETS What happened in 2012 during 'Stop the Clock? UK: Sandbag. Available from: https://sandbag.org.uk/site_media/pdfs/reports/Sandbag_Aviation_and_the_EU_ETS_2012_171213_1.pdf [Accessed 14 October 2016].
280. Saunders, M.N.K., Lewis, P. and Thornhill, A. (2015) *Research Methods for Business Students*, 7th ed, Trans-Atlantic Publications, Inc.
281. Scheelhaase, J., Grimme, W. & Schaefer, M., 2010. The inclusion of aviation into the EU emission trading scheme-Impacts on competition between European and non-European network airlines. Transportation Research Part D: Transport and Environment, 15(1), pp.14–25.
282. Scheelhaase, J.D. & Grimme, W.G., 2007. Emissions trading for international aviation: an estimation of the economic impact on selected European airlines. Journal of Air Transport Management, 13(5), pp.253–263.
283. Schleich, J., Ehrhart, K.M., Hoppe, C. and Seifert, S. (2006) Generous allocation and ban on banking. In Antes, R. Hansjurgens, B. and Letmathe, P. (2006) *Emissions Trading and Business.* Springer.
284. Schniederjans, D.G and Hales, D.N. (2016) Cloud computing and its impact on economic and environmental performance: A transaction cost economics perspective. *Decision Support Systems*, 86, 73-82.
285. Sciacchitano, S. (2013). ECAC-Editorial. ECAC News, *the European Civil Aviation Conference Magazine*, 49: 1.
286. Scotter, A. (2008*). Microeconomics, a modern approach*. USA: Addison-Wisley.
287. Seinfeld, J.H. and Pandis S.N. (2006). *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change* (2nd Edition). USA: Wiley-Interscience.
288. SESAR (2014). eATM Portal, European ATM Master Plan. Available from: https://www.atmmasterplan.eu/essip/AOM21 [Accessed 09 December 2014].

289. Shah, H., A., and Kalaian, S. A. (2009) Which Is the Best Parametric Statistical Method for Analyzing Delphi Data? *Journal of Modern Applied Statistical Methods* 8(1): 226-232.

290. Sheu, J.-B., 2014. Airline ambidextrous competition under an emissions trading scheme – A reference-dependent behavioral perspective. Transportation Research Part B: Methodological, 60(C), pp.115–145.

291. Shresta, S., Neskovic, D., and Williams, S. (2009) Analysis of Continuous Descent Benefits and Impacts during Daytime Operations, Eighth USA/Europe Air Traffic Management Research and Development Seminar (ATM2009), Napa, CA.

292. Shulruf, B., Hattie, J., & Dixon, R. (2008). Factors affecting responses to Likert type questionnaires: Introduction of the ImpExp, a new comprehensive model. *Social Psychology of Education*, 11, 59–78.

293. Singh, M. (2011) *Cooperation in Air navigation services: is Globalization Arriving in the world of ANS?* In O'Connell, J. F. & Williams, G. (2011) Air Transport in the 21st Century Key strategic Developments. UK: Ashgate.

294. Skulmoski, G.J, Hartman, F.T. and Krahn, J. (2007) The Delphi Method for Graduate Research, *Journal of Information Technology Education*, 6, 1-21.

295. SkyBrary (2014) *National Supervisory Authority*. Available from: http://www.skybrary.aero/index.php/National_Supervisory_Authority [Accessed 3 October 2016].

296. SkyBrary (2016) Free Route Airspace (FRA). Available from: http://www.skybrary.aero/index.php/Free_Route_Airspace_(FRA) [Accessed 3 October 2016].

297. Spradley, J. (2016) Participant Observation (Reissue Edition). USA: Waveland Press, Inc.

298. SSE (n.d.) EU ETS reform– SSE's view. UK: SSE. Available from: http://sse.com/media/206701/ets-reform-sse-view.pdf [Accessed 18 September 2016].

299. Stabler, M. J., Papatheodorou, A. & Sinclair, T. M. (2010). *The Economics of Tourism*. 2nd ed. ed. s.l.:Routledge.

300. Stavins, R.N. (1995). Transaction Costs and Tradable Permits. *Environmental Economics and management*, 13-48.

301. Steer Davies Gleave (2014) *Study on Cost of Capital, Return on Equity and Pension Costs of Air Navigation Service Providers* (Prepared for the European

Commission). Available from:
http://ec.europa.eu/transport/modes/air/single_european_sky/doc/2014_03_25_final-report-cost-of_capital-and-pensions-v2-25march2014.pdf [Accessed 07 May 2016].

302. Stoney, C. and Winstanley D. (2001). 'Stakeholding: Confusion or Utopia? Mapping the Conceptual Terrain', *Journal of Management Studies*, 38(5): 603–626.

303. Tashakkori, A., & Teddlie, C. (2010) Handbook of Mixed Methods in Social and Behavioral Research (2nd ed). Thousand Oaks, CA: Sage Publications.

304. The Gold Standard (2012). *The Gold Standard.* Available from: http://www.cdmgoldstandard.org/wp-content/uploads/2012/09/Offset-Handbook-lo-res.pdf [Accessed 20 February 2014].

305. Tietenberg, T. H. (2006). Emissions Trading, Principles and Practice. 2nd ed. ed. Washington DC: Resources for the Future.

306. Tietenberg, T.H. (2010). Environmental and Natural Resource Economics (10th ed.) New York: HarperCollins Publishers Inc.

307. Tracy, S.J. (2013) *Qualitative Research Methods: Collecting Evidence, Crafting Analysis, Communicating Impact.* Wiley-Blackwell.

308. Train, K. E. (1991*). Optimal Regulation. The economic Theory of Natural Monopoly*. USA: MIT.

309. Tuerk, A., Mehling, M., Flachsland, C. & Sterk, W., 2009. Linking Carbon Markets: Concepts, case studies and pathways. *Climate Policy*, 9, 341-357.

310. Turner, R.K, Pearce, D & Bateman I. (1994). *Environmental economics: An elementary introduction*. U.K.: Harvester Wheatsheaf.

311. UNEP (2016). *Climate Change mitigation*. Available from: http://www.unep.org/climatechange/mitigation/ [Accessed 06 May 2016].

312. UNFCCC (2014a). *UNFCCC*. Available from: http://cdm.unfccc.int/about/dev_ben/index.html [Accessed 20 February 2014].

313. UNFCCC (2014b). Appendix I - Quantified economy-wide emissions targets for 2020. Available from: http://unfccc.int/meetings/copenhagen_dec_2009/items/5264.php [Accessed 01 February 2015].

314. UN-REDD Programme, 2014. *UN-REDD Programme*. Available from: http://www.un-redd.org/AboutREDD/tabid/102614/Default.aspx [Accessed 21 February 2014].

315. Uschold, M. and Gruniger, M. (1996) Ontologies: Principles, methods and applications. *Knowledge Engineering Review*, 11(2):93–155.

316. Van der Brug, W. and De Vreese, C.H. (2016) *(Un)intended Consequences of EU Parliamentary Elections*. UK: Oxford University Press.
317. Van der Duin, P. (2016) *Foresight in Organizations: Methods and Tools*, Routledge.
318. Varian, H. R. (1992). *Microeconomic Analysis* (3rd Ed.). USA: W. W. Norton & Company.
319. Varoufakis J. (2001) *Game Theory: Critical Concepts in the Social Sciences.* London: Routledge.
320. Vespermann, J. & Wald, A., 2011. Much Ado about Nothing?-An analysis of economic impacts and ecologic effects of the EU-emission trading scheme in the aviation industry. Transportation Research Part A: Policy and Practice, 45(10), pp.1066–1076.
321. Vettas, N. & Katsoulakos, G. (2004). *Competition Policy and Regulatory Policy.* Athens: Typothito.
322. Viscusi, W.K., Harrington, J.E. and Vernon, J.M. (2005) *Economics of Regulation and Antitrust.* The MIT Press, Cambridge.
323. Waldman, D. E. & Jensen, E. J. (2012) *Industrial Organization: Theory and Practice, New International Edition (The Pearson Series in Economics)* 4th Ed. USA: Routledge.
324. Weissinger, G.J. (2005). Law Enforcement and the INS: A Participant Observation Study of Control Agents (2nd ed.). USA: UPA.
325. Weitzman, M. L. (1974) Prices vs. Quantities, *Review of Economic Studies*, 41 (4), 477– 491.
326. Weitzman, M.L., (2014) Can Negotiating a Uniform Carbon Price Help to Internalize the Global Warming Externality? *Journal of the Association of Environmental and Resource Economists*, 1(1), 29 - 49.
327. Wensveen, J.G (2007) *Air Transport: A Management Perspective* (6th ed.). Ashgate.
328. Williams, C. (2007) Research Methods. *Journal of Business & Economic Research*, 5 (3), 65-72.
329. Williams, S., (1991) *Sovereignty and accountability in the European community*. R.O. Keohane, S. Hoffmann (Eds.), The New European Community: Decision making and Institutional Change, Westview Press, Boulder, CO.
330. Winther, M., Kousgaard, U. and Oxbol, A. (2006) Calculation of odour emissions from aircraft engines at Copenhagen Airport, *Science of the total environment*, 366, 218-232.

331. Winther, M., Kousgaard, U., Ellermann, T., Massling, A., Nojgaard, J.K. and Ketzel, M. (2015) Emissions of NOx, particle mass and particle numbers from aircraft main engines, APU's and handling equipment at Copenhagen Airport, *Atmospheric Environment*, 100, 218-229.

332. World Bank, n.d. *Stakeholder Analysis*. [ONLINE] Available at: http://www1.worldbank.org/publicsector/anticorrupt/PoliticalEconomy/stakeholderanalysis.htm. [Accessed 3 October 2016].

333. World Economic Forum (2010). *The future of industrial biorefineries*. Geneva, WEF.

334. World Economic Forum (2014) *The Global Competitiveness Report 2014–2015*. Geneva: WEF.

335. World Economic Forum (2015) *The Global Competitiveness Report 2015–2016*. Geneva: WEF.

336. Worldbank.org (2001) Stakeholder Analysis. Available from: http://www1.worldbank.org/publicsector/anticorrupt/PoliticalEconomy/stakeholderanalysis.htm [Accessed 18 September 2016].

337. WWF (2012) Aviation Report: Market Based Mechanisms to Curb Greenhouse Gas Emissions from International Aviation. Available from: http://awsassets.panda.org/downloads/aviation_main_report_web_simple.pdf [Accessed on 28 July 2016].

338. Xu, J., Qiu, R. & Lv, C., 2016. Carbon emission allowance allocation with cap and trade mechanism in air passenger transport. Journal of Cleaner Production, 131, pp.308–320.

339. Yin, R.K (2013) *Case Study Research: Design and Methods (Applied Social Research Methods)* 5th Ed. Sage publications.

340. Yin, R.K. (2015) *Qualitative Research from Start to Finish*, 2nd Ed. The Guilford Press.

341. Zanin, M. et al., 2016. Towards a secure trading of aviation CO 2 allowance. Journal of Air Transport Management, 56, pp.3–11.

Appendices

Appendix 1: Definitions of key terms and concepts

Accountable entity	The entity in a cap-and-trade emissions trading system that is responsible for measuring and reporting actual emissions and for submitting sufficient allowances to cover those emissions
Additionality	To avoid giving credits for greenhouse gas (GHG) emissions reductions that would have happened anyway, eligibility criteria have been developed to determine whether the reductions are "additional" — that is, are more than would have occurred in the absence of the project (environmental additionality) or in the absence of the incentive from the clean development mechanism (CDM) (project additionality). The concept of additionality is important as only carbon credits from projects that are "additional to" the business-as-usual scenario represent a net environmental benefit. Without the "additionality" requirement, there is no guarantee that the emissions reduction activities will lead to a reduction of greenhouse gases into the atmosphere.
Aeronautical Information Service (AIS)	A service established within the defined area of coverage responsible for the provision of aeronautical information/data necessary for the safety, regularity and efficiency of air navigation. Such information includes the availability of air navigation facilities and services and the procedures associated with them, and must be provided to flight operations personnel and services responsible for flight information service.
Air navigation services	This term includes air traffic management (ATM), communications, navigation and surveillance systems (CNS), meteorological services for air navigation (MET), search and rescue (SAR) and aeronautical information services/aeronautical information management (AIS/AIM). These services are provided to air traffic during all phases of operations (approach, aerodrome and en route).

Air Operator Certificate (AOC)	An Air Operator Certificate (AOC) is a certificate authorising an operator to carry out specified commercial air transport operations. (ICAO Annex 6)
Air Traffic Management (ATM)	is the dynamic, integrated management of air traffic and airspace including air traffic services, airspace management and air traffic flow management - safely, economically and efficiently - through the provision of facilities and seamless services in collaboration with all parties and involving airborne and ground-based functions. The general objective of ATM is to enable aircraft operators to meet their planned departure and arrival times and to adhere to their preferred flight profiles with the minimum constraints, without compromising agreed levels of safety.
Aircraft operator	Aircraft operator means a holder of an air carrier operating certificate
Allocation	The initial distribution of allowances to accountable entities for a compliance period. This allocation could, for example, be based on historical emissions or a performance standard and level of production; it could be made for free or through an auctioning process or both.
Allowance	An allowance is a tradable emission permit that can be used for compliance purposes in a cap-and-trade system. Each allowance allows the holder to emit a specific quantity of a pollutant (e.g. one tonne of CO2) one time.
Annex B countries	Annex B countries are the 39 emissions-capped industrialized countries and economies in transition listed in Annex B of the Kyoto Protocol.
Annex I countries	Annex I countries are the 36 industrialized countries and economies in transition listed in Annex I of the United Nations Framework Convention on Climate Change (UNFCCC).
Annex I Parties	A group of industrialized countries and economies in transition included in Annex I to the United Nations Framework Convention on

or Countries	Climate Change (UNFCCC) that committed individually or jointly to returning to their 1990 levels of GHG emissions by the year 2000.
Approach phase	The operating phase defined by the time during which the engine is operated in the approach operating mode.
Area Control Centre (ACC)	is a unit established to provide air traffic control service to controlled flights in control areas under its jurisdiction.
Assigned amount units (AAUs)	Emissions targets for industrialized country Parties to the Kyoto Protocol are expressed as levels of allowed emissions or "assigned amounts" for the 2008-2012 commitment period. Such assigned amounts are denominated in tonnes of CO2 equivalent emissions (CO2e).
International aviation bunkers	International aviation bunkers includes deliveries of aviation fuels to aircraft for international aviation. Fuels used by airlines for their road vehicles are excluded. The domestic/international split should be determined on the basis of departure and landing locations and not by the nationality of the airline. For many countries this incorrectly excludes fuel used by domestically owned carriers for their international departures.
Air traffic complexity	Air traffic complexity is a measure of the control activity required to accept an aircraft entering into the sector. In this paper we measure control activity by the total change in heading summed over all aircraft in the sector.
Auctioning	The distribution of allowance - either the initial distribution or from a set-aside, this is achieved through an auction in which system participants bid for the right to purchase allowances. Different auction models could be used. Auctions often complement other forms of allowance allocation. ICAO Documents 9949/50/51
Banking	A banking provision permits allowances issued for one compliance period to be saved for use during a subsequent compliance period. ICAO Documents 9949/50/51

Baseline A reference level of emissions. For example, a baseline can be used to calculate the total quantity of allowances to be distributed under a cap-and-trade system or the quantity of credits generated under a baseline-and-credit (emissions intensity) system. A baseline also sets the level of emissions that would occur without policy intervention in an offset programme.

Benchmarking A reference level, such as emissions per unit of output that can be part of the formula for the free allocation of allowances under a cap-and-trade system or that can define the target in an emissions intensity system. It is a method for distribution of obligations under an MBM scheme. It establishes a reference level based on efficiency such as emissions per unit of output, e.g. CO2/RTK

Biofuels Products refer to non-fossil energy sources which are made from living organisms or from biogenic feedstocks (plant oils or animal fats). In order to be considered as biofuel, the fuel must contain over 80 percent renewable materials.

Borrowing A borrowing provision permits an accountable entity to use allowances for a future period to achieve compliance in the current period. ICAO Documents 9949/50/51

Cap and Trade The Cap and Trade system involves trading of emission allowances, where the total amount of allowances is strictly limited or 'capped' by a regulatory authority. Allowances are created to account for the total allowed emissions. At the end of each compliance period each entity must surrender sufficient allowances to cover its emissions during that period. Trading occurs when an entity can reduce units of emission at a lower cost than another entity and then sells the allowance. A Cap and Trade system is generally based on those entities included in the cap.

Carbon Dioxide Equivalent (CO2e) CO2e is a measurement unit to indicate the global warming potential (GWP) of greenhouse gases. Carbon dioxide is the reference gas against which other greenhouse gases are measured. Other greenhouse gases that are reported as Carbon Dioxide Equivalent

	are: Carbon dioxide (CO_2); Methane (CH_4); Nitrous oxide (N_2O); Sulphur hexafluoride (SF_6); Perfluorocarbons (PFCs); Hydrofluorocarbons (HFCs). For the EU ETS CO_2 is the main greenhouse gas that is covered, with N_2O and PFCs also covered for selected industry sectors.
Carbon Leakage	Emission reductions in one location could be offset by an increase in emissions in another location. Leakage occurs when laws or activities designed to cut greenhouse gas emissions implemented in one jurisdiction or project area lead to the movement rather than the reduction of the targeted emitting activities, such as a carbon-intensive industry moving in response to regulation.
Certified emission reductions (CERs)	A compliance unit under the Kyoto Protocol issued for emissions reductions achieved from project activities in non-Annex I Parties that meet the requirements of the clean development mechanism (CDM). One CER is equal to one metric tonne of CO_2 equivalent.
Clean development mechanism (CDM)	A mechanism established by the Kyoto Protocol that enables emissions reduction projects in non-Annex I Parties to earn CERs that can be sold to entities in Annex I Parties for compliance with their emissions limitation or reduction commitments under the Kyoto Protocol.
Climb phase	The operating phase defined by the time during which the engine is operated in the climb operating mode.
Code sharing	The use of the flight designator code of one air carrier on a service performed by a second air carrier, which service is usually also identified (and may be required to be identified) as a service of, and being performed by, the second air carrier.
Compliance	System for checking adherence to reduction obligations, including measures and sanctions to be implemented if a country (in case of the Kyoto Protocol) or operator (in case of an ETS) does not fulfil its obligations to reduce emissions as laid down in legislation of the system

Distances Aerodrome-to-aerodrome great circle distances should be used in all items involving distance computations (Items 1, 6, 7, 9, 10, 12, 17, 18, 19 and 20). Distances can be calculated using the Great Circle Distance which is defined as the shortest distance between any two points on the surface of the Earth which should be approximated using the Vincenty distance formula associated with the World Geodesic System – 1984 (WGS 84) adopted by ICAO and referred to in Annex 15 to the Chicago Convention. The latitude and longitude of aerodromes can be taken either form aerodrome data published in Aeronautical Information Publication (AIP).

Domestic A flight stage not classifiable as international. Domestic flight stages include all flight stages flown between points within the domestic boundaries of a State by an air carrier whose principal place of business is in that State. Flight stages between a State and territories belonging to it, as well as any flight stages between two such territories, should be classified as domestic. This applies even though a stage may cross international waters or over the territory of another State.

NOTES:

1. In the case of multinational air carriers owned by partner States, traffic within each partner State should be reported separately as domestic and all other traffic as international.

2. “Foreign” cabotage traffic (i.e. traffic carried between city-pairs in a State other than the one where the reporting carrier has its principal place of business) should be reported as international traffic.

3. A technical stop should not result in any flight stage being classified differently than would have been the case had the technical stop not been made.

Economies of density are defined in relation to the impact on unit costs when output increases holding network size constant. There are economies of density when unit costs fall as output increases on a fixed network

	and there are diseconomies of density when unit costs rise as output increases on a fixed network
Economies of scale	are defined in relation to the impact on unit costs when both output and size of network increase in the same proportion and other characteristics of the operating environment are held constant. There are economies of scale when unit costs fall as output and network size increase, and there are diseconomies of scale when unit costs rise as output and network size increase.
Filed Flight Plan (FPL)	is the flight plan as filed with an ATS unit by the pilot or a designated representative, without any subsequent changes.
Final Approach Fix (FAF) or Final Approach Point (FAP)	The final approach starts at the Final Approach Fix (FAF), sometimes also called Final Approach Point (FAP). At the FAF the aircraft has reached its landing configuration with the landing gear and the flaps in the correct landing position.
Flexible mechanisms	The Kyoto Protocol makes provision for three instruments that provide flexibility to its signatories in implementing their reduction goals: emissions trading, Joint Implementation (projects carried out jointly by industrial countries) and the Clean Development Mechanism (projects which reduce emissions in developing countries). The underlying philosophy of all three flexible mechanisms is that the Annex B countries can make some of the reductions to which they have committed themselves outside their own country.
Flexible Use of Airspace (FUA) Concept	is based on the fundamental principle that airspace should not be designated as either pure civil or military airspace, but rather be considered as one continuum in which all user requirements have to be accommodated to the extent possible.
Flight Information Region (FIR)	is an airspace of defined dimensions within which flight information service and alerting service are provided
Flight stage	A flight stage is the operation of an aircraft from take-off to its next landing. A flight stage is classified as either international or domestic

based on the following definitions:

Free Route Operations Airspace (FRA) A specified airspace within which users may freely plan a route between a defined entry point and a defined exit point, with the possibility to route via intermediate (published or unpublished) way points, without reference to the ATS route network, subject to airspace availability. Within this airspace, flights remain subject to air traffic control.

Grandfathering Allocation methodology under an ETS under which the distribution of allowances to entities is based on historical emissions.

International A flight stage with one or both terminals in the territory of a State, other than the State in which the air carrier has its principal place of business.

Joint implementation (JI) Joint implementation is a flexible mechanism established by Article 6 of the Kyoto Protocol for project-based emissions reduction activities in Annex B countries. Emissions reductions from JI projects earn ERUs.

Key performance areas (KPAs) Key areas of performance corresponding to the expectations of providers, regulators, users and other interested parties.

Key performance indicators (KPIs) Current/past performance, expected future performance (estimated as part of forecasting and performance modelling), as well as actual progress in achieving performance objectives are quantitatively expressed by means of indicators. Since indicators support objectives, they should be defined having a specific performance objective in mind.

Kyoto Protocol (KP) The 1997 Kyoto Protocol commits 39 industrial nations as a whole to a five-percent reduction from 1990 levels in their emissions of gases damaging to the climate between 2008 and 2012 in the first commitment period. It came into force on February 16, 2005. The European Union is committed to reduce emissions between the years 2008 and 2012 by eight percent compared to the level in 1990.

	138/138 The second commitment period is between 2013 and 2020 and the EU has committed to reduce its GHG emissions by 20% by 2020 compared to 1990 levels.
LTO cycle	The reference emissions LTO cycle defines the thrust settings to be used when making emissions and smoke measurements and the time to be used for each mode in the subsequent calculations of Dp. These thrust settings and times are listed in Annex 16, Volume II, Part III, Chapter 2 (engines for subsonic propulsion).
Market-based measures	Sometimes referred to as market instruments, MBMs provide financial incentives and disincentives to regulated entities towards desired behaviour, e.g. lowering emissions. These measures can be implemented to reduce damage to the environment
Network Manager	means the entity established under Article 6 of regulation (EC) No 551/2004 (the Airspace regulation) to perform the duties provided for in that article and in regulation (EU) 677/2011 (the ATM Network Functions regulation).
Offset Credit or Offset	In this report the term “credit”, “offset credit” or “offset” is used to denote the compensating emissions reductions (product) that have been achieved and can be applied in the activity of offsetting. An offset credit could equate to a one-tonne reduction of carbon dioxide (CO_2) emissions or a one kilogram reduction of nitrogen oxide (NO_x) emissions, for example. These credits can be tradable units.
Offsetting	Offsetting is the activity of “cancelling out” or “neutralizing” emissions from a sector like aviation using offset credits — compensating emissions reductions created in a different activity or location that have been rigorously quantified and verified. It is only when credits are acquired from outside the emissions trading scheme or linked schemes and used to meet commitments/obligations under the scheme that the activity is referred to as offsetting. On the other hand, if a regulated emitter acquires compliance units (allowances or credits) from another regulated emitter within the same emissions trading scheme, or from a linked scheme, this is referred to simply as

emissions trading. ICAO Documents 9949/50/51

Open emissions trading	An emissions trading system where allowances can be traded in and outside the given scheme or sector. For example, within an emissions trading scheme for aviation, participants would be allowed to buy allowances from sectors outside the aviation emissions trading scheme.
Performance	Performance can be expressed as a set of parameters or indicators that are complementary, and sometimes contradictory. Performance measures are categorised in the four following measures
Pooling arrangements	An air carrier commercial agreement which may involve some degree of capacity control and may cover matters such as routes operated, conditions of operation, and the sharing between the parties of traffic, frequencies, equipment, revenues and costs.
Public-private partnership (PPP)	An ownership and management structure in which the private and the public sectors both participate. PPPs refer to arrangements where the private sector supplies infrastructure assets and services that traditionally have been provided by the government. This technique provides private financing for infrastructure investment without immediately adding to government borrowing and debt, and can be a source of government revenue. PPPs also present business opportunities for the private sector in areas from which it was in many cases previously excluded.
Registry	Registries usually use electronic databases to record the unit holdings and transactions for each account, as well as verified emissions. Registry systems facilitate accounting and compliance for market based mechanisms.
Revenue passengers	A passenger for whose transportation an air carrier receives commercial remuneration. NOTES: 1. This definition includes, for example, a) passengers travelling

under publicly available promotional offers (for example, “two-for-one”) or loyalty programmes (for example, redemption of frequent-flyer points); b) passengers travelling as compensation for denied boarding; c) passengers travelling on corporate discounts; d) passengers travelling on preferential fares (government, seamen, military, youth, student, etc.).

2. This definition excludes, for example, a) persons travelling free; b) persons travelling at a fare or discount available only to employees of air carriers or their agents or only for travel on business for the carriers; c) infants who do not occupy a seat.

Surrendering Submitting allowances for emissions by the accountable entity in order to fulfil the obligations under the emissions trading scheme. Surrender’ typically refers to the process by which public/private entities submit units for compliance under their applicable regulatory system, whereas ‘retire’ typically refers to the process by which countries submit units under an international agreement.

Unit (Includes permit) The compliance instruments, otherwise referred to as “credit”, “offset credit”, “offset” or “allowance” are called emissions units. One emissions unit equals one tonne of CO2.

United Nations Framework Convention on Climate Change (UNFCCC) The UN Convention on Climate Change has been ratified by 192 countries, and it sets an overall framework for intergovernmental efforts to tackle the challenge of climate change. Under the Convention, governments share information on GHG emissions, national policies and best practices, commit to GHG limitation/reduction activities/targets, and provide financial and technical support for the adaptation and mitigation activities of other countries.

Verification Verification provides independent assurance that the emissions quantification and reporting have been accurately completed. The “level of assurance” provided depends on the system requirements. In most systems the verifiers must be accredited by a standard-setting organization.

Voluntary Market	Voluntary markets for emissions reductions cover those buyers and sellers of Verified Emission Reductions, which seek to manage their emission exposure for non-regulatory purposes. Such credits are not eligible in the EU ETS due to a potential lack of transparency and control exercised compared to government controlled compliance systems.

Appendix 2: Key features of the EU ETS for aviation (EC, 2013:16)

EU ETS feature	Description
Geographical coverage	European Economic Area (EEA) which includes the 28 EU Member States, Iceland, Norway and Liechtenstein). Territories of Member States are treated as follows: - The 13 territories that are part of the EU are included in the EU ETS for aviation: Guadeloupe, French Guiana, Martinique, Reunion, the Azores, Madeira, the Canary Islands, Aland Islands, Akrotiri, Dhekelia, Ceuta, Melilla and Gibraltar - All other territories of Member States that are not part of the EU are outside of the scope of EU ETS for aviation (e.g. Greenland or Channel Islands)
Flights covered	All flights landing at or departing from EEA airports.
Emissions coverage	All CO2 emissions released during the whole flight.
Open or closed system	Aviation is regulated under the same rules as the general EU ETS i.e. as an open system, but allowances are specific to the aviation sector (i.e. they cannot be used by other EU ETS operators).
Quantity of allowances	Total number of allowances (cap): 210,349,264 per annum from 2013 Free allowances: 172,486,396 per annum from 2013 Allowances to be auctioned: 31,552,390 per annum from 2013 Special reserve: 50,483,824
Allocation of allowances	82% of allowances are allocated for free to operator based on a benchmark in line with their activity levels in 2010. In addition, 15% of allowances can be purchased through auctions. The special

	reserve shall ensure access to the market for new aircraft operators and to assist aircraft operators which increase sharply the number of tonne-kilometres that they perform.
International credits	Aircraft operators may use Certified Emission Reductions and Emission Reduction Units for up to 1.5 % of the number of allowances they are required to surrender.
Exclusions	Commercial airlines that operate fewer than 243 flights per period for three consecutive four-month periods or flights with total annual emissions lower than 10,000 tonnes per year. Other types of special purpose airplanes are also excluded (e.g. military flights, medical / rescue / scientific research flights or flights performed in the framework of public service obligations on routes within outermost regions or on routes where the capacity offered does not exceed 30,000 seats per year). A full list is in Annex I to the Directive.
MRV approach	CO2 emissions are based on applying an agreed emission factor (tCO2/km) to fuel consumption measured by considering tank levels at specific points in time as well as fuel uplift at the airport. A simplified approach is available for small emitters with emissions estimated using a standardised distance flown based on Great Circle Distance.

Appendix 3: DANUBE FAB Performance Plan (Draft version)

Signatories

Performance plan details	
FAB Name	DANUBE FAB
Version number	0.6.7
Date of issue	09/05/2014
Date of adoption	xx.06.2014

Member State	Name, title and signature of representative
Bulgaria	Mintcho Tzvetkov - Director General DG CAA
Romania	Armand PETRESCU - Director General, Romanian Civil Aeronautical Authority

Additional comments	

Table of Content

Mapping between the template for the FAB performance plan and Annex II of the performance Regulation

IMPORTANT NOTE FOR SECTION 3.1.(d) – Cost-efficiency:

The data and justifications for the cost-efficiency targets at local level are split into two distinct parts of the performance plan, aiming at optimising workload and avoiding duplication of reporting. They comprise:

1. In the body of the performance plan document, the information to be presented at charging zone level (some of the data requested being pre-filled by the PRB):
   - The targets with a description of the contribution to, and consistency with, the EU-wide target and/or their contribution to the performance of the European ATM network;:
   - The entries and justification requiring data from external sources i.e.
     - The traffic forecast used and, if applicable, their justification against STATFOR
     - The inflation assumptions used and, if applicable, their justification against Eurostat/ IMF.
   - The local alert thresholds, if any, and their justification.
   - A presentation of the consolidation of the targets at FAB level.

2. In Annex C, the information needed at the level of the entities submitted to the performance scheme within the charging zones (ANSPs including MET providers, National authorities…), as follows:
   - The data and justifications in the reporting tables and additional information, as per Annexes II, III, VI and VII of the charging Regulation, at entity level plus a consolidation at charging zone level;
   - The data and justifications relating to cost-efficiency required at entity level for the purpose of the Performance Plans, as per Article 11 (3) and Annexes II and IV of the performance Regulation,.

A detailed list of the information to be provided in the body of the performance plan and Annex C will be found in Paragraph 3.1(d) below, showing that duplication has been avoided and workload reduced to the minimum required by the performance and charging Regulations.

Annex C forms an integral part of the performance plan and will be used to carry out the assessment of the performance plan.

The table below shows the correspondence between Annex II of EU Regulation 390/2013 and the Performance Plan template with its Annexes.

Structure of ANNEX II of the performance Regulation	Link with PRB Performance Plan template			
	Body of Performance Plan	Annex C For cost-effiency		Other annexes
		RT ref.	AI ref.	
1. INTRODUCTION	1			
1.1. Description of the situation (scope of the plan, list of air navigation service providers covered, etc.).	1.1.			
1.2. Description of the macroeconomic scenario for the reference period including overall assumptions (traffic forecast, etc.)	1.2.			
1.3. Description of the outcome of the stakeholder consultation in order to prepare the performance plan and the agreed compromises as well as the points of disagreement and the reasons for disagreement.	1.3.			Annex A
1.4. Description of the actions taken by air navigation service providers to implement the Network Strategy Plan at functional airspace block level and other guiding principles for the operation of the functional airspace block in the long term perspective..	1.4.			Annex B

1.5. List of airports submitted to the performance scheme in application of Article 1 of the Regulation, with their average number of IFR air transport movements.	1.5.			
1.6. List of exempted airports pursuant to Article 1(5) of Implementing Regulation (EU) No 391/2013 together with their average number of IFR air transport movements.				
2. INVESTMENT	2			Annex D
2.1. Description and justification of the cost, nature and contribution to achieving the performance targets of investments in new ATM systems and major overhauls of existing ATM systems, including their relevance and coherence with the European ATM Master Plan, the common projects referred to in Article 15a of Regulation (EC) No 550/2004, and, as appropriate, the Network Strategy Plan.				
2.2. The description and justification referred to in point 2.1 shall in particular:				
(i) relate the amount of the investments, for which description and justification is given following point 2.1, to the total amount of investments;				
(ii) differentiate between investments in new systems, overhaul of existing systems and replacement investments;				
(iii) refer each investment in new ATM systems and major overhaul of existing ATM systems to the European ATM Master Plan, the common projects referred to in Article 15a of Regulation (EC) No 550/2004, and, as appropriate, the Network Strategy Plan;				
(iv) detail the synergies achieved at functional airspace block level or, if appropriate, with other Member States or functional airspace blocks, in particular in terms of common infrastructure and common procurement;				
(v) detail the benefits expected from these investments in terms of performance across the four key performance areas, allocating them between the en route and terminal/airport phases of flight, and the date as from which benefits are expected;				
(vi) provide information on the decision-making process underpinning the investment, such as the existence of a documented cost-benefit analysis, the holding of user consultation, its results and any dissenting views expressed.				
3. PERFORMANCE TARGETS AT LOCAL LEVEL	3			
3.1. Performance targets in each key performance area, set by reference to each key performance indicator as set out in Annex I, Section 2, for the entire reference period, with annual values to be used for monitoring and incentive purposes:	3.1			
(a) Safety	3.1.(a)			

(i) level of effectiveness of safety management: local targets for each year of the reference period;	3.1.(a).(i)			
(ii) application of the severity classification based on the Risk Analysis Tool (RAT) methodology: local targets for each year of the reference period (percentage);	3.1.(a). (ii)			
(iii) just culture: local targets for the last year of the reference period.	3.1.(a). (iii)			
	3.1.(a). (iv) - Optional section - Additional Safety KPI(s)			
(b) Environment	3.1.(b)			
(i) description of the process to improve route design;	3.1.(b).(i) & (ii)			
(ii) average horizontal *en route* flight efficiency of the actual trajectory.				
	3.1.(b).(iii) - Optional section - Additional Environment KPI(s)			
(c) Capacity	3.1.(c)			
(i) minutes of average *en route* ATFM delay per flight;	3.1.(c).(i)			
(ii) minutes of average terminal ATFM arrival delay per flight;	3.1.(c).(ii)			
(iii) the capacity plan established by the air navigation service provider(s).	3.1.(c).(iii)			
	3.1.(c).(iv) - Optional section - Additional Capacity KPI(s)			
(d) Cost-efficiency	3.1.(d)			
(i) determined costs for *en route* and terminal air navigation services set in accordance with the provisions of Article 15(2)(a) and (b) of Regulation (EC) No 550/2004 and in application of the provisions of Implementing Regulation (EU) No 391/2013 for each year of the reference period;	3.1.(d).1.A 3.1.(d).2.A			
(ii) *en route* and terminal service units forecast for each year of the reference period;	3.1.(d).1.A 3.1.(d).2.A 3.1.(d).1.C 3.1.(d).2.C	RT 1 (5.4)		
(iii) as a result, the determined unit costs for the reference period;	3.1.(d).1.A 3.1.(d).2.A	RT 1 (5.5)		
(iv) description and justification of the return on equity of the air navigation service providers concerned, as well as on the gearing ratio and on the level/composition of the asset base used to calculate the cost of capital comprised in the determined costs;		RT 1 (3.1-3.4, 3.6)	AI 1 e)	
(v) description and explanation of the carry-overs from the years preceding the reference period;		RT 1 (3.1-3.4, 3.6)	AI 3 c), d), e)	
(vi) description of economic assumptions, including:	3.1.(d).1.B	RT 1 (5.1-5.2)		

— inflation assumptions used in the plan as compared to an international source such as the IMF (International Monetary Fund) Consumer Price Index (CPI) for the forecasts and Eurostat Harmonised Index of Consumer Price for the actuals. Justification of any deviation from these sources,	3.1.(d).2.B			
— assumptions underlying the calculation of pension costs comprised in the determined costs, including a description on the relevant national pension regulations and pension accounting regulations in place and on which the assumptions are based, as well as information whether changes of these regulations are anticipated,			AI 4 b)	
— interest rate assumptions for loans financing the provision of air navigation services, including relevant information on loans (amounts, duration, etc.) and explanation for the (weighted) average interest on debt used to calculate the cost of capital pre tax rate and the cost of capital comprised in the determined costs,		RT 1 (3.7)	AI 4 c)	
— adjustments beyond the provisions of the International Accounting Standards;			AI 1 Item c)	
(vii) if applicable, description in respect to the previous reference period of relevant events and circumstances set out in Article 14(2)(a) of Implementing Regulation (EU) No 391/2013 using the criteria set out in Article 14(2)(b) of Implementing Regulation (EU) No 391/2013 including an assessment of the level, composition and justification of costs exempt from the application of Article 14(1)(a) and (b) of Implementing Regulation (EU) No 391/2013;		RT 3 (3.1-3.12)	AI 3 b)	
(viii) if applicable, a description of any significant restructuring planned during the reference period including the level of restructuring costs and a justification for these costs in relation to the net benefits to the airspace users over time;		RT 3 (4.1)	AI 4 d)	
(ix) if applicable, restructuring costs approved from previous reference periods to be recovered.		RT 3 (4.1)	AI 4 e)	
3.2. Description and explanation of the consistency of the performance targets with the relevant Union-wide performance targets. When there is no Union-wide performance target, description and explanation of the targets within the plan and how they contribute to the improvement of the performance of the European ATM network.	3.1.(a).(i) 3.1.(a). (ii) 3.1.(a). (iii) 3.1.(a). (iv) 3.1.(b).(i) & (ii) 3.1.(b).(iii) 3.1.(c).(i) 3.1.(c).(ii) 3.1.(c).(iii) 3.1.(c).(iv) 3.1.(d).1.A 3.1.(d).2.A	RT 3 (4.1)	AI 4 e)	
3.3. Description and explanation of the interdependencies and trade-offs between the key performance areas, including the assumptions used to assess the trade-offs.	3.3			

Structure and Purpose

The proposed template for FAB Performance Plans was developed to facilitate the work of Member States and NSAs in their tasks to draw up and adopt performance plans and targets for RP2. It follows the structure provided for in Annex II of Commission Implementing Regulation (EU) No 390/2013 of 3 May 2013 laying down a performance scheme for air navigation services and network functions, hereafter the performance Regulation and allows taking into account the requirements of Commission Implementing Regulation (EU) No 391/2013 of 3 May 2013 laying down a common charging scheme for air navigation services, hereafter the charging Regulation, as well as other relevant pieces of SES legislation.

Furthermore, to reduce the administrative burden on Member States the template is already prefilled to the maximum extent possible.

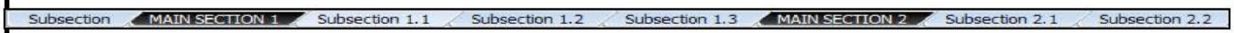
In light of this, different field categories have been identified and colour-coded to facilitate the reporting:

Colour coding	
Item 1	*information to be provided by Member States*
Item 2	*information to be gradually provided by the PRB*
Item 3	*pre-filled but editable information*
Item 4	*pre-filled or automatically computed information*
Item 5	*Dynamic Selection*

Also, for ease of reference, a dedicated table has been included in every chapter mentioning the reference to the legal requirements contained in the various pieces of SES legislation.

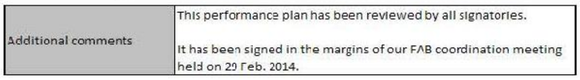
As explained, the Excel-based template follows the structure mandated by Annex II of the performance Regulation. FABs can easily provide additional narrative material by attaching it under Annex E. The Annexes form an integral part of the FAB performance plan.

The worksheets in the Excel file replicate the said structure and the tabs for main sections have been highlighted in black, while subsections are in light blue as shown below:



Tips and tricks

- Since the Excel file is completely unprotected, be careful when filling the cells or adding lines/columns to avoid erasing the prefilled or pre-calculated areas.
- Manually adapt height of cell if necessary, in particular for text or description boxes.
- Within a cell, press ALT+ENTER to jump to the next line.



- For existing text from another source, copy and paste into the formula bar will ensure that all text remains within a single cell.

- In order to **print** your performance plan, please refer to section “Signatories”.

1.2.5. Traffic forecast

En-route

In RP1 the cost-efficiency targets included in Romania National Performance Plan were established based on the STATFOR baseline scenario traffic forecast (5% p.a. traffic service units increase) in accordance to the PRU guidelines for Performance Plans. Nevertheless, we expressed our reserves about the very optimistic forecast which nowadays materialized in a decrease of -1% in 2012 and - 1,3% in 2013. Closure of Simferopol FIR, likely to last indefinitely, shorten the routes over Romanian airspace for the largest traffic flows (to Middle East) decreasing the number of service units. These haven't been taken into cosideration in the STATFOR forecast and it forcing Romania to use a more conservative approach. For RP2 we decided to apply a more realistic traffic forecast that is in line with EUROCONTROL 7-year flight and service units forecast, February 2014 release, low scenario (2,9% p.a. traffic increase). The difference in TSUs generated loses in the first two years of RP1 and are expected to increase in 2014 based on the traffic risk sharing mechanism.

Moreover, the traffic forecast are following the reference values taken into consideration for the cost-efficiency target as stipulated in the Commission Implementing Decision of 11 March 2014 setting the Union-wide performance targets for the ai traffic management network and alert thresholds for the second reference period 2015-2019.

TNC Bucharest airports charging zone

The EUROCONTROL 7-year flight and service units forecast, February 2014 release, baseline scenario (4,2% p.a. traffic increase) was used for planning, although the decrease observed in the terminal traffic in 2012 and 2013 would suggest a less ambitious approach might be more apropriate.

Links for Romanian inputs:

European Commission:

European Economic Forecast 2/2014 http://ec.europa.eu/economy_finance/publications/european_economy/2014/pdf/ee2_en.pdf

BMI Ltd.:

Romania Business Forecast Report www.businessmonitor.com (subscription required)

EUROSTAT: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&plugin=1&language=en&pcode=teimf050

IMF (inflation):

http://www.imf.org/external/pubs/ft/weo/2014/01/weodata/weorept.aspx?pr.x=62&pr.y=11&sy=2012&ey=2019&scsm=1&ssd=1&sort=country&ds=.&br=1&c=968&s=PCPIPCH&grp=0&a=

SDG Report:

http://www.eusinglesky.eu/announcements/news-costs-of-capital-and-pensions-study

SDG Revised Cost of Capital Calculator:

http://www.eusinglesky.eu/announcements/news-revised-cost-of-capital-calculator

Damodaran:

Market premium: http://pages.stern.nyu.edu/~adamodar/

Country default spread www.stern.nyu.edu/~adamodar/pc/datasets/ctryprem.xls

Fernandez IESE: http://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID2359660_code12696.pdf?abstractid=2084213&mirid=1

National Bank of Romania:

http://www.bnr.ro/StatisticsReportHTML.aspx?icid=801&table=580&column=7762,7768,7774,7782 (column N14RL_CSS - average of March 2013 to Feb 2014).

1.3 - Stakeholder consultation

Number of Meetings	3

Meeting #1	
Name of meeting	National consultation for Bulgarian stakeholders
Date	20th May 2014
Type of event	meeting/ written consultation
Level	National
Stakeholders	All stakeholders
Deadline for responses	17/05/2014
Main issues	TBC after meeting
Actions agreed upon	TBC after meeting
Points of disagreement and reasons	TBC after meeting
Additional comments	In Annex A.3 is enclosed a list of invited stakeholder and a list of stakeholders that attended this consultation.

Meeting #2	
Name of meeting	National consultation for Romanian stakeholders
Date	28th May 2014
Type of event	meeting/ written consultation
Level	National
Stakeholders	All stakeholders
Deadline for responses	19/05/2014
Main issues	TBC after meeting
Actions agreed upon	TBC after meeting
Points of disagreement and reasons	TBC after meeting
Additional comments	In Annex A.2 is enclosed a list of invited stakeholder and a list of stakeholders that attended this consultation.

Meeting #3	
Name of meeting	DANUBE FAB Consultation for RP2 Performance Plan in Sofia, Republic of Bulgaria
Date	29th of May 2014
Type of event	meeting/ written consultation
Level	FAB
Stakeholders	All stakeholders
Deadline for responses	19/05/2014
Main issues	TBC after meeting
Actions agreed upon	TBC after meeting
Points of disagreement and reasons	TBC after meeting
Additional comments	In Annex A.1 is enclosed a list of invited stakeholder and a list of stakeholders that attended this consultation.

1.4 - Actions to implement the Network Strategy Plan at FAB level, and other guiding principles for the operation of the FAB in the long-term perspective

Number of Actions	2

FRA - DANUBE FAB	2015	2016	2017	2018	2019
Planned date of entry into operation					December*
Description	1. Route Network optimization 2. Free Route Airspace				
Reference to NSP and evidence of compliance	SO3: Implement a de-fragmented and flexible airspace enabling Free Routes SO4: Plan optimum capacity and flight efficiency				
Contribution to reaching the performance targets	Safety - Medium Capacity - High Environment - High Cost-efficiency - High				
Additional comments	AOM-0401 Multiple Route Options&Airspace Organization Scenarios AOM-0402 Cross-Border Sectorisation and Further Routeing Options The following steps were outlined and proposed for FRA implementation by the Airspace Design Expert Group (ADODEG) - a sub-group of DANUBE FAB Operations Standing Committee: • 2015 – Time extension within LRBB; lower level in LBSR • 2016 – Night cross-border free route (FAB) • 2017 – Time extension (all seasons) • Winter 2017/2018 – Seasonal H24 above a certain FL • Winter 2018/2019 – Seasonal H24 at all FL • 2019 – H24 above a certain FL.*				

ASM/ATFCM - DANUBE FAB	2015	2016	2017	2018	2019
Planned date of entry into operation			December		
Description	Common ASM/ATFCM functions applied within the FAB				
Reference to NSP and evidence of compliance	SO3: Implement a de-fragmented and flexible airspace enabling Free Routes SO4: Plan optimum capacity and flight efficiency SO5:Facilitate business trajectories by cooperative traffic management				
Contribution to reaching the performance targets	Safety - Medium Capacity - High Environment - High Cost-efficiency - High				
Additional comments					

1.5 - List of airports for RP2

List of airports submitted to the Performance and Charging Regulations						
Number of airports	7					
ICAO code	Airport name	State	IFR air transport movements			
			2011	2012	2013	Average
LBSF	SOFIA	Bulgaria	46,603	42,941	39,683	43,076
LRBS	BUCURESTI / BANEASA-AUREL VLAICU	Romania	23,258	8,163	3,870	11,764
LROP	BUCURESTI / HENRI COANDA	Romania	74,210	86,296	87,515	82,674

List of airports exempted from the Performance and Charging Regulations

Additional comments

SECTION 2: INVESTMENTS

Mapping between the template for the FAB performance plan and Annex II of the performance Regulation				
Structure of ANNEX II of the performance Regulation	Link with PRB Performance Plan template			
	Body of Performance Plan	Annex C For cost-effiency		Other annexes
		RT ref.	AI ref.	
2. INVESTMENT	2			Annex D
2.1. Description and justification of the cost, nature and contribution to achieving the performance targets of investments in new ATM systems and major overhauls of existing ATM systems, including their relevance and coherence with the European ATM Master Plan, the common projects referred to in Article 15a of Regulation (EC) No 550/2004, and, as appropriate, the Network Strategy Plan.				
2.2. The description and justification referred to in point 2.1 shall in particular:				
(i) relate the amount of the investments, for which description and justification is given following point 2.1, to the total amount of investments;				
(ii) differentiate between investments in new systems, overhaul of existing systems and replacement investments;				
(iii) refer each investment in new ATM systems and major overhaul of existing ATM systems to the European ATM Master Plan, the common projects referred to in Article 15a of Regulation (EC) No 550/2004, and, as appropriate, the Network Strategy Plan;				
(iv) detail the synergies achieved at functional airspace block level or, if appropriate, with other Member States or functional airspace blocks, in particular in terms of common infrastructure and common procurement;				
(v) detail the benefits expected from these investments in terms of performance across the four key performance areas, allocating them between the en route and terminal/airport phases of flight, and the date as from which benefits are expected;				
(vi) provide information on the decision-making process underpinning the investment, such as the existence of a documented cost-benefit analysis, the holding of user consultation, its results and any dissenting views expressed.				

2 - INVESTMENTS

Number of ANSPs	2

BULATSA

Number of capex	8

Name of capex 1	**New ATM system (incl.en-route AMAN)**
Description	Procurement and deployment of a new automated ATC system to implement the Common projects and the SESAR deployment program
Accountable entity	ANSP

Justification of the cost, nature and contribution		
Differentiation	*New system*	
Common project	*Yes*	<u>PCP:</u> AF1 - Arrival Management extended to en-route Airspace, AF3 - Flexible Airspace Management And Free Route, AF4 - Network Collaborative Management, AF6 Initial Trajectory Information Sharing
Network Strategy Plan	*Click to select*	
Ref. to European ATM MP or NSP		<u>ATM MP</u>: IDP - SWP5.2.1, IDP WP4, ESSIP - ATC, ITY, FCM, AOM etc. objectives, OIs - multiple
Joint investment	*No*	
Synergies achieved at FAB level or other MS	*Yes*	The system will be required to ensure interoperability with the other neigbouring systems ensureing synergy at regional level and with the NM sytems.
Consultation with stakeholders	*Click to select*	
Decision-making process	*Click to select*	

KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases of flight>
Safety	*Yes*	According the SESAR Deployment program and Common projects functionalities.	01/01/2022	En-route/ Terminal/ Airport
Environment	*Yes*	According the SESAR Deployment program and Common projects functionalities. E-AMAN - Reduced holding and low level vectoring has a	01/01/2022	En-route/ Terminal/ Airport
Capacity	*Yes*	According the SESAR Deployment program and Common projects functionalities. E-AMAN: Improved airport/TMA capacity of Istanbul. Optimum	01/01/2022	En-route/ Terminal/ Airport
Cost efficiency	*Yes*	According the SESAR Deployment program and Common projects functionalities. E-AMAN: Reduced costs through reduction in delays at Istanbul airport and the adjacent Sofia ACC	01/01/2022	En-route/ Terminal/ Airport

Name of capex 2	New PSRs and SSRs (en-route and TMA)			
Description	New en-route Varbitza and Cherni Vrah PSRs and SSRs and new TMA PSR and SSR at Sofia airport			
Accountable entity	ANSP			
Justification of the cost, nature and contribution				
Differentiation	*New system*			
Common project	*No*			
Network Strategy Plan	*Click to select*			
Ref. to European ATM MP or NSP		**ATM MP:** ESSIP - ITY-SPI, En - CTE-S5		
Joint investment	*No*			
Synergies achieved at FAB level or other MS	*Click to select*			
Consultation with stakeholders	*Click to select*			
Decision-making process	*Click to select*			
KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases of flight>
Safety	*Yes*	Monitoring of independent non-cooperative targets and aircrafts with technical problems. Reservation if frequency 1090 blocked (ADS-B, WAM, Mode-S). Unambiguous radar identification. Improved itegrity of radar data, avoiding the deficiency of codes.	01/01/2017	En-route/ Terminal
Environment	*Yes*	Providing the necessary radar coverage to enable DCT, FRA and shorter routes.	01/01/2017	En-route/ Terminal
Capacity	*Yes*	Providing the necessary radar coverage to provide reduced separation in the ACC /Sofia TMA.	01/01/2017	En-route/ Terminal
Cost efficiency	*Yes*	Lower maintenance costs, distante control and better serviceability.	01/01/2017	En-route/ Terminal

Name of capex 3	Modernisation of the A/G radiocommunication equipment			
Description	Modernization of radio VHF air-ground radio equipment to allow 8,33 KHz channel spacing. Gradual replacement of FM radio radio "air-ground' with 8,33 kHz channel spacing and installation of new frequencies in compliance with Commission Regulation (EC) 1265/2007, Regulation (EU) 1079/2012.			
Accountable entity	ANSP			
Justification of the cost, nature and contribution				
Differentiation	*Overhaul of existing system*			
Common project	*No*			
Network Strategy Plan	*Click to select*			
Ref. to European ATM MP or NSP		**ATM MP:** ESSIP ITY-AGVCS2, En - CTE-C5, OIs - AOM-0304-A, AOM-0804		
Joint investment	*Click to select*			
Synergies achieved at FAB level or other MS	*Click to select*			
Consultation with stakeholders	*Click to select*			
Decision-making process	*Click to select*			
KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases of flight>
Safety	*Yes*	Redundancy and avoidance of frequency interference.	01/01/2016	En-route/ Terminal/ Airport
Environment	*Click to select*			
Capacity	*Yes*	Additional sectors availability for optimal sector configuration	01/01/2016	En-route/ Terminal/ Airport
Cost efficiency	*Click to select*			

Name of capex 4	SATCAS upgrade
Description	Upgrade of the automated ATC system SATCAS to enable CPDLC in compliance with Regulation (EC) 29/2009
Accountable entity	ANSP

Justification of the cost, nature and contribution		
Differentiation	*Overhaul of existing system*	
Common project	*Yes*	AGDL is prerequisite to AF 6 Initial Trajectory Information Sharing (i4D)
Network Strategy Plan	*Click to select*	
Ref. to European ATM MP or NSP		**ATM MP:** IDP WP 4, ESSIP ITY – AGDL, OIs AUO-0301
Joint investment	*No*	
Synergies achieved at FAB level or other MS	*Click to select*	
Consultation with stakeholders	*Click to select*	
Decision-making process	*Click to select*	

KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases of flight>
Safety	*Yes*	Through the delivery of standard and unambiguous messages (entailing significant error and fatigue reduction), the provision of a communications back up and the possibility of immediate message retrieval, data link communications are a major safety enhancement.	01/01/2016	En-route
Environment	*Click to select*			
Capacity	*Yes*	Increased capacity through both reduction of voice congestion and increase in controller efficiency.	01/01/2016	En-route
Cost efficiency	*Yes*	Data link is a cost-effective capacity increase enabler through sector productivity increase and delay cost savings.Staff cost avoidance expected. En-route cost savings and reduction of delays of the AUs.	01/01/2016	En-route

Name of capex 5	VOR – DME upgrade
Description	Modernization of the VOR / DME navigation system alligned with the EUROCONTROL's Navigation Application & Navaid Infrastructure Strategy for the ECAC area up to 2020 and The 2015 Airspace Concept & Strategy for the ECAC Area & Key Enablers
Accountable entity	ANSP

Justification of the cost, nature and contribution		
Differentiation	*New system*	
Common project	*No*	
Network Strategy Plan	*Click to select*	
Ref. to European ATM MP or NSP		**ATM MP:** IDP WP6, ESSIP NAV 03, OIs AOM-0601
Joint investment	*No*	
Synergies achieved at FAB level or other MS	*Click to select*	
Consultation with stakeholders	*Click to select*	
Decision-making process	*Click to select*	

KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases of flight>
Safety	*Yes*	The new system will enable safe operations after expiry of the useful life of the old equipment.	01/01/2016	En-route/ Terminal
Environment	*Click to select*			
Capacity	*Click to select*			
Cost efficiency	*Yes*	Optimisation of the expenses due to unification of the VOR infrastructure.	01/01/2016	En-route/ Terminal

Name of capex 6	New VCS system			
Description	Procurement and deployment of of a new system for operational voice communications (VCS)			
Accountable entity	ANSP			
Justification of the cost, nature and contribution				
Differentiation	*New system*			
Common project	*Click to select*			
Network Strategy Plan	*Click to select*			
Ref. to European ATM MP or NSP		**ATM MP:** ESSIP - COM 11, En - CTE-C8		
Joint investment	*Yes*	VCS will be procured at DANUBE FAB level		
Synergies achieved at FAB level or other MS	*Yes*	Harmonisation of the Communications infrastructure ensuring interoperability at FAB level.		
Consultation with stakeholders	*Click to select*			
Decision-making process	*Click to select*			
KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases of flight>
Safety	*Yes*	Maintained or improved by providing enhanced signalisation functions.	01/07/2015	En-route/ Terminal/ Airport
Environment	*Yes*	Enabler for dynamic sectorisations in Functional Block of Airspace (FAB).	01/07/2015	En-route/ Terminal/ Airport
Capacity	*Yes*	Maintained or improved by providing enhanced signalisation functions. Prerequisite of dynamic sectorisation through dynamic allocation of voice	01/07/2015	En-route/ Terminal/ Airport
Cost efficiency	*Yes*	Optimised cost-efficiency due large scale procurement at FAB level. Internet off the shelf technologies can be based on standard hardware.	01/07/2015	En-route/ Terminal/ Airport

Name of capex 7	Communication infrastructure for A/G Data Link Services			
Description	Building communications infrastructure and contracting the communication providers to ensure the A/G Data Link Services as per Regulation (EC) 29/2009			
Accountable entity	ANSP			
Justification of the cost, nature and contribution				
Differentiation	*New system*			
Common project	*Yes*	AGDL is prerequisite to AF 6 Initial Trajectory Information Sharing (i4D)		
Network Strategy Plan	*Click to select*			
Ref. to European ATM MP or NSP		**ATM MP:** IDP WP 4, ESSIP ITY – AGDL, OIs AUO-0301		
Joint investment	*No*			
Synergies achieved at FAB level or other MS	*Yes*	Common A/G datalink infrastructure at EU-wide level		
Consultation with stakeholders	*Click to select*			
Decision-making process	*Click to select*			
KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases of flight>
Safety	*Yes*	Through the delivery of standard and unambiguous messages (entailing significant error and fatigue reduction), the provision of a communications back up and the possibility of immediate message retrieval, data link communications are a major safety enhancement.	01/03/2015	En-route
Environment	*Click to select*			
Capacity	*Yes*	Increased capacity through both reduction of voice congestion and increase in controller efficiency.	01/03/2015	En-route
Cost efficiency	*Yes*	Data link is a cost-effective capacity increase enabler through sector productivity increase and delay cost savings.Staff cost avoidance expected. En-route cost savings and reduction of delays of the AUs.	01/03/2015	En-route

Name of capex 8	WAM and ADS-B
Description	Procurement and deployment of Wide area multilateration (WAM) and automatic dependent surveillance (ADS-B)
Accountable entity	ANSP

Justification of the cost, nature and contribution		
Differentiation	*New system*	
Common project	*No*	
Network Strategy Plan	*Click to select*	
Ref. to European ATM MP or NSP		**ATM MP:** ESSIP ITY-SPI, En -CTE-S1b, CTE-S5
Joint investment	*No*	
Synergies achieved at FAB level or other MS	*Click to select*	
Consultation with stakeholders	*Click to select*	
Decision-making process	*Click to select*	

KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases of flight>
Safety	*Yes*	Unambiguos radar identification. Improved integrity of the radar data using parameters from the aircraft. Improving the systems ensuring safety.	01/07/2015	En-route/ Terminal
Environment	*Click to select*			
Capacity	*Yes*	Optimised capacity in the TMAs to ensure redundant coverage.	01/07/2015	En-route/ Terminal
Cost efficiency	*Click to select*			

Name of investment	Total CAPEX for the project	Planned Amount of Capital Expenditures (in national currency)					Lifecycle (Amortisation period in years)	Allocation en route / terminal ANS (%)	Planned date of entry into operation (IOC / FOC dates)
		2015	2016	2017	2018	2019			
New ATM system (incl.en-route AMAN)	68,454,050					17,113,513	5		01/01/2022
New PSRs and SSRs (en-route and TMA)	32,500,000	9,750,000	14,615,700				12		01/01/2017
Modernisation of the A/G radiocommunication equipment	10,100,000	7,843,814					12		01/01/2016
SATCAS upgrade	9,779,150	2,933,745					5		01/01/2016
VOR – DME upgrade	8,800,000	6,500,000					12		01/01/2016
New VCS system	4,500,000	900,000					10		01/07/2015
Communication infrastructure for A/G Data Link Services	4,000,000	1,600,000					10		01/03/2015
WAM and ADS-B	2,800,000	1,088,630					12		01/07/2015
Sub-total of **main capex** above (1)	140,933,200	30,616,189	14,615,700	0	0	17,113,513			
Sub-total other Capex (2)	29,533,004	6,487,637	5,000,000	5,000,000	5,000,000	5,000,000	10		annually*
Total capex (1) + (2)	170,466,204	37,103,826	19,615,700	5,000,000	5,000,000	22,113,513			

Additional comments
* These CAPEX projects are planned to be commissioned every year, as their supply or construction/installation is not expected to take more than 12 months.

ROMATSA

Number of capex	11

Name of capex 1	ATM System ROMATSA 2015+ (STEP 1)
Description	Modernization/replacement of flight data processing systems (FDPS), radar data processing systems (RDPS) and human-machine interface (CWP/HMI).
Accountable entity	ANSP

Justification of the cost, nature and contribution		
Differentiation	*New system*	
Replacement investment	*Yes*	
Common project	*Click to select*	
Other investment (in line with interoperability Regulations, the IDP, Master Plan essentials or the NSP)	*Yes*	ESSIP/LSSIP AOM19 ATC07.1 ATC15 ATC17 FCM03 ITY-ADQ ITY-AGDL ITY-COTR IDP WP2.1 WP5.2 WP1.1 WP4.1 WP4.2 WP4.3

Joint investment	*No*	
Synergies achieved at FAB level or other MS	*No*	
Consultation with stakeholders	*Click to select*	
Decision-making process	*Yes*	Feasibility study

KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases
Safety	*Yes*	Safety improvement by including new functions	01/01/2016	En-route/Terminal
Environment	*Yes*	New functions allow route optimization and reduction of CO2 emissions Modernization of existing functions	01/01/2016	En-route/Terminal
Capacity	*Yes*	Enhanced capacity through improved interoperability	01/01/2016	En-route/Terminal
Cost efficiency	*Yes*	Cost reductions through optimization of existing functions and inclusion of new functions.	01/01/2016	En-route/Terminal

Name of capex 2	**ATM System ROMATSA 2015+ (STEP 2)**
Description	Development of ADQ and CDM functionalities and preliminary functionalities for 4D Trajectory and SWIM
Accountable entity	ANSP

Justification of the cost, nature and contribution		
Differentiation	*New system*	
Replacement investment	*Yes*	
Common project	*Click to select*	
Other investment (in line with interoperability Regulations, the IDP, Master Plan essentials or the NSP)	*Yes*	ESSIP/LSSIP AOM19 ATC07.1 ATC15 ATC17 FCM03 ITY-ADQ ITY-AGDL ITY-COTR IDP WP2.1 WP5.2 WP1.1 WP4.1 WP4.2 WP4.3

3.4. Contribution of each air navigation service provider concerned to the achievement of the performance targets set for the functional airspace block in accordance with Article 5(2)(c)(ii).	3.1.(a).(i) 3.1.(a). (ii) 3.1.(a). (iii) 3.1.(a). (iv) 3.1.(b).(i) & (ii) 3.1.(b).(iii) 3.1.(c).(i) 3.1.(c).(ii) 3.1.(c).(iii) 3.1.(c).(iv)	RT 1 (All)	AI 4 a)	
4. INCENTIVE SCHEMES	4			
4.1. Description and explanation of the incentive schemes to be applied on air navigation service providers.	4.1			
5. MILITARY DIMENSION OF THE PLAN	5			
Description of the civil-military dimension of the plan describing the performance of FUA application in order to increase capacity with due regard to military mission effectiveness, and if deemed appropriate, relevant performance indicators and targets consistent with the indicators and targets of the performance plan.				
6. ANALYSIS OF SENSITIVITY AND COMPARISON WITH THE PREVIOUS PERFORMANCE PLAN	6			
6.1. Sensitivity to external assumptions.	6.1			
6.2. Comparison with previous performance plan.	6.2			
7. IMPLEMENTATION OF THE PERFORMANCE PLAN	7			
Description of the measures put in place by the national supervisory authorities to achieve the performance targets, such as:				
(i) monitoring mechanisms to ensure that the ANS safety programmes and business plans are implemented;				
(ii) measures to monitor and report on the implementation of the performance plans including how to address the situation if targets are not reached during the reference period.				

SECTION 1: INTRODUCTION

Mapping between the template for the FAB performance plan and Annex II of the performance Regulation

Structure of ANNEX II of the performance Regulation	Link with PRB Performance Plan template: Body of Performance Plan	Annex C For cost-effiency: RT ref.	Annex C For cost-effiency: AI ref.	Other annexes
1. INTRODUCTION	1			
1.1. Description of the situation (scope of the plan, list of air navigation service providers covered, etc.).	1.1.			
1.2. Description of the macroeconomic scenario for the reference period including overall assumptions (traffic forecast, etc.)	1.2.			
1.3. Description of the outcome of the stakeholder consultation in order to prepare the performance plan and the agreed compromises as well as the points of disagreement and the reasons for disagreement.	1.3.			Annex A
1.4. Description of the actions taken by air navigation service providers to implement the Network Strategy Plan at functional airspace block level and other guiding principles for the operation of the functional airspace block in the long term perspective..	1.4.			Annex B
1.5. List of airports submitted to the performance scheme in application of Article 1 of the Regulation, with their average number of IFR air transport movements.	1.5.			
1.6. List of exempted airports pursuant to Article 1(5) of Implementing Regulation (EU) No 391/2013 together with their average number of IFR air transport movements.				

1 - INTRODUCTION

1.1 - The situation

NSAs responsible for drawing up the Performance Plan	Directorate General Civil Aviation Administration (DG CAA) of the Republic of Bulgaria Romanian Civil Aeronautical Authority
NSA responsible for the coordination within the FAB	DANUBE FAB NSA Board
List of accountable entities	Republic of Bulgaria: - Bulgarian Air Traffic Services Authority (BULATSA) Romania: - Romanian Air Traffic Services Administration – ROMATSA
Geographical scope	Danube FAB airspace comprises the airspace over the territory of the Rupublic of Bulgaria, the territory over Romania and the airspace over those parts of the high seas where the parties have accepted, pursuant to a regional agreement, the responsibility of providing air traffic services, referred to Sofia FIR and Bucharest FIR.

Additional comments	

1.2 - Description of the macroeconomic scenario including overall assumptions

REPUBLIC OF BULGARIA

1.2.1. General economic situation and expected development of the GDP[1]

1.2.1.1. Economic Growth

GDP data for 2013 indicates a slight pick-up in growth, mainly in the second half of the year. Growth was driven by net exports and a surge in public expenditure, whereas household consumption contracted. The annual growth in 2013 remained well below the estimated potential growth rate of the economy.

Even though the purchasing power of households has been buoyed by growth in wages in a low inflation environment and by a discretionary pensions hike of over 9% in April 2013, households have so far remained cautious in spending. However, consumer confidence appears to be gradually firming, as indicated by recent surveys. Also, retail trade recorded strong growth over the second half of 2013, which suggests an imminent recovery in household consumption. Household consumption is therefore forecast to rebound over 2014-15.

The recovery in private investment is forecast to be gradual given that the rebound in economic activity is expected to be modest. However, investment is supported by the relatively strong financial sector, which has been capable of upholding credit to the private sector over the crisis years. Also, both deposit and lending interest rates have continued on a downward trend, implying an improvement in lending conditions and credit availability.

Risks to this macroeconomic forecast seem broadly balanced. The most significant downside risk is related to the expected recovery in household consumption, which could prove weaker than expected given that the Bulgarian labour market and household sentiment are still fragile. However, as observed over the recent years, in periods of weaker domestic demand the Bulgarian economy has been able to partly compensate this with higher net exports.

The general government deficit increased as a percent of GDP in 2013. This was due to a combination of a soft patch in economic recovery and additional spending for social expenditure (including the increase in pensions) and various current expenditure items. The general government deficit is estimated at a rate of 1.9% of GDP in 2014 and slightly decline to 1.7% in 2015. This reflects the expansionary fiscal stance in 2013, and a broadly neutral one in 2014-15. The general government gross debt is forecast to increase from 18.5% in 2012 to about 24% of GDP in 2015.

1.2.1.2. Cyclical Position

Going forward, the economic recovery is expected to be more broad-based, with domestic demand forecast to reinforce the export-driven growth momentum. GDP growth is forecast to reach 1.7% in 2014 and 2% in 2015 according to the European Commission latest forecast released in February 2014 (Table 1 below). The recovery is expected to be slow compared to many other converging economies, as a significant population decline (due to ageing and emigration) continues to erode the growth potential.

1.2.2. Inflation rates

In the Table 2 below different forecasts for inflation rates are presented. The IMF forecast is adopted for the purposes of preparation of the Performance Plan.

The inflation data and forecasts have been very dynamic recently. Average inflation amounted to only 0.4% in 2013. Inflation fell sharply over 2013, turning even negative in the second half of the year, driven by falling import prices, decreases in the administratively-set energy prices and the good harvest that led to lower food prices. As the base effects from these factors fade, inflation is forecast to rebound in the second half of 2014. Nevertheless, inflationary pressures are expected to remain low also in 2014, with average annual inflation projected to reach 0.5% according to the European Commission latest forecast released in February 2014 (Table 2 below). Inflation is forecast to accelerate in 2015 to 1.8%, in line with the projected recovery in domestic demand and the ongoing convergence of prices towards the EU average.

1.2.3. Expected EUR/BGN exchange rate development

The fixed exchange rate of the BGN to the EUR being 1.95583 is expected to remain unchanged for RP2. For expressing the costs in EUR2009 and EUR2012, the costs in national currency at 2009 and 2012 prices are converted at the actual annual exchange rates for 2009 and 2012 (based on Reuters daily rates). For the purposes of the calculation of the unit rates during RP2, there are possible slight deviations from this value, subject to the provisions of the Conditions of Application of the Route Charges System and Conditions of Payment.

1.2.4. Return on equity

1.2.4.1. Under the EU regulations a risk premium should be accrued above the 10-year government bond rates used as a reference, taking into account the actual financial risk. The equity risk premium represents the additional return that investors require to hold equity rather than risk-free investments. A standard practice for the calculation of the cost of equity is the CAPM. It is also to be noted that the individual estimate of the risk premium depends on a number of factors, including the gearing (debt/equity ratio) of the company, general economic conditions, and the degree of correlation of risks in the company considered in correlation to the market as a whole.

1.2.4.2. In the case of BULATSA, the direct application of the CAPM is slightly limited. As BULATSA is a state-owned enterprise and its capital is not divided into shares traded on the Bulgarian Stock Exchange.

1.2.4.3. Nevertheless, market surveys have been performed on the bonds issued and traded at the Bulgarian Stock Exchange. It is to be noted that the maturity of the biggest part of these bonds is up to five years and the respective yield to maturity, as well as the current yield range between 6% and 10%[2].

1.2.4.4. The latest sovereign credit rating of Bulgaria is BBB (or equivalent)[3]. The latest data for the long-term risk-free harmonised long-term interest rates of government bonds for Bulgaria is around 3.5%[4]. A survey reveals that current benchmark spread to be borne by non-financial institutions is above the risk-free rate. The 7-10 years benchmark spread for BBB EUR-denominated corporate securities is about 250-255 basis points, while the 10+-year benchmark spread is slightly about 270 basis points. Taking into account these data, the minimum cost of equity for Bulgaria should be 7%. This is the one used for RP1.

Year / Metrics	2012	2013	2014	2015	2016	2017	2018	2019
	A	A	F	D	D	D	D	D
Real GDP growth[5]	0.59%	0.86%	1.60%	2.50%	3.00%	3.00%	3.00%	3.00%
Nominal GDP[6] (millions, national currency)	78,089	78,115	79,054	81,787	85,747	90,263	95,016	100,020
Real GDP growth[7]	0.59%	0.86%	2.10%	2.60%	3.40%	3.40%	-	-
Real GDP growth[8]	0.60%	0.90%	1.70%	2.00%	-	-	-	-
Real GDP[9]	53,233	53,691	-	-	-	-	-	-

Table 1 General economic situation in Bulgaria

	Annual average inflation rates							
Year / Source	2012	2013	2014	2015	2016	2017	2018	2019
	A	A	F	D	D	D	D	D
IMF[10]	2.39%	0.38%	-0.39%	0.93%	1.79%	2.20%	2.20%	2.20%
EUROSTAT[11]	2.40%	0.40%	0.50%	1.80%	-	-	-	-
National data[12] (National Statistical Institute)	2.40%	0.40%	-0.20%	2.40%	1.70%	1.80%	-	-

Table 2 Inflation rates in Bulgaria

1.2.5. En-route SU Forecast
The en-route service units generated in the Bulgarian airspace stem from aircraft flying through the airspace over the territory of Bulgaria and over the High Seas, for which responsibility has been delegated to the Republic of Bulgaria by ICAO, as well as from international and domestic arrivals and departures in the airspace outside the 20 km zone around the airports. The structure of the service units generated by these two major types of traffic has been relatively stable over the years. The overflights generate about 95% of the total en-route service units, while the en-route service units related to international arrivals and departures generate the remaining 5%.
1.2.5.1. The overflying traffic consists of five main two-way flows, as follows: Turkey; Middle East (ICAO Zone O); Far East (ICAO zones V and W); Greece, Cyprus and Israel; North-East Africa.
1.2.5.2. The annual correlations between the volumes of these flows vary significantly over the length of the period analysed, starting from 1998 due to two main factors:
- development of the route network
- different pace at which the traffic flows have evolved

Further to that each flow is influenced by specific events related to certain airspace to be flown over to reach these destinations. This suggests that despite the general trend for traffic increase each flow follows its own pattern of development through the airspace of Bulgaria.

1.2.5.3. A number of events have materialised in April 2014 which have significant impact on the traffic which is flying in the airspace Bulgaria, as follows:
- The opening of Kosovo airspace (KFOR sector), effective from 03 April 2014. This amendment has negative impact on the volume of traffic in our airspace. The effect for BULATSA in terms of traffic is negative and has been estimated up to -10% of the present traffic levels. It will have impact on the traffic flows to/from Israel, Greece, Cyprus, some destinations in Turkey; the situation with the traffic outflow will be monitored and estimated more precisely in 2014.
- The closure of route UP975 via Syrian airspace, effective from 08 April 2014. This small change will have big impact on the volume of traffic to/from Gulf area. It represents the removal of a shorter option for the traffic flows flying in the direction of southeast to the Gulf area.Thus the only waypoints between the Gulf area and Turkey, other than these at the Turkey/Iran airspace, which have been used at present due to the situation in Syria are KABAN (westbound) and NINVA (eastbound).
- Since the beginning of 2011, due to the unrest in North-East Africa the flow to that destination has dropped significantly. It is expected to be partially offset due to a shift of tourists to/from that destination to Turkey but in the same time the opening of the Kosovo airspace would lead to outflow of aircraft flying to this destination from the Bulgarian airspace.
- The situation with the Simferopol ACC. As a result of the state of play of the events in the Crimea Peninsula , this airspace has been rarely used since 03 April 2014 due to safety issues related to ATS provision. This has shifted some traffic related to the destinations to/from the Gulf area as well as smaller portion of traffic to/from India, Thailand, Singapore and Malaysia. The situation with the traffic increase will be monitored and estimated more precisely in 2014. We do consider this situation as temporarily and expect it to be resolved very soon. For the purposes of charging we are in the opinion that this amount of volatile traffic shall not be taken into account and in case that there are increases above the normal level of the traffic development, these are to be settled via the risk sharing mechanism.

These events have opposite in size and magnitude effects, which are not subject to variations at this stage.

1.2.5.4. The optimizations in the route network implemented in the recent years have resulted in a decrease in the average distance overflown. This fact has a positive effect on the flight efficiency results, however it leads to a less than proportionate growth in the service units as compared to the traffic. Besides, there is an ongoing decrease in the average weight factor. These two facts have led to a constant reduction of the ratio “service units per flight” as shown in the Figure 1 below. Taking into account the forecast for the development of the overflying traffic, as well as the shortening of the routes due to the implementation of FABs, this trend will most probably continue and the average value of this ratio is expected to be around 4.0 in the future. This ratio has its lowest values in the summer, when it drops even below this value. In 2013 the average distance overflown has remained at the 2012 level, but the weight factor decreased slightly due to reduction of the traffic flows to the Gulf and to V and W ICAO areas.

1.2.5.5. This optimisation is to be further followed by the planned free route implementation, which is expected to reduce further the average distance flown versus the present levels. The effect is estimated to be a reduction of the service units from (-2-3%) after implementation.

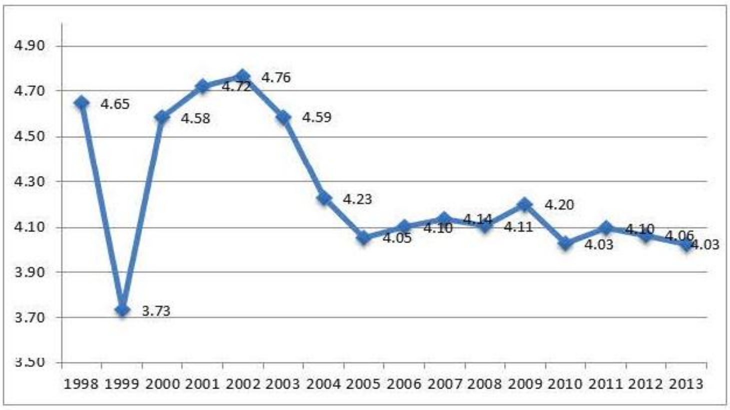


Figure 1 Service units per overflying flight for Bulgaria

To better illustrate the effect described above, please refer to the following table:

Year	2009	2010	2011	2012	2013
Number of aircraft flying over Bulgaria	406,075	430,360	463,974	469,268	482,440
Δ +/-	-	5.98%	7.81%	1.14%	2.81%
Chargeable service units, generated by overflying traffic (national data)	1,705,151	1,734,340	1,900,479	1,907,488	1,942,811
Δ +/-	-	1.71%	9.58%	0.37%	1.85%

Table 3

Further to the decomposition of the figures provided in Table 4 below, our forecast for service units corresponds to the following numbers of overflying aircraft during RP1: 2015 - 515 K; 2016 - 532K; 2017 - 550K, 2018 – 570 K, 2019 - 590K, which corresponds to 2.93% of the annual average growth using 2013 as a base and to 2.76% annual growth of the service units. The adopted scenario by EC and STATFOR is for 1.2% traffic growth of service units.
Bottom-line, the forecasted total service units used for the determined unit rate are presented in the Table below:

Service units in '000

Year	2009A	2010A	2011A	2012A	2013A	2014F	2015F	2016F	2017F	2018F	2019F
STATFOR-High Sep'2013	1798	1840	2019	2020	2064	2168	2292	2420	2541	2676	2815
STATFOR-Base Sep'2013	1798	1840	2019	2020	2054	2121	2208	2301	2385	2479	2576
BULATSA	1798	1840	2019	2020	2058	2118	2168	2240	2316	2400	2484
STATFOR-Low Sep'2013	1798	1840	2019	2020	2044	2072	2118	2175	2221	2273	2326

Table 4 Number of service units

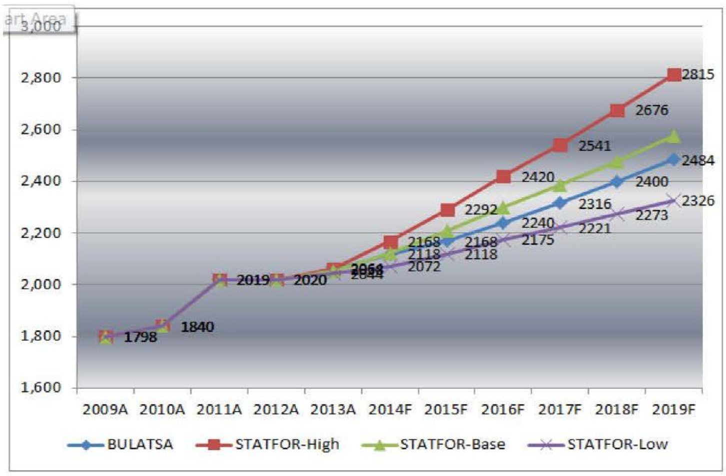


Figure 2 Traffic scenarios

[1] http://ec.europa.eu/economy_finance/publications/european_economy/2014/pdf/ee2_en.pdf

[2] http://www.bse-sofia.bg/?page=DailyBulletin&language=en

[3] http://www.minfin.bg/en/page/69

[4] http://www.ecb.int/stats/money/long/html/index.en.html

[5] http://www.imf.org/external/Datamapper/index.php

[6] http://www.imf.org/external/Datamapper/index.php

[7] 2012-2013: http://www.nsi.bg/en/content/11240/macroeconomic-statistics
2014-2017: http://www.minfin.bg/bg/page/867

[8] 2012-2013: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tec00115
2014-2015: http://ec.europa.eu/economy_finance/publications/european_economy/2014/pdf/ee2_en.pdf

[9] http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do
(exchanged to BGN by rate of 1EUR=1.95583 BGN)

[10] http://www.imf.org/external/Datamapper/index.php

[11] 2012-2013: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tec00118
2014-2015: http://ec.europa.eu/economy_finance/publications/european_economy/2014/pdf/ee2_en.pdf
The inflation stated is based on the HICP.

[12] 2012-2013: http://www.nsi.bg/en/content/11240/macroeconomic-statistics
2014-2017: http://www.minfin.bg/bg/page/867

ROMANIA

1.2.1 General economic situation and expected development of the GDP

Real GDP growth in 2013 has come out at 3.5% thanks to a strong export performance driven by a robust industrial output and an abundant harvest. Growth is forecast to decelerate in 2014, to 2.3%, before slightly recovering to 2.5% in 2015. It is projected to remain above potential over the forecast horizon, reflecting improved confidence and more supportive international conditions but also the payoff of product and labour market reforms implemented under the financial support programmes.

Annual growth rate (%)								
Year	2012	2013	2014	2015	2016	2017	2018	2019
Metrics /Source	A	e	F	F	F	F	F	F
GDP annual % change (EC)	0,70	3,50	2,30	2,50				
GDP growth y-o-y (BMI)		3,30	2,80	3,30	3,50	3,60	3,70	4,00

1.2.2. Inflation rates

Several sets of data for actual and forecast inflation are presented in the Table below. For RP2 Performance Plan (2015-2019) the IMF inflation forecast was used.

HICP inflation sharply declined in the second half of 2013 to reach 1.3% (y-o-y) in December. This can be ascribed to a very good harvest, a reduction in VAT on flour and bakery products (applied in September 2013), and lower inflation expectations.

Annual average inflation is projected to decelerate in 2014 mainly due to falling food prices leading to historical lows in the first half of 2014. It is expected to return to the upper part of the central bank's target band (2.5%±1pp.) in the second half of the year. In 2015, a gradual recovery in domestic demand and continued price convergence towards the EU average are expected to translate into higher inflation, averaging 3.4%.

Annual average inflation rate (%)								
Year	2012	2013	2014	2015	2016	2017	2018	2019
Source	A	A	F	F	F	F	F	F
IMF	3,34	4,00	2,17	3,09	3,00	2,80	2,80	2,70
EUROSTAT	3,40	3,20	2,40	3,40				
National Institute of Statistics	3,33	3,98						
BMI	3,30	4,00	1,70	2,80	3,80	4,00	4,00	

1.2.3. Expected EUR/RON exchange rate development

The RON has proved relatively resilient to volatility compared with regional currencies gaining 0,2% against the euro in 2014. However, due to declining demand for Romanian local debt it is expected that the currency will continue to lose value agains the euroover the coming quarters. The volatility of the currency introduces a significant risk for the costs expressed in national currency, especially due to the high degree of euroisation of the Romanian market in general and the conditions for the ANSP in particular, due to the need to buy equipment and services in euro.

Annual exchange rate RON/EUR avg								
Year / Source	2012	2013	2014	2015	2016	2017	2018	2019
	A	A	F	F	F	F	F	F
Reuters (Eurocontrol)	4,41604	4,41604	4,45831*					
GDP growth y-o-y (BMI)		4.42	4.54	4.61	4.64	4.66	4.68	4.72

* Average April 2014 rate of exchange

1.2.4. Cost of capital

Following the reccommendations of the study commissioned by the EC on the Cost of capital, the CAPM model was applied using the Excel model developed by Steer Davies Gleaves with the following assumptions:

1.2.4.1. CAPM assumptions:

Risk free rate

Reasonable proxies for risk free rates are long-term government bond yields. The value used is 5.31% which is the March 2014 value given by Eurostat. The value used in RP1 was over 7%. Unlike the examples given in the SDG report, Romania's risk free rate has decreased during RP1, therefore use of the latest available value is more reasonable than the Steer Davies Gleaves suggested long term.

Market premium

The value of 7.35% has been calculated using the equity market premium (5.15%) and the country risk premium (CDS spread) for Romania (2.20%). Damodaran has been used for the source of data. This is consistent with data from Fernandez-IESE Business School, that calculated an

Equity beta

Following the recommendation of the SDG report the asset beta has been set at 0.5 taking into account the specific risk factors for ROMATSA:

• Risks in traffic forecasts – due to high volatility of traffic and conflicts at the border (Ukraine) affecting traffic flows,
• Cost risks due to large fluctuations in the exchange rate

Debt risk premium

Debt risk premium has been calculated as the diffrence between the cost of debt (market rate) less the risk free rate. The average cost of debt for Romania from March 2013 to Feb 2014 is 8.43%, less the risk free rate (5.31%), giving a debt risk premium of 3.12%.

1.2.4.2. WACC calculated

Using the cost of capital calculator developed by SDG we have calculated a rate of return on equity of 8,99% after tax, while the model suggests a typically efficient rate of 9,92% after tax.

1.2.4.3. Vanilla WACC

Following the recommendations of the SDG report, Romania intends to use the typically efficient nominal Vanilla WACC calculated using

• SDG typically efficient values of: asset beta, gearing, debt beta, debt risk premium and risk free rate; and
• Planned values of: Inflation expectation (IMF average for RP2), market premium (Damodaran), and effective tax rate.

The typically efficient value of Vanilla WACC (7.85%) is lower than the planned value (8.99%).

1.2.4.4 Restated and historic assets

The typically efficient nominal Vanilla WACC (7.85%) has been applied to historic valued assets and the typically efficient real Vanilla WACC (7.85% less inflation) has been applied to the restated assets, as recommended by the SDG report.

Description of the process to improve route design
1. DANUBE FAB is making continuous efforts in order to achieve and maintain horizontal en route flight efficiency and minimization of the difference between the length of the en route part of the actual flight trajectory and the optimum trajectory. *2. Route Design improvement is the primary objective of Airspace Design Expert Group (ADODEG) being a sub-group of DANUBE FAB Operations Standing Committee. ADODEG meetings are organised as often as four times a year - airspace design improvements are discussed and planned, starting from single segment adaptation to full-scale area reorganisation.* *3. A study carried out with the extensive support of Eurocontrol showed that fragmented segment improvements have limited potential in regard to KEA. Therefore, it was agreed at ADODEG 26 meeting, held in Sofia, Bulgaria on 23-24.04.2014 that a stepped approach towards Full Free Route should be adopted.* *4. The following major steps were outlined and proposed:* *• 2015 – Time extension within LRBB; lower level in LBSR* *• 2016 – Night cross-border free route (FAB)* *• 2017 – Time extension (all seasons)* *• Winter 2017/2018 – Seasonal H24 above a certain FL* *• Winter 2018/2019 – Seasonal H24 at all FL* *• 2019 – H24 above a certain FL.* *5. Due to high level of uncertainty, high seasonability and other factors with stohastic nature it was decided that all implementation aspects of FRA will be put in the correct timeframe by running a full scale Real Time Simulation at Eurocontrol Experimental Center under a TEN-T financial support action DANUBE FAB-2012-EU-40003-S. The simulation is scheduled for April 2015.*

Additional comments
1. BULATSA has developed a tool for calculation of KEA with the close support of PRB. The software was used extensively during the preparation of the present plan to fully estimate the expected benefit of each airspace improvement project. *2. The following assumptions were used during the analisis of the contribution ot KEA of all major projects:* *- Neighbouring FIRs will be able implement the planned route network improvement projects.* *- No penalisation is accrued due to Network effect, such as FIR closures/contingency situations.* *- Minor fluctuation in contribution to KEA might be expected due to flight planning objectives of Aircraft Operators.* *3. In accordance with Sec. 20 of the Meta-Data for the Average horizontal en-route inefficiency (http://prudata.webfactional.com/wiki/index.php/Average_horizontal_en-route_inefficiency) the source data for this LPI is provided by the Network Manager and is processed by EUROCONTROL.*

3.1.(a).(iii) - Optional section - Additional Environment KPI(s)

Number of additional Environment KPIs	Click to select number of additional KPIs

SECTION 3.1.(c): CAPACITY KPA

Mapping between the PRB FAB performance plan template and the Annex II of EU Regulation 390/2013				
	Link with PRB template			
Structure of ANNEX II of Regulation 390/2013	Level 1' FAB PP	Level2' FAB PP - Annex C		FAB PP Other annexes
		RT ref.	AI ref.	
(c) Capacity	3.1.(c)			
(i) minutes of average *en route* ATFM delay per flight;	3.1.(c).(i)			
(ii) minutes of average terminal ATFM arrival delay per flight;	3.1.(c).(ii)			
(iii) the capacity plan established by the air navigation service provider(s).	3.1.(c).(iii)			
	3.1.(c).(iv) - Optional section - Additional Capacity KPI(s)			

3.1.(c) - Capacity

3.1.(c).(i) - Capacity KPI #1: En route ATFM delay per flight

		2015 Value	2016 Value	2017 Value	2018 Value	2019 Target
Union-wide targets		0.50	0.50	0.50	0.50	0.50
FAB reference values		0.08	0.08	0.08	0.09	0.09
FAB level		0.08	0.08	0.08	0.09	0.09
Description of the consistency between FAB targets and FAB reference values		The presented figures are fully consistent with the breakdown at FAB level that was included as part of SSC51 Item 3 2 - Annex 2 to WP4 5 - draft Decision on RP2 targets.pdf document. Later, the distribution was erased from the draft Decision. Official information on the matter is yet to be provided.				
Detailed justification in case of inconsistency						
	Select Number of ANSPs >>	2				
National level	***BULATSA***	0.12	0.12	0.12	0.14	0.14
	ANSP contribution to FAB targets	The figures represent the cost-optimum delay. Continuous optimisation of roster scheme has allowed Sofia FIR to keep zero delay statistics. In addition a number of airspace design projects and ATM system upgrades are planned in order to maintain the required level of capacity throughout the reference period.				
	ROMATSA	0.00	0.00	0.00	0.00	0.00
	ANSP contribution to FAB targets	No delays were generated by Bucharest FIR during RP1. As for RP2 and based on the asssumptions described below Bucharest FIR will not register ATFM delays. In addition a number of airspace design projects and ATM system upgrades are planned in order to maintain the required level of capacity throughout the reference period.				

Additional comments
DANUBE FAB has had historically a very good delay performance record.Virtually no delays have been generated during the last five years. Exceptions are rare and mostly related to exceptional events in adjacent FIRs, unexpectedly and significantly altering the traffic levels and flow distribution within a short period of time. *Bucharest FIR has no delays, whereas Sofia FIR considers that low delay figures would be tolerable, as long as these are consistent with European wide targets and remain within the cost-optimum zone (capacity vs. cost of service provision).* *The numbers provided above are fully consistent with EU wide targets and are based on the following assumptions:* *- Traffic levels will not differ from those predicted in EUROCONTROL 7-year flight and service units forecast, February 2014 release.* *- No significant penalisation network effects are observed during the reference period (e.g. closure of or significant restrictions in other FIRs.)*

3.1.(c).(ii) - Capacity KPI #2: Terminal and airport ANS ATFM arrival delay per flight

Number of States	2

Bulgaria

	2015 Value	2016 Value	2017 Value	2018 Value	2019 Target
National level	0	0	0	0	0
Contribution to the improvement of the European ATM network performance					

Number of airports	1

Airport level						
	LBSF (SOFIA)	0	0	0	0	0
	Airport contribution to national targets					

Additional comments

Romania

	2015 Value	2016 Value	2017 Value	2018 Value	2019 Target
National level	0	0	0	0	0
Contribution to the improvement of the European ATM network performance					

Number of airports	2

Airport level						
	LRBS (BUCURESTI / BANEASA-AUREL VLAICU)	0	0	0	0	0
	Airport contribution to national targets					
	LROP (BUCURESTI / HENRI COANDA)	0	0	0	0	0
	Airport contribution to national targets					

Additional comments
For RP1 Romania did not establish a target for terminal air navigation services. In 2012 Romania registered 0,02 minutes of ATFM delay attributable to terminal ANS due to a special event (in May 2012 UEFA Europa League Final was held in Bucharest), with no impact on en-route ATFM delay. In 2013 no delays have been registered.The terminal and airport ANS ATFM arrival delay for RP2 are to be maintained at the same level as for RP1 based on the actual traffic assumptions.

3.1.(c).(iii) - Capacity Plans

In order to avoid duplication, Member States will not be requested to attach ANSPs capacity plans when submitting the performance plans, for as long as they are already available to the PRB and the Commission. In any case, they are an integral part of the FAB performance plans.

3.1.(c).(iv) - Optional section - Additional Capacity KPI(s)

Number of additional Capacity KPIs	Click to select number of additional KPIs

SECTION 3.1.(d): COST-EFFICIENCY KPA

Mapping between the template for the FAB performance plan and Annex II of the performance Regulation				
Structure of ANNEX II of the performance Regulation	Link with PRB Performance Plan template			
	Body of Performance Plan	Annex C For cost-effiency		Other annexes
		RT ref.	AI ref.	
(d) Cost-efficiency	3.1.(d)			
(i) determined costs for *en route* and terminal air navigation services set in accordance with the provisions of Article 15(2)(a) and (b) of Regulation (EC) No 550/2004 and in application of the provisions of Implementing Regulation (EU) No 391/2013 for each year of the reference period;	3.1.(d).1.A 3.1.(d).2.A			
(ii) *en route* and terminal service units forecast for each year of the reference period;	3.1.(d).1.A 3.1.(d).2.A 3.1.(d).1.C 3.1.(d).2.C	RT 1 (5.4)		
(iii) as a result, the determined unit costs for the reference period;	3.1.(d).1.A 3.1.(d).2.A	RT 1 (5.5)		
(iv) description and justification of the return on equity of the air navigation service providers concerned, as well as on the gearing ratio and on the level/composition of the asset base used to calculate the cost of capital comprised in the determined costs;		RT 1 (3.1-3.4, 3.6)	AI 1 e)	
(v) description and explanation of the carry-overs from the years preceding the reference period;		RT 1 (3.1-3.4, 3.6)	AI 3 c), d), e)	
(vi) description of economic assumptions, including: — inflation assumptions used in the plan as compared to an international source such as the IMF (International Monetary Fund) Consumer Price Index (CPI) for the forecasts and Eurostat Harmonised Index of Consumer Price for the actuals. Justification of any deviation from these sources,	3.1.(d).1.B 3.1.(d).2.B	RT 1 (5.1-5.2)		
— assumptions underlying the calculation of pension costs comprised in the determined costs, including a description on the relevant national pension regulations and pension accounting regulations in place and on which the assumptions are based, as well as information whether changes of these regulations are anticipated,			AI 4 b)	
— interest rate assumptions for loans financing the provision of air navigation services, including relevant information on loans (amounts, duration, etc.) and explanation for the (weighted) average interest on debt used to calculate the cost of capital pre tax rate and the cost of capital comprised in the determined costs,		RT 1 (3.7)	AI 4 c)	
— adjustments beyond the provisions of the International Accounting Standards;			AI 1 Item c)	
(vii) if applicable, description in respect to the previous reference period of relevant events and circumstances set out in Article 14(2)(a) of Implementing Regulation (EU) No 391/2013 using the criteria set out in Article 14(2)(b) of Implementing Regulation (EU) No 391/2013 including an assessment of the level, composition and justification of costs exempt from the application of Article 14(1)(a) and (b) of Implementing Regulation (EU) No 391/2013;		RT 3 (3.1-3.12)	AI 3 b)	
(viii) if applicable, a description of any significant restructuring planned during the reference period including the level of restructuring costs and a justification for these costs in relation to the net benefits to the airspace users over time;		RT 3 (4.1)	AI 4 d)	
(ix) if applicable, restructuring costs approved from previous reference periods to be recovered.		RT 3 (4.1)	AI 4 e)	

Name of capex 4	VCSS Systems (CNS 03 - 14)	
Description	VCSS Systems	
Accountable entity	ANSP	

Justification of the cost, nature and contribution		
Differentiation	*New system*	
Replacement investment	*Yes*	
Common project	*Yes*	
Other investment (in line with interoperability Regulations, the IDP, Master Plan essentials or the NSP)	*Yes*	ATM Master Plan Enabler CTE-C8, VoIP for ground telephony ESSIP Objective - COM11, Implementation of Voice over Internet Protocol (VoIP) in ATM
Joint investment	*Yes*	
Synergies achieved at FAB level or other MS	*Yes*	DANUBE FAB Strategic and Harmonisation Plan for CNS Assets DANUBE FAB Strategic Program 2013-2017 and beyond [ACTIVITY A40] Implementation of Voice Over Internet Protocol (VoIP) in ATM (ground-ground) [TASK A40.T03] Purcahse and install VCS equipment and/or gateways able to support VoIP in ATM
Consultation with stakeholders	*Click to select*	
Decision-making process	*Yes*	Feasibility study

KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases
Safety	*Yes*	Increased reliability	01/01/2015	En-route/Terminal
Environment	*No*			
Capacity	*Yes*	Enhanced capacity, flexibility and disponibility of communication system.	01/01/2015	En-route/Terminal
Cost efficiency	*Yes*	Reduction of OPEX	01/01/2015	En-route/Terminal

Name of capex 5	Improvement of surveillance service using ADS-B solutions (CNS05 - 13)	
Description	ADS-B	
Accountable entity	ANSP	

Justification of the cost, nature and contribution		
Differentiation	*New system*	
Replacement investment	*No*	
Common project	*No*	
Other investment (in line with Interoperability Regulations, the IDP, Master Plan essentials or the NSP)	*Yes*	SESAR Master Plan and ICAO DANUBE FAB Strategic Program 2013-2017 and beyond
Joint investment	*No*	
Synergies achieved at FAB level or other MS	*Yes*	DANUBE FAB Strategic Program 2013-2017 and beyond [ACTIVITY A48] Implement ADS-B
Consultation with stakeholders	*Click to select*	
Decision-making process	*Yes*	Feasibility study

KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases
Safety	*Yes*	Safety improvement by automated insruments of alert, prevention and quick intervention	01/12/2017	En-route
Environment	*Yes*	Reduction of block time and waiting time for departure	01/12/2017	En-route
Capacity	*Yes*	Improved planning, organizing and air traffic management coordination	01/12/2017	En-route
Cost efficiency	*Yes*	Improved flight efficiency due to delays reduction in maneuver area and in departure/arrival planning sequence.	01/12/2017	En-route

Name of capex 6	ILS/DME Systems (CNS04 - 1)
Description	ILS/DME Systems
Accountable entity	ANSP

Justification of the cost, nature and contribution		
Differentiation	*New system*	
Replacement investment	*No*	
Common project	*No*	
Other investment (in line with interoperability Regulations, the IDP, Master Plan essentials or the NSP)	*Click to select*	
Joint investment	*No*	
Synergies achieved at FAB level or other MS	*Yes*	
Consultation with stakeholders	*Click to select*	
Decision-making process	*Yes*	Feasibility study

KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases
Safety	*Yes*	Ensure PBN (Performance-Based Navigation) implementation ATCOs performance improvement	01/12/2018	Terminal
Environment	*Yes*	CO2 emission reductions by using direct routes	01/12/2018	Terminal
Capacity	*Yes*	Improved aispace usage	01/12/2018	Terminal
Cost efficiency	*Yes*	OPEX reductions	01/12/2018	Terminal

Name of capex 7	ILS/DME Systems (CNS04 - 8)
Description	ILS/DME Systems
Accountable entity	ANSP

Justification of the cost, nature and contribution		
Differentiation	*New system*	
Replacement investment	*No*	
Common project	*No*	
Other investment (in line with interoperability Regulations, the IDP, Master Plan essentials or the NSP)	*Click to select*	
Joint investment	*No*	
Synergies achieved at FAB level or other MS	*No*	
Consultation with stakeholders	*Click to select*	
Decision-making process	*Yes*	Feasibility study

KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases
Safety	*Yes*	Ensure PBN (Performance-Based Navigation) implementation ATCOs performance improvement	01/12/2018	Terminal
Environment	*Yes*	CO2 emission reductions by using direct routes	01/12/2018	Terminal
Capacity	*Yes*	Improved aispace usage	01/12/2018	Terminal
Cost efficiency	*Yes*	OPEX reductions	01/12/2018	Terminal

Name of capex 8	ILS/DME Systems (CNS04 - 9)	
Description	ILS/DME Systems	
Accountable entity	ANSP	

Justification of the cost, nature and contribution		
Differentiation	*New system*	
Replacement investment	*No*	
Common project	*No*	
Other investment (in line with interoperability Regulations, the IDP, Master Plan essentials or the NSP)	*Click to select*	
Joint investment	*No*	
Synergies achieved at FAB level or other MS	*No*	
Consultation with stakeholders	*Click to select*	
Decision-making process	*Yes*	Feasibility study

KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases
Safety	*Yes*	Ensure PBN (Performance-Based Navigation) implementation ATCOs performance improvement	01/12/2018	Terminal
Environment	*Yes*	CO2 emission reductions by using direct routes	01/12/2018	Terminal
Capacity	*Yes*	Improved aispace usage	01/12/2018	Terminal
Cost efficiency	*Yes*	OPEX reductions	01/12/2018	Terminal

Name of capex 9	DVOR Systems (CNS 04 - 27-30)	
Description	DVOR/DME Systems	
Accountable entity	ANSP	

Justification of the cost, nature and contribution		
Differentiation	*New system*	
Replacement investment	*Yes*	
Common project	*No*	
Other investment (in line with interoperability Regulations, the IDP, Master Plan essentials or the NSP)	*Yes*	Airspace Strategy for ECAC States SESAR Master Plan ICAO Resolution 37-11 DANUBE FAB Strategic Program 2013-2017 and beyond
Joint investment	*No*	
Synergies achieved at FAB level or other MS	*No*	
Consultation with stakeholders	*Click to select*	
Decision-making process	*Yes*	Feasibility study

KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases
Safety	*Yes*	Ensure PBN (Performance-Based Navigation) implementation ATCOs performance improvement	01/12/2017	En-route
Environment	*Yes*	CO2 emission reductions by using direct routes	01/12/2017	En-route
Capacity	*Yes*	Improved aispace usage	01/12/2017	En-route
Cost efficiency	*Yes*	OPEX reductions	01/12/2017	En-route

Name of capex 10	DVOR Systems (CNS 04 - 31-32)			
Description	DVOR/DME Systems			
Accountable entity	ANSP			
Justification of the cost, nature and contribution				
Differentiation	*New system*			
Replacement investment	*Yes*			
Common project	*No*			
Other investment (in line with interoperability Regulations, the IDP, Master Plan essentials or the NSP)	*Yes*	Airspace Strategy for ECAC States SESAR Master Plan ICAO Resolution 37-11 DANUBE FAB Strategic Program 2013-2017 and beyond		
Joint investment	*No*			
Synergies achieved at FAB level or other MS	*No*			
Consultation with stakeholders	*Click to select*			
Decision-making process	*Yes*	Feasibility study		
KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases
Safety	*Yes*	Ensure PBN (Performance-Based Navigation) implementation ATCOs performance improvement	01/12/2017	En-route
Environment	*Yes*	CO2 emission reductions by using direct routes	01/12/2017	En-route
Capacity	*Yes*	Improved aispace usage	01/12/2017	En-route
Cost efficiency	*Yes*	OPEX reductions	01/12/2017	En-route

Name of capex 11	MSSR Mode S radar (CNS05-2,3,4)			
Description	MSSR Mode S radar			
Accountable entity	ANSP			
Justification of the cost, nature and contribution				
Differentiation	*New system*			
Replacement investment	*Yes*			
Common project	*No*			
Other investment (in line with interoperability Regulations, the IDP, Master Plan essentials or the NSP)	*Yes*	Commission Implementing Regulation (EU) no. 1206/2011 of 22 Noember 2011 laying down reequirements on aircraft identification for surveillance for the Single European Sky. ESSIP - ITY-SPI DANUBE FAB Strategic Program 2013-2017 and beyond		
Joint investment	*No*			
Synergies achieved at FAB level or other MS	*Yes*	DANUBE FAB Strategic Program 2013-2017 and beyond [ACTIVITY A53] Implement aircraft identification for surveillance for Single European Sky		
Consultation with stakeholders	*Click to select*			
Decision-making process	*Yes*	Feasibility study		
KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases
Safety	*Yes*	Safety improvement by automated insruments of alert, prevention and quick intervention	01/12/2015	En-route/Terminal
Environment	*Yes*	Reduction of block time and waiting time for departure	01/12/2015	En-route/Terminal
Capacity	*Yes*	Improved planning, organizing and air traffic management coordination	01/12/2015	En-route/Terminal
Cost efficiency	*Yes*	Improved flight efficiency due to delays reduction in maneuver area and in departure/arrival planning sequence.	01/12/2015	En-route/Terminal

Name of investment	Total CAPEX for the project	Planned Amount of Capital Expenditures (in national currency)					Lifecycle (Amortisation period in years)	Allocation en route / terminal ANS (%)	Planned date of entry into operation (IOC / FOC dates)
		2015	2016	2017	2018	2019			
ATM System ROMATSA 2015+ (STEP 1)	151,466,521	65,820,555					12	95%/5%	15/11/2015
ATM System ROMATSA 2015+ (STEP 2)	66,893,550		26,757,420	26,757,420	13,378,710		12	100%/0%	01/12/2018
VCSS Systems (CNS 03 - 10-13)	21,985,680						9	75%/25%	01/12/2014
VCSS Systems (CNS 03 - 14)	5,619,058	5,619,058					9	40%/60%	01/12/2015
Improvement of surveillance service using ADS-B solutions (CNS05 - 13)	11,148,925	2,229,785	4,459,570	4,459,570			12	100%/0%	01/12/2017
ILS/DME Systems (CNS04 - 1)	3,790,635	3,730,635					12	0%/100%	01/12/2015
ILS/DME Systems (CNS04 - 8)	3,790,635		3,790,635				12	0%/100%	01/12/2016
ILS/DME Systems (CNS04 - 9)	3,790,635		222,979	1,783,828	1,783,828		12	0%/100%	01/12/2018
DVOR Systems (CNS 04 - 27-30)	8,027,226	8,027,226					12	100%/0%	01/12/2015
DVOR Systems (CNS 04 - 31-32)	5,351,484			5,351,484			12	100%/0%	01/12/2017
MSSR Mode S radar (CNS05-2,3,4)	31,662,947	22,911,560					12	62%/38%	01/12/2015
Sub-total of **main capex** above (1)	313,527,296	108,338,819	35,230,604	38,352,302	15,162,538	0			
Sub-total other Capex (2)		51,392,945	64,501,160	40,379,462	43,569,226	58,731,764			
Total capex (1) + (2)	313,527,296	159,731,764	99,731,764	78,731,764	58,731,764	58,731,764			

Additional comments

SECTION 3: PERFORMANCE TARGETS

Mapping between the template for the FAB performance plan and Annex II of the performance Regulation				
Structure of ANNEX II of the performance Regulation	Link with PRB Performance Plan template			
	Body of Performance Plan	Annex C For cost-effiency		Other annexes
		RT ref.	AI ref.	
3. PERFORMANCE TARGETS AT LOCAL LEVEL	3			
3.1. Performance targets in each key performance area, set by reference to each key performance indicator as set out in Annex I, Section 2, for the entire reference period, with annual values to be used for monitoring and incentive purposes:	3.1			
3.2. Description and explanation of the consistency of the performance targets with the relevant Union-wide performance targets. When there is no Union-wide performance target, description and explanation of the targets within the plan and how they contribute to the improvement of the performance of the European ATM network.	3.1.(a).(i) 3.1.(a). (ii) 3.1.(a). (iii) 3.1.(a). (iv) 3.1.(b).(i) & (ii) 3.1.(b).(iii) 3.1.(c).(i) 3.1.(c).(ii) 3.1.(c).(iii) 3.1.(c).(iv) 3.1.(d).1.A 3.1.(d).2.A	RT 3 (4.1)	AI 4 e)	
3.3. Description and explanation of the interdependencies and trade-offs between the key performance areas, including the assumptions used to assess the trade-offs.	3.3			
3.4. Contribution of each air navigation service provider concerned to the achievement of the performance targets set for the functional airspace block in accordance with Article 5(2)(c)(ii).	3.1.(a).(i) 3.1.(a). (ii) 3.1.(a). (iii) 3.1.(a). (iv) 3.1.(b).(i) & (ii) 3.1.(b).(iii) 3.1.(c).(i) 3.1.(c).(ii) 3.1.(c).(iii) 3.1.(c).(iv)	RT 1 (All)	AI 4 a)	

SECTION 3.1.(a): SAFETY KPA

Mapping between the template for the FAB performance plan and Annex II of the performance Regulation				
Structure of ANNEX II of the performance Regulation	Link with PRB Performance Plan template			
	Body of Performance Plan	Annex C For cost-effiency		Other annexes
		RT ref.	AI ref.	
(a) Safety	3.1.(a)			
(i) level of effectiveness of safety management: local targets for each year of the reference period;	3.1.(a).(i)			
(ii) application of the severity classification based on the Risk Analysis Tool (RAT) methodology: local targets for each year of the reference period (percentage);	3.1.(a). (ii)			
(iii) just culture: local targets for the last year of the reference period.	3.1.(a). (iii)			
	3.1.(a). (iv) - Optional section - Additional Safety KPI(s)			

3 - PERFORMANCE TARGETS AT LOCAL LEVEL

3.1 - Key Performance Areas

3.1.(a) - Safety

3.1.(a).(i) - Safety KPI #1: Level of Effectiveness of Safety Management

		2015 Target	2016 Target	2017 Target	2018 Target	2019 Target
Union-wide targets at State level		-	-	-	-	C
Union-wide targets at ANSP level	For Safety Culture MO	-	-	-	-	C
	For all other MOs	-	-	-	-	D
FAB level	**Regulatory authorities**	B	B	B	B	C
	Description of the consistency between local and Union-wide targets	NSA targets consistent with Union-wide targets				
	Detailed justification in case of inconsistency	N/A				
	ANSPs (for Safety Culture MO)	C	C	C	C	C
	ANSPs (for all other Mos)	C	C	C	C	D
	Description of the consistency between local and Union-wide targets	ANSP targets consistent with Union-wide targets				
	Detailed justification in case of inconsistency	N/A				

	Select Number of States >>	2				
National level	*Bulgaria*	B	B	C	C	D
	Romania	B	B	B	B	C

	Select Number of ANSPs **for Safety Culture MO** >>	2				
National level	*BULATSA*	C	C	D	D	D
	ROMATSA	C	C	C	C	C

	Select Number of ANSPs **for all other MOs** >>	2				
National level	*BULATSA*	C	D	D	D	D
	ROMATSA	C	C	C	C	D

Additional comments
Fig. 1 illustrates the present status of BULATSA Level of Effectiveness of Safety Management System.

Fig. 1

Status of the Air Navigation Service Provider

Study Area	Level (1-5)	Score (%)	Responses (A-E)			
SA1 – Safety Culture	3	75.00	D	C	D	
SA2 – Organisational and Individual Safety Responsibilities	4	78.02	D	E	E	D
SA3 – Timely Compliance with International Obligations	4	81.37	D	D		
SA4 - Safety Achievement	4	77.67	E	D	E	
SA5 - Competency	5	75.27	E			
SA6 – Risk Management	4	77.13	D			
SA7 – Safety Interfaces	4	75.79	D	D		
SA8 – Safety Assurance	4	76.12	D	D	D	
SA9 – Safety Performance Monitoring	3	75.82	D	D	C	
SA10 – Organisational Safety Surveys and SMS Audits	4	75.57	D			
SA11 – Adoption and Sharing of Best Practices	3	75.87	D	C	C	
Overall Maturity Level and Maturity Score	3	76.70				

Lowest Scoring Study Area	SA1	Highest Scoring Study Area	SA3

3.1.(a).(ii) - Safety KPI #2: Application of the severity classification based on the Risk Analysis Tool (RAT) methodology

Ground Score			2015 Target	2016 Target	2017 Target	2018 Target	2019 Target
Union-wide targets		SMIs	-	-	>= 80%	-	100%
		Ris	-	-	>= 80%	-	100%
		ATM-S	-	-	>= 80%	-	100%
FAB level		SMIs	85.00%	85.00%	90.00%	90.00%	100.00%
		RIs	85.00%	85.00%	90.00%	90.00%	100.00%
		ATM-S	75.00%	77.50%	85.00%	87.50%	100.00%
Description of the consistency between local and Union-wide targets			FAB targets consistent with Union-wide targets				
Detailed justification in case of inconsistency			N/A				
	Select Number of ANSPs >>		2				
National level	***BULATSA***	SMIs	100.00%	100.00%	100.00%	100.00%	100.00%
		RIs	100.00%	100.00%	100.00%	100.00%	100.00%
		ATM-S	80.00%	85.00%	90.00%	95.00%	100.00%
	ROMATSA	SMIs	70.00%	70.00%	80.00%	80.00%	100.00%
		RIs	70.00%	70.00%	80.00%	80.00%	100.00%
		ATM-S	70.00%	70.00%	80.00%	80.00%	100.00%

Additional comments

Overall Score			2015 Target	2016 Target	2017 Target	2018 Target	2019 Target
Union-wide targets		SMIs	-	-	>= 80%	>= 80%	>= 80%
		RIs	-	-	>= 80%	>= 80%	>= 80%
		ATM-S	-	-	>= 80%	-	100%
FAB level		SMIs	55.00%	70.00%	80.00%	90.00%	90.00%
		RIs	70.00%	80.00%	85.00%	90.00%	90.00%
		ATM-S	70.00%	70.00%	80.00%	80.00%	100.00%
Description of the consistency between local and Union-wide targets			FAB targets consistent with Union-wide targets				
Detailed justification in case of inconsistency			N/A				
	Select Number of States >>		2				
National level	***Bulgaria***	SMIs	60.00%	70.00%	80.00%	100.00%	100.00%
		RIs	90.00%	90.00%	90.00%	100.00%	100.00%
		ATM-S	70.00%	70.00%	80.00%	80.00%	100.00%
	Romania	SMIs	50.00%	70.00%	80.00%	80.00%	80.00%
		RIs	50.00%	70.00%	80.00%	80.00%	80.00%
		ATM-S	70.00%	70.00%	80.00%	80.00%	100.00%

Additional comments

BULATSA reports that RAT is currently being used to assess severity of runway incursions, and minima infringement occurrences. Regarding ATM occurrences, BULATSA established a working group and initiated a process of defining a T1 parameter for every operational system. By the end of 2014 the working group has to accomplish the mission and to report the defined T1. BULATSA is 100% compliant with the performance scheme Regulation.

At FAB level both ANSPs exchanged experiences in the use of RAT, and plan to hold a joint workshop in Bulgaria or Romania to ensure a common approach for the use of RAT. At this workshop EUROCONTROL experts shall be invited, with the aim of facilitating a series of exercises, in order to ensure the practical use of RAT in DANUBE FAB for reported occurrences.

3.1.(a).(iii) - Safety KPI #3: Just Culture

		2019 Target
FAB level	Regulatory authorities	Have you established a common FAB approach in certain areas for Just Culture improvements?
		YES
		If YES, please specify details and level of presence. If NO, please specify any impediments, intent for common FAB approach.
		The common DANUBE FAB approach is to implement Just Culture provisions contained in the EU regulations. As per DANUBE FAB Safety Policy, all levels of management accountable for safety in DANUBE FAB promote a safety culture based on staff motivation, competency, reporting of safety occurrences, a fair and just judgment, flexibility and use of best practices. During the 2nd DANUBE FAB NSA Board meeting, in the RP2 Performance Regulation context, Just Culture at FAB Level was analised (WP 02.09/15.10.2013).
	ANSPs	Have you established a common FAB approach in certain areas for Just Culture improvements?
		YES
		If YES, please specify details and level of presence. If NO, please specify any impediments, intent for common FAB approach.
		The common FAB approach is to implement the Just Culture EU regulations. As per DANUBE FAB Safety Policy, all levels of management accountable for safety in DANUBE FAB promote a safety culture based on staff motivation, competency, reporting of safety occurrences, a fair and just judgment, flexibility and use of best practices.

Number of States	2

National level	***Bulgaria***	What actions have you undertaken to optimise Just Culture?
		The organisation operates informed learning and reporting cultures, as well as a just culture with respect to errors in operations. All staff within BULATSA actively promoting and improving safety. This are results of the external and internal Safety surveys which were done within the organisation.
	Romania	What actions have you undertaken to optimise Just Culture?
		The applicable provisions of existing EU regulations related to Just Culture have been implemented through the following Romanian aviation acts: *o The Romanian safety policy is approved by OMT 64/ 01.02.2012 and contains just culture provisions.* *o RACR REAC - Reports of the civil aviation occurrences;* *o The declaration of the RCAA Director and the CIAS Director (former Head of Civil Aviation Inspectorate) contains provision related to Just Culture principles.* *In April 2014, in Bucharest, Romanian CAA together with EUROCONTROL has organised a Just Culture workshop for prosecutors. This meeting was attended by all organisations involved in the Just Culture implementation al national level.*

Number of ANSPs	2

National level	***BULATSA***	What actions have you undertaken to optimise Just Culture?
		Periodical the external and internal Safety surveys which were done within the organisation.BULATSA plans to conduct a media campaign to promote the profession of ATCOs. The campaign aims to describe the enormous psychological strain in a high level of stress, and the great responsibility that ATCOs have to ensure safety in air traffic services.
	ROMATSA	What actions have you undertaken to optimise Just Culture?
		The applicable provisions of existing EU regulations related to Just Culture have been implemented through the Safety Management System procedures.

Additional comments

3.1.(a).(iv) - Optional section - Additional Safety KPI(s)

Number of additional Safety KPIs	Click to select number of additional KPIs

SECTION 3.1.(b): ENVIRONMENT KPA

Mapping between the template for the FAB performance plan and Annex II of the performance Regulation				
Structure of ANNEX II of the performance Regulation	Link with PRB Performance Plan template			
	Body of Performance Plan	Annex C For cost-effiency		Other annexes
		RT ref.	AI ref.	
(b) Environment	3.1.(b)			
(i) description of the process to improve route design;	3.1.(b).(i) & (ii)			
(ii) average horizontal *en route* flight efficiency of the actual trajectory.				
	3.1.(b).(iii) - Optional section - Additional Environment KPI(s)			

3.1.(b) - Environment

3.1.(b).(i) & (ii) - Environment KPI #1: Horizontal en route flight efficiency (KEA)

	2015 Value	2016 Value	2017 Value	2018 Value	2019 Target
Union-wide targets	-	-	-	-	2.60%
FAB reference values	1.55%	1.50%	1.46%	1.41%	1.37%
FAB level	1.55%	1.50%	1.46%	1.41%	1.37%
	0.00%	0.06%	0.01%	0.04%	0.07%
Description of the consistency between FAB targets and FAB reference values	The KEA of the actual trajectory, defined as: • part of the actual trajectory derived from surveillance data(where available) and the achieved distance, summed over all IFR flights within or traversing the local airspace; • 'en route' refers to the distance flown outside a circle of 40NM around the airports; • where a flight departs from or arrives at a place outside the local airspace, only the part inside the local airspace is considered; • 'achieved distance' is a function of the position of the entry and exit points of the flight into and out of the local airspace. Achieved distance represents the contribution that these points make to the distance used in the Union- wide indicator. The sum of these distances over all traversed local airspaces equals the distance used in the Union-wide indicator. The figures on the first row are based solely on Eurocontrol's methodology to calculate KEA at network level. The whole trajectory from departure to destination is taken into consideration during the computational process.These figures should be considered as reference values at network level. The latter figures are further complemented by the ones on the second row representing the calculated annual contribution to horisontal flight efficiency based on the achieved distance methodology, developed by PRB. It is in fact the contribution that is achieved at local (FAB) level - local reference values . Both sets of data represent the contribution to horisontal flight efficiency and annual improvement for RP2.				
Detailed justification in case of inconsistency	N/A				
ANSP contribution to local targets	BULATSA and ROMATSA: 1. As of November 2013 both BULATSA and ROMATSA implemented Night Free Route operations within national boundaries, for Sofia FIR and Bucuresti FIR respectively. Aircraft operators may chose the most economic and environmentally friendly route to flight, taking account not only of the shortest distance, but the MET conditions as well, thus reducing the fuel use and CO_2/NOx emissions. 2. FRA concept implementation will be further expanded both in terms of time and geographical terms. 3. All airspace design improvement initiatives are coordinated at DANUBE FAB level and are fully consistent with European Route Network Improvement Plan. 4. Subject to economic viability and availability, both ANSPs will exploit future technological developments (e.g. advanced tactical tools for ATCOs, 4D trajectories) to ensure further optimisation of KEA and will support efforts to improve the flight efficiency at FAB level.				

Joint investment	*No*	
Synergies achieved at FAB level or other MS	*No*	
Consultation with stakeholders	*Click to select*	
Decision-making process	*Yes*	Feasibility study

KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases
Safety	*Yes*	Safety improvement by including new functions	01/01/2019	En-route/Terminal
Environment	*Yes*	New functions allow route optimization and reduction of CO2 emissions Modernization of existing functions	01/01/2019	En-route/Terminal
Capacity	*Yes*	Enhanced capacity through improved interoperability	01/01/2019	En-route/Terminal
Cost efficiency	*Yes*	Cost reductions through optimization of existing functions and inclusion of new functions.	01/01/2019	En-route/Terminal

Name of capex 3	**VCSS Systems (CNS 03 - 10-13)**
Description	VCSS Systems
Accountable entity	ANSP

Justification of the cost, nature and contribution		
Differentiation	*New system*	
Replacement investment	*Yes*	
Common project	*Yes*	
Other investment (in line with interoperability Regulations, the IDP, Master Plan essentials or the NSP)	*Yes*	ATM Master Plan Enabler CTE-C8, VoIP for ground telephony ESSIP Objective - COM11, Implementation of Voice over Internet Protocol (VoIP) in ATM
Joint investment	*Yes*	
Synergies achieved at FAB level or other MS	*Yes*	DANUBE FAB Strategic and Harmonisation Plan for CNS Assets DANUBE FAB Strategic Program 2013-2017 and beyond [ACTIVITY A40] Implementation of Voice Over Internet Protocol (VoIP) in ATM (ground-ground) [TASK A40.T03] Purcahse and install VCS equipment and/or gateways able to support VoIP in ATM
Consultation with stakeholders	*Click to select*	
Decision-making process	*Yes*	Feasibility study

KPA	Impact	Expected benefits per KPA	Date of expected benefits	Area <En-route/ Terminal/ Airport/ Phases
Safety	*Yes*	Increased reliability	01/01/2015	En-route/Terminal
Environment	*No*			
Capacity	*Yes*	Enhanced capacity, flexibility and disponibility of communication system.	01/01/2015	En-route/Terminal
Cost efficiency	*Yes*	Reduction of OPEX	01/01/2015	En-route/Terminal

IMPORTANT NOTE

The data and justifications for the cost-efficiency targets at local level are split into two distinct parts of the performance plan, aiming at optimising workload and avoiding duplication of reporting. They comprise:

1.In the body of the performance plan document, the information to be presented at charging zone level (some of the data requested being pre-filled by the PRB):
- The targets with a description of the contribution to, and consistency with, the EU-wide target and/or their contribution to the performance of the European ATM network;:
- The entries and justification requiring data from external sources i.e.
  - The traffic forecast used and, if applicable, their justification against STATFOR
  - The inflation assumptions used and, if applicable, their justification against Eurostat/ IMF.
- The local alert thresholds, if any, and their justification.
- A presentation of the consolidation of the targets at FAB level.

2.In Annex C, the information needed at the level of the entities submitted to the performance scheme within the charging zones (ANSPs including MET providers, National authorities...), as follows:
- The data and justifications in the reporting tables and additional information, as per Annexes II, III, VI and VII of the charging Regulation, at entity level plus a consolidation at charging zone level;
- The data and justifications relating to cost-efficiency required at entity level for the purpose of the Performance Plans, as per Article 11 (3) and Annexes II and IV of the performance Regulation,.

Annex C forms an integral part of the performance plan and will be used to carry out the assessment of the performance plan.

3.1.(d).2 - En Route ANS at FAB level

A - Cost efficiency KPI #1: Determined unit cost (DUC) for en route ANS aggregated at FAB level

		Historical data (actual 2009-2013, latest 2014 forecast)						RP2 Performance Plan					RP1 PP	Average percentage variation per annum			
		2009 A	2010 A	2011 A	2012 A	2013 A	2014 F	2015 D	2016 D	2017 D	2018 D	2019 D	2014 D	2009A-2019D	2014F-2019D	2011A-2019D	2014D-2019D
	Total en route Service Units (TSU)	4,931,292	5,235,243	5,551,466	5,595,344	5,809,502	5,975,844	6,181,308	6,357,019	6,534,852	6,717,155	6,925,753	6,125,995	3.5%	3.0%	2.8%	2.5%
	Trend in Total en route Service Units (TSU)%n/n-1		6.16%	6.04%	0.79%	3.83%	2.86%	3.44%	2.84%	2.80%	2.79%	3.11%					
€2012 prices	Total en route costs in real terms (in €$_{2012}$ prices)	232,171,562	225,364,752	209,652,704	233,665,021	230,495,292	236,309,700	227,649,586	224,630,858	221,899,144	219,614,096	217,763,860	236,309,700	-0.6%	-1.6%	0.5%	-1.6%
€2012 prices	Trend in total en route costs in real terms (in €$_{2012}$ prices) %n/n-1		-2.93%	-6.97%	11.45%	-1.36%	2.52%	-3.66%	-1.33%	-1.22%	-1.03%	-0.84%					
€2012 prices	Real en route UCs/DUCs (in €$_{2012}$ prices)	47.08	43.05	37.77	41.76	39.68	39.54	36.83	35.34	33.96	32.69	31.44	38.57	-4.0%	-4.5%	-2.3%	-4.0%
€2012 prices	Trend in real en route UCs/DUCs (in €$_{2012}$ prices)%n/n-1		-8.57%	-12.27%	10.58%	-4.99%	-0.33%	-6.87%	-4.05%	-3.90%	-3.72%	-3.83%					
€2009 prices	Total en route costs in real terms (in €$_{2009}$ prices)	211,361,307	205,120,434	190,860,325	212,599,627	209,844,872	215,127,671	207,260,695	204,508,120	202,016,021	199,929,123	198,236,675	215,127,671	-0.6%	-1.6%	0.5%	-1.6%
€2009 prices	Trend in total en route costs in real terms (in €$_{2009}$ prices) %n/n-1		-2.95%	-6.95%	11.39%	-1.30%	2.52%	-3.66%	-1.33%	-1.22%	-1.03%	-0.85%					
€2009 prices	Real en route UCs/DUCs (in €$_{2009}$ prices)	42.86	39.18	34.38	38.00	36.12	36.00	33.53	32.17	30.91	29.76	28.62	35.12	-4.0%	-4.5%	-2.3%	-4.0%
€2009 prices	Trend in real en route UCs/DUCs (in €$_{2009}$ prices)%n/n-1		-8.59%	-12.25%	10.52%	-4.93%	-0.34%	-6.86%	-4.06%	-3.91%	-3.72%	-3.83%					

3.1.(d).3 - Terminal Charging Zone #1

A - Cost efficiency KPI #2: Determined unit cost (DUC) for terminal ANS

in BGN

	Bulgaria	2015 D	2016 D	2017 D	2018 D	2019 D	Avg pct var p.a. 2015D-2019D
		RP2 Performance Plan					
Local currency (Nominal and 2012 prices)	Total terminal determined costs in nominal terms (in national currency)	22,503,955	22,352,400	23,064,904	23,072,348	23,453,788	1.0%
	Inflation %	0.93%	1.79%	2.20%	2.20%	2.20%	
	Inflation index (Base = 100 in 2012)	100.94	102.75	105.01	107.32	109.68	2.1%
	Total terminal determined costs in real terms (in national currency at 2012 prices)	22,294,277	21,755,152	21,965,379	21,499,479	21,384,458	-1.0%
	Total terminal Service Units (TSU) used for the determined unit cost	45,087	46,890	48,767	50,718	52,747	4.0%
	Real terminal DUCs (in national currency at 2012 prices)	494.47	463.96	450.42	423.90	405.42	-4.8%
€2012 prices	2012 average exchange rate (1EUR=)	1.95536	1.95536	1.95536	1.95536	1.95536	
	Total terminal determined costs in real terms (in $€_{2012}$ prices)	11,401,622	11,125,906	11,233,419	10,995,151	10,936,328	-1.0%
	Trend in total terminal determined costs in real terms %n/n-1		-2.4%	1.0%	-2.1%	-0.5%	
	Real terminal DUCs (in $€_{2012}$ prices)	252.88	237.28	230.35	216.79	207.34	-4.8%
	Trend in real terminal DUCs (in $€_{2012}$ prices) %n/n-1		-6.2%	-2.9%	-5.9%	-4.4%	
€2009 prices	Inflation index (Base = 100 in 2009)	110.08	112.05	114.52	117.04	119.61	
	2009 average exchange rate (1EUR=)	1.9553	1.9553	1.9553	1.9553	1.9553	
	Total terminal determined costs in real terms (in $€_{2009}$ prices)	10,454,957	10,202,133	10,300,720	10,082,235	10,028,296	-1.0%
	Trend in total terminal determined costs in real terms %n/n-1		-2.4%	1.0%	-2.1%	-0.5%	
	Real terminal DUCs (in $€_{2009}$ prices)	231.88	217.58	211.22	198.79	190.12	-4.8%
	Trend in real terminal DUCs (in $€_{2009}$ prices) %n/n-1		-6.2%	-2.9%	-5.9%	-4.4%	

Description and justification of how the local targets contribute to the performance of the European ATM network	

B - Inflation assumptions

Bulgaria	2015 D	2016 D	2017 D	2018 D	2019 D
Inflation %	0.93%	1.79%	2.20%	2.20%	2.20%
Inflation index (2012=100)	100.9	102.7	105.0	107.3	109.7
Eurostat HICP (actuals) and IMF CPI (forecasts)	2.30%	2.50%	2.50%	2.50%	2.50%
Inflation index (2012=100) HICP and IMF	105.79	108.44	111.15	113.92	116.77
Difference in percentage points		-0.01	0.00	0.00	0.00
Cumulative difference in percentage points		-0.06	-0.06	-0.07	-0.07
Justification and data source in case of deviation from inflation references					

C - Service Units forecast for terminal

Bulgaria	2015 D	2016 D	2017 D	2018 D	2019 D
Total terminal service units (TNSU)	45,087	46,890	48,767	50,718	52,747
Year on Year variation TNSU		4.0%	4.0%	4.0%	4.0%
STATFOR terminal service units forecast (Baseline scenario)	46,000	50,000	53,300	57,200	60,700
Year on Year variation TNSU STATFOR		8.7%	6.6%	7.3%	6.1%
Difference in percentage		-0.05	-0.03	-0.03	-0.02
Cumulative difference in percentage		-0.06	-0.09	-0.11	-0.13
Explanation of the differences (if any), justification, rationale and source					

D - Alert thresholds (terminal service units)

Bulgaria	2015 D	2016 D	2017 D	2018 D	2019 D
Local thresholds	10%	10%	10%	10%	10%
Local thresholds set by the European Commission	10%	10%	10%	10%	10%
Detailed justification in case of deviation					

IMPORTANT NOTE

The data and justifications for the cost-efficiency targets at local level are split into two distinct parts of the performance plan, aiming at optimising workload and avoiding duplication of reporting. They comprise:

1. In the body of the performance plan document, the information to be presented at charging zone level (some of the data requested being pre-filled by the PRB):
   - The targets with a description of the contribution to, and consistency with, the EU-wide target and/or their contribution to the performance of the European ATM network;:
   - The entries and justification requiring data from external sources i.e.
     - The traffic forecast used and, if applicable, their justification against STATFOR
     - The inflation assumptions used and, if applicable, their justification against Eurostat/ IMF.
   - The local alert thresholds, if any, and their justification.
   - A presentation of the consolidation of the targets at FAB level.

2. In Annex C, the information needed at the level of the entities submitted to the performance scheme within the charging zones (ANSPs including MET providers, National authorities...), as follows:
   - The data and justifications in the reporting tables and additional information, as per Annexes II, III, VI and VII of the charging Regulation, at entity level plus a consolidation at charging zone level;
   - The data and justifications relating to cost-efficiency required at entity level for the purpose of the Performance Plans, as per Article 11 (3) and Annexes II and IV of the performance Regulation,.

Annex C forms an integral part of the performance plan and will be used to carry out the assessment of the performance plan.

3.1.(d).3 - Terminal Charging Zone #2

A - Cost efficiency KPI #2: Determined unit cost (DUC) for terminal ANS

in RON

	Romania	2015 D	2016 D	2017 D	2018 D	2019 D	Avg pct var p.a. 2015D-2019D
		RP2 Performance Plan					
Local currency (Nominal and 2012 prices)	Total terminal determined costs in nominal terms (in national currency)	57,546,125	61,182,324	64,955,730	67,415,394	69,106,434	4.7%
	Inflation %	3.09%	3.00%	2.80%	2.80%	2.70%	
	Inflation index (Base = 100 in 2012)	109.36	112.65	115.80	119.04	122.26	2.8%
	Total terminal determined costs in real terms (in national currency at 2012 prices)	52,618,610	54,314,031	56,093,226	56,631,610	56,525,950	1.8%
	Total terminal Service Units (TSU) used for the determined unit cost	50,670	52,793	55,069	57,299	59,938	4.3%
	Real terminal DUCs (in national currency at 2012 prices)	1,038	1,029	1,019	988	943	-2.4%
€2012 prices	2012 average exchange rate (1EUR=)	4.45407	4.45407	4.45407	4.45407	4.45407	
	Total terminal determined costs in real terms (in $€_{2012}$ prices)	11,813,602	12,194,247	12,593,701	12,714,576	12,690,854	1.8%
	Trend in total terminal determined costs in real terms %n/n-1		3.2%	3.3%	1.0%	-0.2%	
	Real terminal DUCs (in $€_{2012}$ prices)	233.15	230.98	228.69	221.90	211.73	-2.4%
	Trend in real terminal DUCs (in $€_{2012}$ prices) %n/n-1		-0.9%	-1.0%	-3.0%	-4.6%	
€2009 prices	Inflation index (Base = 100 in 2009)	126.94	130.75	134.41	138.17	141.90	
	2009 average exchange rate (1EUR=)	4.23303	4.23303	4.23303	4.23303	4.23303	
	Total terminal determined costs in real terms (in $€_{2009}$ prices)	10,709,432	11,054,500	11,416,618	11,526,195	11,504,690	1.8%
	Trend in total terminal determined costs in real terms %n/n-1		3.2%	3.3%	1.0%	-0.2%	
	Real terminal DUCs (in $€_{2009}$ prices)	211.36	209.39	207.32	201.16	191.94	-2.4%
	Trend in real terminal DUCs (in $€_{2009}$ prices) %n/n-1		-0.9%	-1.0%	-3.0%	-4.6%	

Description and justification of how the local targets contribute to the performance of the European ATM network	

B - Inflation assumptions

Romania	2015 D	2016 D	2017 D	2018 D	2019 D
Inflation %	3.09%	3.00%	2.80%	2.80%	2.70%
Inflation index (2012=100)	109.4	112.6	115.8	119.0	122.3
Eurostat HICP (actuals) and IMF CPI (forecasts)	3.09%	3.00%	2.80%	2.80%	2.70%
Inflation index (2012=100) HICP and IMF	109.36	112.65	115.80	119.04	122.26
Difference in percentage points		0.00	0.00	0.00	0.00
Cumulative difference in percentage points		0.00	0.00	0.00	0.00
Justification and data source in case of deviation from inflation references					

C - Service Units forecast for terminal

Romania	2015 D	2016 D	2017 D	2018 D	2019 D
Total terminal service units (TNSU)	50,670	52,793	55,069	57,299	59,938
Year on Year variation TNSU		4.2%	4.3%	4.0%	4.6%
STATFOR terminal service units forecast (Baseline scenario)	50,670	52,793	55,069	57,299	59,938
Year on Year variation TNSU STATFOR		4.2%	4.3%	4.0%	4.6%
Difference in percentage		0.00	0.00	0.00	0.00
Cumulative difference in percentage		0.00	0.00	0.00	0.00
Explanation of the differences (if any), justification, rationale and source					

D - Alert thresholds (terminal service units)

Romania	2015 D	2016 D	2017 D	2018 D	2019 D
Local thresholds	10%	10%	10%	10%	10%
Local thresholds set by the European Commission	10%	10%	10%	10%	10%
Detailed justification in case of deviation					

IMPORTANT NOTE

The data and justifications for the cost-efficiency targets at local level are split into two distinct parts of the performance plan, aiming at optimising workload and avoiding duplication of reporting. They comprise:

1.In the body of the performance plan document, the information to be presented at charging zone level (some of the data requested being pre-filled by the PRB):

- The targets with a description of the contribution to, and consistency with, the EU-wide target and/or their contribution to the performance of the European ATM network;:
- The entries and justification requiring data from external sources i.e.
  - The traffic forecast used and, if applicable, their justification against STATFOR
  - The inflation assumptions used and, if applicable, their justification against Eurostat/ IMF.
- The local alert thresholds, if any, and their justification.
- A presentation of the consolidation of the targets at FAB level.

2.In Annex C, the information needed at the level of the entities submitted to the performance scheme within the charging zones (ANSPs including MET providers, National authorities...), as follows:

- The data and justifications in the reporting tables and additional information, as per Annexes II, III, VI and VII of the charging Regulation, at entity level plus a consolidation at charging zone level;
- The data and justifications relating to cost-efficiency required at entity level for the purpose of the Performance Plans, as per Article 11 (3) and Annexes II and IV of the performance Regulation,.

Annex C forms an integral part of the performance plan and will be used to carry out the assessment of the performance plan.

3.1.(d).4 - Optional Section - Additional Cost-Efficiency KPIs at FAB and local level

Number of additional Cost-Efficiency KPIs	Click to select number of additional KPIs

3.2 - Consistency of the performance targets with the relevant Union-wide performance targets or, when there is no Union-wide target, contribution to the performance of the European ATM network

This section has been integrated within each individual KPI.

3.3 - Description of KPAs interdependencies and trade-offs

Safety

Safety KPA establishes mandatory requirements in ATM operations and represents the key element of ANS. No safety compromises should be made in order to improve other KPAs especially the cost-efficiency. The Performance Scheme Regulation and corresponding targets for RP2 are more oriented on cost-effectiveness while focusing less on the safety key performance area. Thus, for the second reference period and the next to come the biggest challenge for States and FABs will be to keep focusing on safety while trying to achieve the targets in different KPAs.

Capacity

The very good performance of ATFM delays recorded by the DANUBE FAB in the last five years and for RP2 implies extra cost through investments, staff and corresponding procedures. DANUBE FAB RP2 capacity targets followed the PRB expectations and indicative figures while contributing to the very challenging cost-efficiency objectives. We appreciate that having one of the most reduced FAB determined unit cost and ATFM delays represent a very challenging objective and should be carefully assessed.

Environment

Similarly to the capacity targets the flight efficiency requires extras cost through investments, staff and corresponding procedures that are requested for reaching the targets.

3.4 - Contribution of each air navigation service provider

This section has been integrated within each individual KPI.

SECTION 4: INCENTIVE SCHEMES

Mapping between the template for the FAB performance plan and Annex II of the performance Regulation				
Structure of ANNEX II of the performance Regulation	Link with PRB Performance Plan template			
	Body of Performance Plan	Annex C For cost-effiency		Other annexes
		RT ref.	AI ref.	
4. INCENTIVE SCHEMES	4			
4.1. Description and explanation of the incentive schemes to be applied on air navigation service providers.	4.1			

4 - INCENTIVE SCHEMES

4.1 - Incentive schemes for the environment targets

Number of incentive schemes	2

<Incentive Scheme Environment - ROMATSA>	
Entity being incentivised	*ROMATSA*
KPI description	*Horizontal en route flight efficiency (KEA)*
Type of incentive	Non financial
Formula	*N/A*
Justification	COMMISSION IMPLEMENTING REGULATION (EU) No. 390/2013
Description of performance variation levels and the applicable level of bonuses and penalties	*Romanian NSA will perform the neccesary audits to ensure that ROMATSA is committed to deliver the environment targets established for RP2. The audit findings and corrective actions (if applicable) will be communicated to ROMATSA. ROMATSA shall determine neccesary actions to correct nonconformity and the time frame for their implementation. They will be subject to assessment and acceptance by the Romanian NSA.*
Additional comments	

<Incentive Scheme Environment - BULATSA>	
Entity being incentivised	*BULATSA*
KPI description	*Horizontal en route flight efficiency (KEA)*
Type of incentive	Non financial
Formula	N/A
Justification	COMMISSION IMPLEMENTING REGULATION (EU) No. 390/2013
Description of performance variation levels and the applicable level of bonuses and penalties	*If the annual targets are not met, BULATSA shall report to the Bulgarian NSA the following:* *- The possible reason for the horisontal flight inefficiency calculated, based on the infromation received by the Network Manager, responsible for data collection and compilation;* *- The possible influence that the ANSP can have for further reducing the horisontal flight ineficiency; and* *- The extend to which achieving additional flight efficiencies would prejudice greater gains elswhere (interrelations and trade-offs with other KPAs/KPIs).*
Additional comments	

4.1 - Incentive schemes for the capacity targets

Number of incentive schemes	4

Incentive Scheme Capacity - ROMATSA	
Entity being incentivised	*ROMATSA*
KPI description	*En-route ATFM delay*
Type of incentive	Financial
Formula	*Bonuses or penalties shall be 0,1% of revenue from en route air navigation services*
Justification	COMMISSION IMPLEMENTING REGULATION (EU) No. 390/2013
Description of performance variation levels and the applicable level of bonuses and penalties	*The maximum amount of aggregated bonus and the maximum amount of aggregated penalties shall not exceed 0,1% of the revenue from the en-route air navigation services in year "n".In order not to penalise the ANSPs for very small deviations from the targets and only reward a significant improvement of performance, deadbands around the targest are established. Since the capacity targets for Romania are zero, a deadband of 0.05 minutes from the national targets has been established. This deadband is therefore within 10% of the EU-wide target of 0.5 minutes per flight.* *Value of delay and related level of incentive for ROMATSA is described below:* *Delay value min/flight — Level of penality (% of revenue)* *0 - <= 0.05 — Deadband* *> 0.05 - <= 0.1 — 0.02* *> 0.1 - <= 0.15 — 0.03* *> 0.15 - <= 0.2 — 0.04* *> 0.2 - <= 0.25 — 0.05* *> 0.25 - <= 0.3 — 0.06* *> 0.3 - <= 0.35 — 0.07* *> 0.35 - <= 0.4 — 0.08* *> 0.4 - <= 0.45 — 0.09* *> 0.45 - <= 0.5 — 0.1*
Additional comments	

Incentive Scheme Capacity - ROMATSA	
Entity being incentivised	*ROMATSA*
KPI description	*Terminal ATFM delay*
Type of incentive	Financial
Formula	*Bonuses or penalties shall be 0,1% of revenue from terminal air navigation services*
Justification	COMMISSION IMPLEMENTING REGULATION (EU) No. 390/2013
Description of performance variation levels and the applicable level of bonuses and penalties	*The maximum amount of aggregated bonus and the maximum amount of aggregated penalties shall not exceed 0,1% of the revenue from the terminal air navigation services in year "n".In order not to penalise the ANSPs for very small deviations from the targets and only reward a significant improvement of performance, deadbands around the targest are established. Since the capacity targets for Romania are zero a deadband of 0.05 minutes from the national targets has been established. This deadband is therefore within 10% of the EU-wide target of 0.5 minutes per flight.* *Value of delay and related level of incentive for ROMATSA is described below:* *Delay value min/flight — Level of penality (% of revenue)* *0 - <= 0.05 — Deadband* *> 0.05 - <= 0.1 — 0.02* *> 0.1 - <= 0.15 — 0.03* *> 0.15 - <= 0.2 — 0.04* *> 0.2 - <= 0.25 — 0.05* *> 0.25 - <= 0.3 — 0.06* *> 0.3 - <= 0.35 — 0.07* *> 0.35 - <= 0.4 — 0.08* *> 0.4 - <= 0.45 — 0.09* *> 0.45 - <= 0.5 — 0.1*
Additional comments	

Incentive Scheme Capacity - BULATSA	
Entity being incentivised	*BULATSA*
KPI description	*En-route ATFM delay*
Type of incentive	Financial
Formula	*Bonuses or penalties shall be 0,1% of revenue from en route air navigation services*
Justification	COMMISSION IMPLEMENTING REGULATION (EU) No. 390/2013
Description of performance variation levels and the applicable level of bonuses and penalties	*The maximum amount of aggregated bonus and the maximum amount of aggregated penalties shall not exceed 0,1% of the revenue from the en-route air navigation services in year "n".* *Since the capacity target for Bulgaria is 0.12 for the first 3 years and 0.14 for the last two years of the reference period, any achievment below the target to zero value is positively incentivised. A deadband of 0.05 minutes from the national targets has been established. This deadband is therefore within 10% of the EU-wide target of 0.5 minutes per flight. Any value above the target is penalised as in the table below.* *Value of delay and related level of incentive for BULATSA (2015-2017) is described below:* *Delay value min/flight (% of revenue)* *> 0.22 - 0.03* *0.22 - 0.17 - 0.02* *0.17 - 0.14 - 0.01* *0,14 - 0,09 Deadband* *0.09 - 0.05 + 0.01* *0.05 - >0 + 0.02* *= 0.0 + 0.03* *Value of delay and related level of incentive for BULATSA (2018-2019) is described below:* *Delay value min/flight (% of revenue)* *> 0.24 - 0.03* *0.24 - 0.19 - 0.02* *0.19 - 0.16 - 0.01* *0,16 - 0,11 Deadband* *0.11 - 0.07 + 0.01* *0.07 - >0 + 0.02* *= 0.0 + 0.03*
Additional comments	

Incentive Scheme Capacity - BULATSA	
Entity being incentivised	*BULATSA*
KPI description	*Terminal ATFM delay*
Type of incentive	Financial
Formula	*Bonuses or penalties shall be 0,1% of revenue from terminal air navigation services*
Justification	COMMISSION IMPLEMENTING REGULATION (EU) No. 390/2013
Description of performance variation levels and the applicable level of bonuses and penalties	*The maximum amount of aggregated bonus and the maximum amount of aggregated penalties shall not exceed 0,1% of the revenue from the terminal air navigation services in year "n".In order not to penalise the ANSPs for very small deviations from the targets and only reward a significant improvement of performance, deadbands around the target are established. Since the capacity targets for Bulgaria are zero, a deadband of 0.05 minutes from the national targets has been established. This deadband is therefore within 10% of the EU-wide target of 0.5 minutes per flight.* *Value of delay and related level of incentive for BULATSA is described below:* *Delay value min/flight Level of penality (% of revenue)* *0 - <= 0.05 Deadband* *> 0.05 - <= 0.1 0.02* *> 0.1 - <= 0.15 0.03* *> 0.15 - <= 0.2 0.04* *> 0.2 - <= 0.25 0.05* *> 0.25 - <= 0.3 0.06* *> 0.3 - <= 0.35 0.07* *> 0.35 - <= 0.4 0.08* *> 0.4 - <= 0.45 0.09* *> 0.45 - <= 0.5 0.1*
Additional comments	

4.1 - Incentive schemes for the cost-efficiency targets

The parameters used by the Member States in the setting of the risk-sharing mechanism defined in Article 13 and 14 of the charging Regulation will be detailed under lines 3.13 and 3.14 of Reporting Table 2 as per Annex VI of the same Regulation.
Therefore, the information is included in the Reporting Tables attached in Annex C.

SECTION 5: MILITARY DIMENSION OF THE PLAN

Mapping between the template for the FAB performance plan and Annex II of the performance Regulation				
Structure of ANNEX II of the performance Regulation	Link with PRB Performance Plan template			
	Body of Performance Plan	Annex C For cost-effiency		Other annexes
		RT ref.	AI ref.	
5. MILITARY DIMENSION OF THE PLAN	5			
Description of the civil-military dimension of the plan describing the performance of FUA application in order to increase capacity with due regard to military mission effectiveness, and if deemed appropriate, relevant performance indicators and targets consistent with the indicators and targets of the performance plan.				

5 - MILITARY DIMENSION OF THE PLAN

REPUBLIC OF BULGARIA

Performance of the FUA Application

The following important actions were undertook, to ensure FUA concept implementation:

- Establishment of criteria and procedures providing the creation and use of airspace structures with adjustable lateral and vertical limits;
- Replacement when applicable of the segregation of airspace with reservation (TSAs with TRAs) and adopt the modular TSA/TRA activation in accordance with military requirements;
- Definition of the conditions under which the responsibility for separation between civil flights and military activities rests with the ATS units or with the controlling military units and establishment of the relevant procedures.

FUA compliance

The FUA concept has been implemented in Bulgaria. In order to achieve a full compliance with the FUA regulation, the following improvements are either finished or ongoing:

- Full coverage of Strategic airspace management;
- Application of the provisions concerning the Safety assessment, hazard identification and risk assessment/mitigation before any change in FUA structure introduction;
- Establishment of procedures concerning the direct communication between Civil and Military ATS units.

The State has established a safety management process to conduct all safety assessment activities prior to the introduction of any changes to the operations of the FUA.FUA compliance monitoring is part of NSA safety audit. DG CAA assesses the FUA and FUA monitoring process description is being included in the NSA's auditing handbook and the Manual of NSA Operation.

LARA Implementation

- Airspace management tool (LARA) was implemented to support transparency, and facilitate real-time CDM between all involved partners enabling informed, performance-based decision making;

ROMANIA

The application of the FUA concept in Romania is in line with Regulation (EC) No 551/2004 and Regulation (EC) No 2150/2005. The major objective of the FUA concept is the more efficient use of airspace by civil and military users.

The FUA concept increased the flexibility of airspace use and provided ATM with the potential to increase the air traffic system performance.

The FUA concept is also applied to enhance airspace usage based on any temporary airspace structures as a function of achieving increased airspace capacity and environmental performance.

In FIR București the FUA Concept is implemented at strategic, pre-tactical and tactical levels of airspace management as follow:

ASM Level 1 – Strategic

Joint civil-military regulation established the rules for application of all three FUA levels, Strategic, Pre-tactical and Tactical level. According to this regulation the High-Level Civil-Military Policy Body - Council for Airspace Management (CMSA) is responsible for policy establishment and airspace management in FIR București.

ASM Level 2 – Pre-tactical

ASM Level 2 responsibilities are accomplished by a joint civil-military cell AMC Romania, which is operated with qualified personnel both from the Air Force Staff and ROMATSA.

AMC Romania allocates airspace on a 24-Hrs basis according to the requests submitted by airspace users and to its specific procedures. The responsibilities of AMC Romania are established by joint civil-military regulations.

ASM Level 3 – Tactical

Specific civil-military coordination procedures established the rules for application of FUA at Tactical level. The military coordination units are collocated with the civil ATS units (ACC and APP) and are responsible for ASM Level 3.

An airspace reservation for exclusive or specific use by categories of users is of a temporary nature and is applied only for limited periods of time which are based on actual use and which are released as soon as the activity that caused its establishment ceases and according to the civil-military collaboration procedures, the crossing of the restricted airspace is permitted for GAT flights even the area is in use for military activities.

An airspace structure reorganized to increase the accessibility of many airspace users is accepted as essential to increasing the capacity of the ATS system and reducing GAT delays. Therefore, Area Control Centre (ACC) sector capacity figures were improved in response to the different route and airspace organization resulting from the daily AMC allocation.

Romania is in process to implement the EUROCONTROL‟s LARA software, as an automated ASM support tool for the application of the flexible use of airspace, which will be operational at the end 2015.

Romania planned to use PRISMIL starting 2014 as support of civil-military dimension of the performance plan including military mission effectiveness performance requirements. This decision was supported by the PRISMIL main functionalities:

- To facilitate performance measurements, monitoring, analysis, reporting and review;
- To support performance assessment at national and FAB level;
- To assist in the implementation of the civil-military dimension of the performance plan.

IMPORTANT NOTE FOR SECTION 3.1.(d) – Cost-efficiency:

The data and justifications for the cost-efficiency targets at local level are split into two distinct parts of the performance plan, aiming at optimising workload and avoiding duplication of reporting. They comprise:

1. In the body of the performance plan document, the information to be presented at charging zone level (some of the data requested being pre-filled by the PRB):
   - The targets with a description of the contribution to, and consistency with, the EU-wide target and/or their contribution to the performance of the European ATM network;:
   - The entries and justification requiring data from external sources i.e.
     - The traffic forecast used and, if applicable, their justification against STATFOR
     - The inflation assumptions used and, if applicable, their justification against Eurostat/ IMF.
   - The local alert thresholds, if any, and their justification.
   - A presentation of the consolidation of the targets at FAB level.

2. In Annex C, the information needed at the level of the entities submitted to the performance scheme within the charging zones (ANSPs including MET providers, National authorities…), as follows:
   - The data and justifications in the reporting tables and additional information, as per Annexes II, III, VI and VII of the charging Regulation, at entity level plus a consolidation at charging zone level;
   - The data and justifications relating to cost-efficiency required at entity level for the purpose of the Performance Plans, as per Article 11 (3) and Annexes II and IV of the performance Regulation,.

Annex C forms an integral part of the performance plan and will be used to carry out the assessment of the performance plan.

3.1.(d) - Cost Efficiency

List of En Route Charging Zones

Number of en route charging zones	2

1	***Bulgaria***
2	***Romania***

List of Terminal Charging Zones

Number of terminal charging zones	2

1	***Bulgaria***
2	***Romania***

3.1.(d).1 - En Route Charging Zone #1

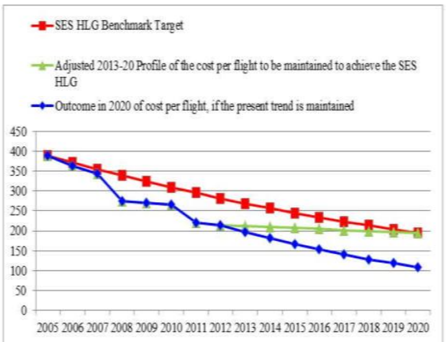
A - Cost efficiency KPI #1: Determined unit cost (DUC) for en route ANS

in BGN

		Historical data (actual 2009-2013, latest 2014 forecast)						RP2 Performance Plan					RP1 PP	Average pct variation p.a.			
	Bulgaria	2009 A	2010 A	2011 A	2012 A	2013 F	2014 F	2015 D	2016 D	2017 D	2018 D	2019 D	2014 D	2009A-2019D	2014F-2019D	2011A-2019D	2014D-2019D
Local currency (Nominal and 2012 prices)	Total en route actual/forecast/determined costs in nominal terms (in national currency)	152,872,468	145,025,362	146,918,540	145,071,417	167,981,280	169,542,886	168,044,476	167,970,227	168,575,592	169,183,138	169,792,875	169,542,886	1.1%	0.0%	1.8%	0.0%
	Inflation %		3.00%	3.40%	2.40%	0.40%	-0.39%	0.93%	1.79%	2.20%	2.20%	2.20%					
	Inflation index (Base = 100 in 2012)	91.69	94.45	97.66	100.00	100.40	100.01	100.94	102.75	105.01	107.32	109.68	100.01	1.8%	1.9%	1.5%	1.9%
	Total en route actual/forecast/determined costs in real terms (in national currency at 2012 prices)	166,719,730	153,555,174	150,444,585	145,071,417	167,312,032	169,530,280	166,478,735	163,482,117	160,539,439	157,649,729	154,812,034	169,530,280	-0.7%	-1.8%	0.4%	-1.8%
	Total en route Service Units (TSU)	1,798,292	1,820,961	2,018,783	2,020,149	2,057,979	2,117,995	2,168,421	2,240,000	2,315,789	2,400,000	2,484,211	2,117,995	3.3%	3.2%	2.6%	3.2%
	Real en route UCs/DUCs (in national currency at 2012 prices)	92.71	84.33	74.52	71.81	81.30	80.04	**76.77**	**72.98**	**69.32**	**65.69**	**62.32**	80.04	-3.9%	-4.9%	-2.2%	-4.9%
€2012 prices	2012 average exchange rate (1EUR=)	1.95536	1.95536	1.95536	1.95536	1.95536	1.95536	1.95536	1.95536	1.95536	1.95536	1.95536	1.95536				
	Total **en route** costs in real terms (in $€_{2012}$ prices)	85,262,933	78,530,385	76,939,584	74,191,666	85,565,846	86,700,290	85,139,685	83,607,171	82,102,242	80,624,401	79,173,162	86,700,290	-0.7%	-1.8%	0.4%	-1.8%
	Trend in total **en route** costs in real terms %n/n-1		-7.9%	-2.0%	-3.6%	15.3%	1.3%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%					
	Real **en route** UCs/DUCs (in $€_{2012}$ prices)	47.41	43.13	38.11	36.73	41.58	40.94	39.26	37.32	35.45	33.59	31.87	40.94	-3.9%	-4.9%	-2.2%	-4.9%
	Trend in real **en route** UCs/DUCs (in $€_{2012}$ prices) %n/n-1		-9.0%	-11.6%	-3.6%	13.2%	-1.5%	-4.1%	-4.9%	-5.0%	-5.2%	-5.1%					
€2009 prices	Inflation index (Base = 100 in 2009)	100.00	103.00	106.50	109.06	109.49	109.07	110.08	112.05	114.52	117.04	119.61	109.07				
	2009 average exchange rate (1EUR=)	1.9553	1.9553	1.9553	1.9553	1.9553	1.9553	1.9553	1.9553	1.9553	1.9553	1.9553	1.9553				
	Total **en route** costs in real terms (in $€_{2009}$ prices)	78,183,638	72,010,087	70,551,368	68,031,607	78,461,400	79,501,653	78,070,623	76,665,352	75,285,376	73,930,239	72,599,495	79,501,653	-0.7%	-1.8%	0.4%	-1.8%
	Trend in total **en route** costs in real terms %n/n-1		-7.9%	-2.0%	-3.6%	15.3%	1.3%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%					
	Real **en route** UCs/DUCs (in $€_{2009}$ prices)	43.48	39.55	34.95	33.68	38.13	37.54	36.00	34.23	32.51	30.80	29.22	37.54	-3.9%	-4.9%	-2.2%	-4.9%
	Trend in real **en route** UCs/DUCs (in $€_{2009}$ prices) %n/n-1		-9.0%	-11.6%	-3.6%	13.2%	-1.5%	-4.1%	-4.9%	-5.0%	-5.2%	-5.1%					

Description of the consistency between local and Union-wide targets	BULATSA cost efficiency versus the SES High-level Goals. "To support the expected growth in a safe and sustainable manner, a seamless and modern air transport system is required for Europe. This is the objective of the Single European Sky (SES) initiative which carries high-level goals to achieve by 2020 relative to 2005 [From European ATM Master Plan Edition 1 2009]: • A three-fold increase in capacity where needed; • Improve safety performance by a factor of 10; • A 10% reduction in the effects flights have on the environment; and • Reduce the cost of ATM services to airspace users by at least 50%." Further to that, please refer to the annex for the calculations; below there is analysis of overall performance of BULATSA in respect of the SES HLG. BULATSA performance has been measured versus three main metrics (in nominal and in real terms) starting from 2005. The outcome related to the gate-to-gate costs (G2GC), including EUROCONTROL costs, for the period 2005-2012 in real terms is as follows: - G2GC per flight - -44.88% - G2GC per CFHC – 44.91% - G2GC per km - -46.29% These three metrics show that regardless of the metric used, the results for each one of them are very close, thus each one could be used as a proxy to measure the progress towards the SES HLG. If we assume that the benchmark for the SES HLG should be – 50% of the costs per flight in 2020, starting from 2005, in the case for Bulgaria this would mean a (-4.52%) compound annual average reduction for the whole period. Subsequently, the SES HLG for cost per flight should be 282 BGN and cumulative benchmark reduction should be of (-27.64%). The actual data is BGN 215 per flight and G2GC have been reduced by (-44.88%).

Year	ANS cost (BGN) nominal terms per			ANS cost (BGN) real terms (in 2005 prices), per				
	flight	CFHC	km	flight	flight SES HLG	flight, adjusted 2013-20	CFHC	km
2005	390	1 044	1.57	390	390	390	1 044	1.57
2006	397	1 023	1.60	363	372	363	972	1.46
2007	354	904	1.43	343	355	343	885	1.38
2008	358	927	1.44	274	339	274	698	1.10
2009	362	947	1.39	270	324	270	699	1.08
2010	312	833	1.20	265	309	265	693	1.02
2011	311	832	1.22	221	295	221	590	0.85
2012	305	836	1.21	215	282	215	575	0.84
2013				*197*	269	212		
2014				*181*	257	210		
2015				*166*	245	207		
2016				*153*	234	205		
2017				*140*	224	202		
2018				*129*	214	200		
2019				*118*	204	197		
2020				*109*	195	195		
	Results 2005-2012			-44.88%	-27.64%		-44.91%	-46.29%
	Results 2005-2020			-72.10%	-50.00%			



B - Inflation assumptions

Bulgaria	2009 A	2010 A	2011 A	2012 A	2013 A	2014 F	2015 D	2016 D	2017 D	2018 D	2019 D
Inflation %				2.40%	0.40%	-0.39%	0.93%	1.79%	2.20%	2.20%	2.20%
Inflation index (2012=100)				100.00	100.40	100.01	100.94	102.75	105.01	107.32	109.68
Eurostat HICP (actuals) and IMF CPI (forecasts)				2.40%	0.40%	3.00%	2.30%	2.50%	2.50%	2.50%	2.50%
Inflation index (2012=100) HICP and IMF				100.00	100.40	103.41	105.79	108.44	111.15	113.92	116.77
Difference in percentage points					0.00	-0.03	-0.01	-0.01	0.00	0.00	0.00
Cumulative difference in percentage points					0.00	-0.03	-0.05	-0.06	-0.06	-0.07	-0.07
Justification and data source in case of deviation from inflation references											

C - Service Units forecast for en route

	Bulgaria	2009 A	2010 A	2011 A	2012 A	2013 A	2014 F	2015 D	2016 D	2017 D	2018 D	2019 D
	Total **en route** service units (TSU)				2,020,149	2,057,979	2,117,995	2,168,421	2,240,000	2,315,789	2,400,000	2,484,211
	Year on Year variation TSU					1.9%	2.9%	2.4%	3.3%	3.4%	3.6%	3.5%
Baseline	STATFOR **en route** service units forecast (Baseline scenario)				2,020,149	2,057,979	2,154,000	2,260,000	2,350,000	2,446,000	2,502,000	2,626,000
Baseline	Year on Year variation TSU STATFOR					1.9%	4.7%	4.9%	4.0%	4.1%	2.3%	5.0%
Baseline	Difference in percentage points					0.00	-0.02	-0.03	-0.01	-0.01	0.01	-0.01
Baseline	Cumulative difference in percentage points					0.00	-0.02	-0.04	-0.05	-0.05	-0.04	-0.05
Low	STATFOR **en route** service units forecast (Low scenario)				2,020,149	2,057,979	2,108,000	2,176,000	2,230,000	2,286,000	2,334,000	2,408,000
Low	Year on Year variation TSU STATFOR					1.9%	2.4%	3.2%	2.5%	2.5%	2.1%	3.2%
Low	Difference in percentage points					0.00	0.00	-0.01	0.01	0.01	0.02	0.00
Low	Cumulative difference in percentage points					0.00	0.00	0.00	0.00	0.01	0.03	0.03
	Explanation of the differences (if any), justification, rationale and source											

D - Alert thresholds (en route service units)

Bulgaria	2009 A	2010 A	2011 A	2012 A	2013 A	2014 F	2015 D	2016 D	2017 D	2018 D	2019 D
Local thresholds							10%	10%	10%	10%	10%
Local thresholds set by the European Commission							10%	10%	10%	10%	10%
Detailed justification in case of deviation											

IMPORTANT NOTE

The data and justifications for the cost-efficiency targets at local level are split into two distinct parts of the performance plan, aiming at optimising workload and avoiding duplication of reporting. They comprise:

1. In the body of the performance plan document, the information to be presented at charging zone level (some of the data requested being pre-filled by the PRB):
   - The targets with a description of the contribution to, and consistency with, the EU-wide target and/or their contribution to the performance of the European ATM network;:
   - The entries and justification requiring data from external sources i.e.
     - The traffic forecast used and, if applicable, their justification against STATFOR
     - The inflation assumptions used and, if applicable, their justification against Eurostat/ IMF.
   - The local alert thresholds, if any, and their justification.
   - A presentation of the consolidation of the targets at FAB level.

2. In Annex C, the information needed at the level of the entities submitted to the performance scheme within the charging zones (ANSPs including MET providers, National authorities...), as follows:
   - The data and justifications in the reporting tables and additional information, as per Annexes II, III, VI and VII of the charging Regulation, at entity level plus a consolidation at charging zone level;
   - The data and justifications relating to cost-efficiency required at entity level for the purpose of the Performance Plans, as per Article 11 (3) and Annexes II and IV of the performance Regulation,.

Annex C forms an integral part of the performance plan and will be used to carry out the assessment of the performance plan.

3.1.(d).1 - En Route Charging Zone #2

A - Cost efficiency KPI #1: Determined unit cost (DUC) for en route ANS

in RON

	Romania	Historical data (actual 2009-2013, latest 2014 forecast) 2009 A	2010 A	2011 A	2012 A	2013 A	2014 F	RP2 Performance Plan 2015 D	2016 D	2017 D	2018 D	2019 D	RP1 PP 2014 D	Average pct variation p.a. 2009A-2019D	2014F-2019D	2011A-2019D	2014D-2019D
Local currency (Nominal and 2012 prices)	Total en route actual/forecast/determined costs in nominal terms (in national currency)	563,745,065	597,831,159	571,676,524	710,305,485	666,182,726	706,950,101	694,190,697	707,559,622	721,043,784	736,953,023	754,678,070	706,950,101	3.0%	1.3%	3.5%	1.3%
	Inflation %		6.10%	5.80%	3.40%	3.20%	2.80%	3.09%	3.00%	2.80%	2.80%	2.70%					
	Inflation index (Base = 100 in 2012)	86.15	91.41	96.71	100.00	103.20	106.09	109.36	112.65	115.80	119.04	122.26	106.09	3.6%	2.9%	3.0%	2.9%
	Total en route actual/forecast/determined costs in real terms (in national currency at 2012 prices)	654,341,316	654,010,549	591,113,526	710,305,485	645,525,897	666,370,785	634,749,075	628,129,374	622,665,187	619,069,827	617,292,669	666,370,785	-0.6%	-1.5%	0.5%	-1.5%
	Total en route Service Units (TSU)	3,133,000	3,414,282	3,532,683	3,575,195	3,751,523	3,857,849	4,012,887	4,117,019	4,219,063	4,317,155	4,441,542	4,008,000	3.6%	2.9%	2.9%	2.1%
	Real en route UCs/DUCs (in national currency at 2012 prices)	208.85	191.55	167.33	198.68	172.07	172.73	**158.18**	**152.57**	**147.58**	**143.40**	**138.98**	166.26	-4.0%	-4.3%	-2.3%	-3.5%
€2012 prices	2012 average exchange rate (1EUR=)	4.45407	4.45407	4.45407	4.45407	4.45407	4.45407	4.45407	4.45407	4.45407	4.45407	4.45407	4.45407				
	Total **en route** costs in real terms (in €2012 prices)	146,908,629	146,834,367	132,713,120	159,473,355	144,929,446	149,609,410	142,509,901	141,023,687	139,796,902	138,989,694	138,590,698	149,609,410	-0.6%	-1.5%	0.5%	-1.5%
	Trend in total **en route** costs in real terms %n/n-1		-0.1%	-9.6%	20.2%	-9.1%	3.2%	-4.7%	-1.0%	-0.9%	-0.6%	-0.3%					
	Real **en route** UCs/DUCs (in €2012 prices)	46.89	43.01	37.57	44.61	38.63	38.78	35.51	34.25	33.13	32.19	31.20	37.33	-4.0%	-4.3%	-2.3%	-3.5%
	Trend in real **en route** UCs/DUCs (in €2012 prices) %n/n-1		-8.3%	-12.6%	18.7%	-13.4%	0.4%	-8.4%	-3.5%	-3.3%	-2.8%	-3.1%					
€2009 prices	Inflation index (Base = 100 in 2009)	100.00	106.10	112.25	116.07	119.78	123.14	126.94	130.75	134.41	138.17	141.90	123.14				
	2009 average exchange rate (1EUR=)	4.23303	4.23303	4.23303	4.23303	4.23303	4.23303	4.23303	4.23303	4.23303	4.23303	4.23303	4.23303				
	Total **en route** costs in real terms (in €2009 prices)	133,177,668	133,110,347	120,308,957	144,568,020	131,383,472	135,626,018	129,190,072	127,842,768	126,730,646	125,998,885	125,637,181	135,626,018	-0.6%	-1.5%	0.5%	-1.5%
	Trend in total **en route** costs in real terms %n/n-1		-0.1%	-9.6%	20.2%	-9.1%	3.2%	-4.7%	-1.0%	-0.9%	-0.6%	-0.3%					
	Real **en route** UCs/DUCs (in €2009 prices)	42.51	38.99	34.06	40.44	35.02	35.16	32.19	31.05	30.04	29.19	28.29	33.84	-4.0%	-4.3%	-2.3%	-3.5%
	Trend in real **en route** UCs/DUCs (in €2009 prices) %n/n-1		-8.3%	-12.6%	18.7%	-13.4%	0.4%	-8.4%	-3.5%	-3.3%	-2.8%	-3.1%					

Description of the consistency between local and Union-wide targets	In RP1 the cost-efficiency targets inlcuded in Romania National Performance Plan were established based on the STATFOR baseline scenario traffic forecast (5% p.a. traffic service units increase) in accordance to the PRU guidelines for Performance Plans. Nevertheless, we expressed our reserves about the very optimistic forecast which nowadays materialized in a decrease of -1% in 2012 and - 1,3% in 2013. Closure of Simferopol FIR, likely to last indefinitely, shorten the routes over Romanian arispace for the largest traffic flows (to Middle East) decreasing the number of service units. These haven't been taken into cosideration in the STATFOR forecast and it forcing Romania to use a more conservative approach. For RP2 we decided to apply a more realistic traffic forecast that is in line with EUROCONTROL 7-year flight and service units forecast, February 2014 release, low scenario (2,9% p.a. traffic increase). The difference in TSUs generated loses in the first two years of RP1 and are expected to increase in 2014 based on the traffic risk sharing mechanism. Moreover, the traffic forecast are following the reference values taken into consideration for the cost-efficiency target as stipulated in the Commission implementing Decision of 11 March 2014 setting the Union-wide performance targets for the ai traffic management network and alert thresholds for the second reference period 2015-2019. For RP2 the en-route DCs expressed in real terms are projected to decrease by an average of -1,5% p.a. (2014 vs 2019) and -0,6% p.a. (2009 vs 2019). Regarding the en-route DUCs expressed in real terms is projected to decrease by an average of -3,5% p.a. (2014 vs 2019) and 4% p.a. (2009 vs 2019) exceeding the EU-wide target of -3,3% p.a.

B - Inflation assumptions

Romania	2009 A	2010 A	2011 A	2012 A	2013 A	2014 F	2015 D	2016 D	2017 D	2018 D	2019 D
Inflation %				3.40%	3.20%	2.80%	3.09%	3.00%	2.80%	2.80%	2.70%
Inflation index (2012=100)				100.00	103.20	106.09	109.36	112.65	115.80	119.04	122.26
Eurostat HICP (actuals) and IMF CPI (forecasts)				0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Inflation index (2012=100) HICP and IMF				100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Difference in percentage points					0.03	0.03	0.03	0.03	0.03	0.03	0.03
Cumulative difference in percentage points					0.03	0.06	0.09	0.13	0.16	0.19	0.22
Justification and data source in case of deviation from inflation references											

C - Service Units forecast for en route

	Romania	2009 A	2010 A	2011 A	2012 A	2013 A	2014 F	2015 D	2016 D	2017 D	2018 D	2019 D
	Total **en route** service units (TSU)				3,575,195	3,751,523	3,857,849	4,012,887	4,117,019	4,219,063	4,317,155	4,441,542
	Year on Year variation TSU					4.9%	2.8%	4.0%	2.6%	2.5%	2.3%	2.9%
Baseline	STATFOR **en route** service units forecast (Baseline scenario)				3,575,195	3,751,523	3,921,607	4,109,330	4,288,742	4,464,312	4,603,385	4,818,513
	Year on Year variation TSU STATFOR					4.9%	4.5%	4.8%	4.4%	4.1%	3.1%	4.7%
	Difference in percentage points					0.00	-0.02	-0.01	-0.02	-0.02	-0.01	-0.02
	Cumulative difference in percentage points					0.00	-0.02	-0.02	-0.04	-0.05	-0.06	-0.08
Low	STATFOR **en route** service units forecast (Low scenario)				3,575,195	3,751,523	3,857,849	4,012,887	4,117,019	4,219,063	4,317,155	4,441,542
	Year on Year variation TSU STATFOR					4.9%	2.8%	4.0%	2.6%	2.5%	2.3%	2.9%
	Difference in percentage points					0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cumulative difference in percentage points					0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Explanation of the differences (if any), justification, rationale and source											

D - Alert thresholds (en route service units)

Romania	2009 A	2010 A	2011 A	2012 A	2013 A	2014 F	2015 D	2016 D	2017 D	2018 D	2019 D
Local thresholds							10%	10%	10%	10%	10%
Local thresholds set by the European Commission							10%	10%	10%	10%	10%
Detailed justification in case of deviation											

2017 Target	2018 Target	2019 Target
>= 80%	-	100%
>= 80%	-	100%
>= 80%	-	100%

2017 Target	2018 Target	2019 Target
>= 80%	>= 80%	>= 80%
>= 80%	>= 80%	>= 80%
>= 80%	-	100%

Flight Efficiency (KEA)

	2015 Value	2016 Value
Union-wide targets	-	-
Baltic FAB	1.50%	1.47%
BLUE MED FAB	2.78%	2.70%
DANUBE FAB	1.55%	1.50%
DK-SE FAB	1.20%	1.20%
FAB CE	1.99%	1.94%
FABEC	3.30%	3.22%
NEFAB	1.35%	1.32%
SW FAB	3.85%	3.71%
UK-Ireland FAB	3.36%	3.27%

2017 Value	2018 Value	2019 Target
-	-	2.60%
1.44%	1.40%	1.36%
2.62%	2.54%	2.45%
1.46%	1.41%	1.37%
1.20%	1.20%	1.19%
1.90%	1.85%	1.81%
3.14%	3.05%	2.96%
1.29%	1.26%	1.22%
3.57%	3.43%	3.28%
3.18%	3.09%	2.99%

En-route delay per flight

	2015 Value	2016 Value	2017 Value
Union-wide targets	0.50	0.50	0.50
Baltic FAB	0.21	0.21	0.21
BLUE MED FAB	0.17	0.18	0.18
DANUBE FAB	0.08	0.08	0.08
DK-SE FAB	0.10	0.10	0.10
FAB CE	0.30	0.29	0.29
FABEC	0.43	0.42	0.42
NEFAB	0.12	0.12	0.13
SW FAB	0.30	0.31	0.31
UK-Ireland FAB	0.25	0.26	0.26

2018 Value	2019 Target
0.50	0.50
0.22	0.22
0.18	0.18
0.09	0.09
0.09	0.09
0.29	0.29
0.42	0.43
0.13	0.13
0.30	0.30
0.26	0.26

Union-wide alert thresholds

	2015	2016	2017	2018	2019
Threshold	10%	10%	10%	10%	10%

2012 -2009 Exchange rate and currency

State	2012 Currency	2012 Exchange Rate	2009 Exchange Rate
Austria	EUR	1	1
Belgium	EUR	1	1
Belgium-Luxembourg	EUR	1	1
Bulgaria	BGN	1.95536	1.9553
Croatia	HRK	7.51523	7.33804
Cyprus	EUR	1	1
Czech Republic	CZK	25.1016	26.4147
Denmark	DKK	7.44164	7.44337
Estonia	EUR	1	1
Finland	EUR	1	1
France	EUR	1	1
Germany	EUR	1	1
Greece	EUR	1	1
Hungary	HUF	288.876	279.699
Ireland	EUR	1	1
Italy	EUR	1	1
Latvia	EUR	1	1
Lithuania	LTL	3.45102	3.45061
Luxembourg	EUR	1	1
Malta	EUR	1	1
Netherlands	EUR	1	1
Norway	NOK	7.47413	8.72807
Poland	PLN	4.1792	4.32383
Portugal	EUR	1	1
Romania	RON	4.45407	4.23303
Slovakia	EUR	1	1
Slovenia	EUR	1	1
Spain	EUR	1	1
Sweden	SEK	8.6998	10.6102
Switzerland	CHF	1.20483	1.50898
United Kingdom	GBP	0.811235	0.890647

Actual inflation 2012 (index 100 in 2009)

State	Index 100 in 2009 Inflation 2012
Austria	108.313
Belgium	108.538
Belgium-Luxembourg	108.538
Bulgaria	109.058
Croatia	106.942
Cyprus	109.376
Czech Republic	107.259
Denmark	107.478
Estonia	112.800
Finland	108.418
France	106.380
Germany	105.908
Greece	109.025
Hungary	115.204
Ireland	101.473
Italy	108.038
Latvia	105.424
Lithuania	108.720
Luxembourg	109.695
Malta	107.896
Netherlands	106.424
Norway	103.332
Poland	110.653
Portugal	107.992
Romania	116.070
Slovakia	108.707
Slovenia	106.848
Spain	107.731
Sweden	103.540
Switzerland	99.804
United Kingdom	111.013

Inflation rate

State		2012 A
Austria	Eurostat HICP (actuals) and IMF CPI (forecasts)	2.60%
Belgium	Eurostat HICP (actuals) and IMF CPI (forecasts)	2.61%
Belgium-Luxembourg	Eurostat HICP (actuals) and IMF CPI (forecasts)	2.61%
Bulgaria	Eurostat HICP (actuals) and IMF CPI (forecasts)	2.40%
Croatia	Eurostat HICP (actuals) and IMF CPI (forecasts)	3.40%
Cyprus	Eurostat HICP (actuals) and IMF CPI (forecasts)	3.10%
Czech Republic	Eurostat HICP (actuals) and IMF CPI (forecasts)	3.50%
Denmark	Eurostat HICP (actuals) and IMF CPI (forecasts)	2.40%
Estonia	Eurostat HICP (actuals) and IMF CPI (forecasts)	4.20%
Finland	Eurostat HICP (actuals) and IMF CPI (forecasts)	3.20%
France	Eurostat HICP (actuals) and IMF CPI (forecasts)	2.22%
Germany	Eurostat HICP (actuals) and IMF CPI (forecasts)	2.10%
Greece	Eurostat HICP (actuals) and IMF CPI (forecasts)	1.00%
Hungary	Eurostat HICP (actuals) and IMF CPI (forecasts)	5.70%
Ireland	Eurostat HICP (actuals) and IMF CPI (forecasts)	1.90%
Italy	Eurostat HICP (actuals) and IMF CPI (forecasts)	3.30%
Latvia	Eurostat HICP (actuals) and IMF CPI (forecasts)	2.30%
Lithuania	Eurostat HICP (actuals) and IMF CPI (forecasts)	3.20%
Luxembourg	Eurostat HICP (actuals) and IMF CPI (forecasts)	2.90%
Malta	Eurostat HICP (actuals) and IMF CPI (forecasts)	3.20%
Netherlands	Eurostat HICP (actuals) and IMF CPI (forecasts)	2.80%
Norway	Eurostat HICP (actuals) and IMF CPI (forecasts)	0.40%
Poland	Eurostat HICP (actuals) and IMF CPI (forecasts)	3.70%
Portugal	Eurostat HICP (actuals) and IMF CPI (forecasts)	2.80%
Romania	Eurostat HICP (actuals) and IMF CPI (forecasts)	3.40%
Slovakia	Eurostat HICP (actuals) and IMF CPI (forecasts)	3.70%
Slovenia	Eurostat HICP (actuals) and IMF CPI (forecasts)	2.80%
Spain	Eurostat HICP (actuals) and IMF CPI (forecasts)	2.40%
Sweden	Eurostat HICP (actuals) and IMF CPI (forecasts)	0.90%
Switzerland	Eurostat HICP (actuals) and IMF CPI (forecasts)	-0.70%
United Kingdom	Eurostat HICP (actuals) and IMF CPI (forecasts)	2.80%

2013 A	2014	2015	2016	2017	2018	2019
2.10%	1.80%	1.70%	1.70%	1.70%	1.70%	1.70%
1.20%	1.03%	1.12%	1.19%	1.32%	1.37%	1.38%
1.20%	1.03%	1.12%	1.19%	1.32%	1.37%	1.38%
0.40%	-0.39%	0.93%	1.79%	2.20%	2.20%	2.20%
2.30%	0.50%	1.10%	1.90%	2.10%	2.30%	2.50%
0.40%	0.45%	1.40%	1.70%	1.70%	1.80%	1.90%
1.40%	1.00%	1.90%	2.00%	2.00%	2.00%	2.00%
0.50%	1.50%	1.80%	2.20%	2.20%	2.20%	2.20%
3.20%	3.20%	2.80%	2.50%	2.40%	2.30%	2.20%
2.20%	1.71%	1.54%	1.70%	1.90%	2.00%	2.00%
1.00%	1.00%	1.23%	1.30%	1.43%	1.53%	1.62%
1.60%	1.36%	1.36%	1.60%	1.70%	1.70%	1.70%
-0.90%	-0.44%	0.35%	1.06%	1.24%	1.25%	1.58%
1.70%	0.90%	3.00%	3.00%	3.00%	3.00%	3.00%
0.50%	0.59%	1.12%	1.23%	1.45%	1.68%	1.68%
1.30%	0.65%	1.03%	1.10%	1.30%	1.50%	1.60%
0.00%	1.50%	2.48%	2.33%	2.30%	2.30%	2.30%
1.20%	0.97%	1.76%	1.97%	2.20%	2.23%	2.23%
1.70%	1.62%	1.84%	1.77%	1.84%	1.92%	1.92%
1.00%	1.21%	2.57%	1.98%	1.80%	1.80%	1.80%
2.60%	0.80%	1.00%	1.24%	1.44%	1.49%	1.51%
2.00%	2.00%	2.00%	2.20%	2.30%	2.50%	2.50%
0.80%	1.46%	2.38%	2.50%	2.50%	2.50%	2.50%
0.40%	0.67%	1.20%	1.47%	1.51%	1.48%	1.50%
3.20%	2.80%	3.09%	3.00%	2.80%	2.80%	2.70%
1.50%	0.74%	1.60%	1.81%	2.01%	2.09%	2.16%
1.90%	1.15%	1.63%	2.13%	1.90%	2.00%	2.00%
1.50%	0.27%	0.84%	0.90%	1.04%	1.02%	1.05%
0.40%	0.38%	1.63%	2.40%	2.10%	2.00%	2.00%
0.10%	0.20%	0.50%	1.00%	1.00%	1.00%	1.00%
2.60%	1.90%	1.90%	1.90%	2.00%	2.00%	2.00%

En-route SUs (actual and Feb STATFOR Forecast)

STATFOR **en route** service units forecast (Feb 2014) (**Baseline scenario**)		2012
Charging zone Name	**State**	**A**
Austria	Austria	2,469,156
Belgium-Luxembourg	Belgium-Luxembourg	2,231,537
Bulgaria	Bulgaria	2,020,149
Croatia	Croatia	1,678,634
Cyprus	Cyprus	1,303,262
Czech Republic	Czech Republic	2,304,641
Denmark	Denmark	1,428,735
Estonia	Estonia	724,536
Finland	Finland	790,296
France	France	17,515,047
Germany	Germany	12,442,470
Greece	Greece	4,357,569
Hungary	Hungary	2,023,649
Ireland	Ireland	3,805,985
Italy	Italy	8,139,130
Latvia	Latvia	707,109
Lithuania	Lithuania	429,631
Malta	Malta	641,289
Netherlands	Netherlands	2,587,398
Norway	Norway	1,845,568
Poland	Poland	3,854,458
Portugal Continental	Portugal	2,782,280
Romania	Romania	3,575,195
Slovakia	Slovakia	921,643
Slovenia	Slovenia	425,205
Spain Canarias	Spain	1,599,207
Spain Continental	Spain	8,443,969
Sweden	Sweden	3,126,197
Switzerland	Switzerland	1,398,574
United Kingdom	United Kingdom	9,607,878

2013 A	2014	2015	2016	2017	2018	2019
2,456,012	2,485,902	2,576,922	2,657,841	2,728,050	2,798,177	2,881,891
2,277,014	2,351,796	2,423,741	2,495,361	2,557,634	2,627,436	2,701,807
2,057,979	2,154,312	2,259,765	2,350,355	2,446,231	2,501,636	2,626,377
1,694,578	1,682,040	1,715,227	1,770,276	1,823,613	1,872,179	1,937,314
1,326,579	1,403,630	1,527,660	1,604,014	1,686,708	1,753,300	1,851,735
2,374,021	2,440,939	2,520,579	2,606,803	2,684,833	2,756,010	2,841,571
1,523,724	1,580,892	1,624,877	1,675,085	1,717,132	1,761,646	1,807,235
740,986	746,339	774,641	801,575	827,117	855,350	885,643
770,452	780,141	796,129	812,467	826,932	843,079	860,929
17,899,945	18,438,168	18,915,225	19,390,057	19,758,910	20,181,185	20,637,333
12,506,062	12,617,867	12,896,166	13,232,680	13,512,409	13,794,870	14,114,049
4,215,705	4,261,808	4,403,818	4,574,943	4,740,207	4,886,708	5,085,956
2,100,927	2,202,955	2,315,709	2,412,101	2,503,638	2,584,126	2,691,016
3,812,940	3,885,941	4,019,231	4,107,186	4,191,019	4,283,117	4,379,144
8,117,393	8,357,654	8,610,504	8,864,636	9,090,419	9,316,436	9,582,960
733,633	796,139	814,187	838,334	860,009	882,724	908,260
450,551	473,231	497,085	515,159	531,569	548,575	566,874
735,327	800,030	857,922	904,261	951,621	992,544	1,050,291
2,701,735	2,770,309	2,847,354	2,918,271	2,977,191	3,041,184	3,109,416
2,050,929	2,176,834	2,242,613	2,305,844	2,358,496	2,411,029	2,469,915
3,983,698	4,172,564	4,362,840	4,543,520	4,698,511	4,861,176	5,039,315
2,876,753	3,104,230	3,248,219	3,324,178	3,388,496	3,463,978	3,539,802
3,751,523	3,921,607	4,109,330	4,288,742	4,464,312	4,603,385	4,818,513
984,989	1,050,816	1,114,110	1,168,019	1,219,358	1,268,326	1,328,910
411,103	428,901	450,416	465,930	479,263	492,058	508,161
1,515,812	1,644,584	1,720,754	1,748,296	1,773,260	1,804,963	1,837,492
8,447,044	8,757,179	9,040,381	9,292,851	9,512,622	9,764,652	10,022,540
3,208,684	3,260,246	3,357,183	3,472,282	3,565,224	3,660,943	3,762,979
1,384,957	1,431,956	1,467,624	1,505,540	1,536,867	1,571,742	1,609,330
9,754,933	10,024,981	10,243,983	10,434,571	10,583,207	10,757,964	10,940,437

SECTION 6: ANALYSIS OF SENSITIVITY AND COMPARISON WITH THE PREVIOUS PERFORMANCE PLAN

Mapping between the template for the FAB performance plan and Annex II of the performance Regulation

Structure of ANNEX II of the performance Regulation	Link with PRB Performance Plan template			
	Body of Performance Plan	Annex C For cost-effiency		Other annexes
		RT ref.	AI ref.	
6. ANALYSIS OF SENSITIVITY AND COMPARISON WITH THE PREVIOUS PERFORMANCE PLAN	6			
6.1. Sensitivity to external assumptions.	6.1			
6.2. Comparison with previous performance plan.	6.2			

6 - ANALYSIS OF SENSITIVITY AND COMPARISON WITH THE PREVIOUS PERFORMANCE PLAN

6.1 - Sensitivity to external assumptions

6.2 - Comparison with previous performance plan

SECTION 7: IMPLEMENTATION OF THE PERFORMANCE PLAN

Mapping between the template for the FAB performance plan and Annex II of the performance Regulation				
Structure of ANNEX II of the performance Regulation	Link with PRB Performance Plan template			
	Body of Performance Plan	Annex C For cost-effiency		Other annexes
		RT ref.	AI ref.	
7. IMPLEMENTATION OF THE PERFORMANCE PLAN	7			
Description of the measures put in place by the national supervisory authorities to achieve the performance targets, such as:				
(i) monitoring mechanisms to ensure that the ANS safety programmes and business plans are implemented;				
(ii) measures to monitor and report on the implementation of the performance plans including how to address the situation if targets are not reached during the reference period.				

7 - IMPLEMENTATION OF THE PERFORMANCE PLAN

DANUBE FAB NSA Board is responsible for monitoring and overseeing DANUBE FAB performance.
The NSAs are responsible for performance oversight and monitoring at national level.
DANUBE FAB NSA Board reports to the DANUBE FAB Governing Council.
Within the DANUBE FAB NSA Board a Performance Expert Group was established which will agree and establish mechanisms/ processes for collecting and assessing performance-related data and measure performance against targets

NSA commitment for data provision

	Active			Inactive
	Date of implementation	Periodicity	Focal point	
Airport dataflow				
Civil Military dataflow				

Number of other dataflows	Click to select number of other dataflows

Additional comments

None of the Environment PIs as per Annex I, Sec.2, point 2.2 of Reg.(EU) No.390/2013 are used as additional local KPIs/targets. Nevertheless, the Bulgarian NSA is commitmed to monitor the Performance Indicators as summarised below for the whole reference period:

1. Additional time in the taxi-out phase - at National level with breakdown at airport level (LBSF only - ref. to sec.1.5 above): will be monitored, based on EUROCONTROL Performance Review Unit (PRU) and the Central Office for Delay Analysis (CODA) data collection and compilation;

2.Additional time in terminal airspace - at National level with breakdown at airport level (LBSF only - ref. to sec.1.5 above): will be monitored, based on EUROCONTROL Performance Review Unit (PRU) and the Central Office for Delay Analysis (CODA) data collection and compilation;

8 - ANNEXES

The following annexes should be provided as part of the local performance plans. These should be completed with any other documentation relevant for the targets justifications.

Annex A. Public consultation material
Annex A.1 DANUBE FAB Consultation
Annex A.2 Romanian National Consultation
Annex A.3 Republic of Bulgaria National Consultation

Annex B. Relevant documentation in line with the NSP

Annex C. Reporting Tables

Reporting Table 1 (Total costs) and Table 2 (Unit rate calculation) and “additional information” as per Article 9 of the charging Regulation (Transparency of costs and of the charging mechanism) for each entity and consolidated at national/charging zone/FAB level from June 2014.

Annex D. ANSPs investment plans

Annex E. Additional material

List of airports with Traffic (data source: EUROCONTROL/NM)

ICAO code	Airport name	State
EBBR	BRUSSELS/BRUSSELS-NATIONAL	Belgium
EDDF	FRANKFURT MAIN	Germany
EDDH	HAMBURG	Germany
EDDK	KOLN/BONN	Germany
EDDL	DUSSELDORF	Germany
EDDM	MUNCHEN	Germany
EDDS	STUTTGART	Germany
EDDT	BERLIN-TEGEL	Germany
EETN	LENNART MERI TALLINN	Estonia
EFHK	HELSINKI-VANTAA	Finland
EGBB	BIRMINGHAM	United Kingdom
EGCC	MANCHESTER	United Kingdom
EGGW	LONDON LUTON	United Kingdom
EGKK	LONDON GATWICK	United Kingdom
EGLC	LONDON/CITY	United Kingdom
EGLL	LONDON HEATHROW	United Kingdom
EGPF	GLASGOW	United Kingdom
EGPH	EDINBURGH	United Kingdom
EGSS	LONDON STANSTED	United Kingdom
EHAM	AMSTERDAM/SCHIPHOL	Netherlands
EIDW	DUBLIN INTERNATIONAL	Ireland
EKCH	KOEBENHAVN / KASTRUP	Denmark
ELLX	LUXEMBOURG/LUXEMBOURG	Luxembourg
ENBR	BERGEN/FLESLAND	Norway
ENGM	OSLO/GARDERMOEN	Norway
ENZV	STAVANGER/SOLA	Norway
EPWA	WARSAW CHOPIN AIRPORT	Poland
ESSA	STOCKHOLM-ARLANDA	Sweden
EVRA	RIGA	Latvia
EYVI	VILNIUS/INTERNATIONAL	Lithuania
GCLP	GRAN CANARIA	Spain
LBSF	SOFIA	Bulgaria
LCLK	LARNAKA INTL	Cyprus
LDZA	ZAGREB / PLESO	Croatia
LEBL	BARCELONA	Spain
LEMD	MADRID BARAJAS	Spain
LEMG	MALAGA	Spain
LEPA	PALMA DE MALLORCA	Spain
LFBO	TOULOUSE BLAGNAC	France
LFLL	LYON SAINT EXUPERY	France
LFML	MARSEILLE PROVENCE	France
LFMN	NICE COTE D'AZUR	France
LFPG	PARIS CHARLES DE GAULLE	France

LFPO	PARIS ORLY	France
LFSB	BALE-MULHOUSE	France
LGAV	ATHINAI/ ELEFTHERIOS VENIZELOS	Greece
LHBP	BUDAPEST LISZT FERENC INTERNATIONAL	Hungary
LIMC	MILANO/MALPENSA	Italy
LIME	BERGAMO/ORIO AL SERIO	Italy
LIML	MILANO/LINATE	Italy
LIPZ	VENEZIA/TESSERA	Italy
LIRF	ROMA/FIUMICINO	Italy
LJLJ	LJUBLJANA/BRNIK	Slovenia
LKPR	PRAHA/RUZYNE	Czech Republic
LMML	LUQA	Malta
LOWW	WIEN-SCHWECHAT	Austria
LPPT	LISBOA	Portugal
LROP	BUCURESTI / HENRI COANDA	Romania
LSGG	GENEVE	Switzerland
LSZH	ZURICH	Switzerland
LZIB	BRATISLAVA/M. R. STEFANIK	Slovakia
EBAW	ANTWERPEN/DEURNE	Belgium
EBCI	CHARLEROI/BRUSSELS SOUTH	Belgium
EBLG	LIEGE/LIEGE	Belgium
EBOS	OOSTENDE-BRUGGE/OOSTENDE	Belgium
EDDB	BERLIN/SCHONEFELD	Germany
EDDC	DRESDEN	Germany
EDDE	ERFURT-WEIMAR	Germany
EDDG	MUNSTER/OSNABRUCK	Germany
EDDN	NURNBERG	Germany
EDDP	LEIPZIG/HALLE	Germany
EDDR	SAARBRUCKEN	Germany
EDDV	HANNOVER	Germany
EDDW	BREMEN	Germany
EETU	TARTU	Estonia
EHBK	MAASTRICHT/MAASTRICHT AACHEN	Netherlands
EHGG	GRONINGEN/EELDE	Netherlands
EHRD	ROTTERDAM	Netherlands
ENVA	TRONDHEIM/VAERNES	Norway
EPBY	BYDGOSZCZ/SZWEREDOWO	Poland
EPGD	GDANSK/LECH WALESA	Poland
EPKK	KRAKOW/BALICE	Poland
EPKT	KATOWICE/PYRZOWICE	Poland
EPLB	LUBLIN	Poland
EPLL	LODZ/LUBLINEK	Poland
EPMO	WARSZAWA/MODLIN	Poland
EPPO	POZNAN/LAWICA	Poland
EPRA	RADOM	Poland
EPRZ	RZESZOW/JASIONKA	Poland
EPSC	SZCZECIN/GOLENIOW	Poland
EPWR	WROCLAW/STRACHOWICE	Poland
EPZG	ZIELONA GORA/BABIMOST	Poland
ESGG	GOTEBORG/LANDVETTER	Sweden

EVLA	LIEPAJA	Latvia
EVVA	VENTSPILS	Latvia
EYKA	KAUNAS/INTERNATIONAL	Lithuania
EYPA	PALANGA/INTERNATIONAL	Lithuania
EYSA	SIAULIAI/INTERNATIONAL	Lithuania
LBBG	BURGAS	Bulgaria
LBGO	GORNA ORYAHOVITSA	Bulgaria
LBPD	PLOVDIV	Bulgaria
LBWN	VARNA	Bulgaria
LCPH	PAFOS INTL	Cyprus
LFAQ	ALBERT BRAY	France
LFBA	AGEN LA GARENNE	France
LFBD	BORDEAUX-MERIGNAC	France
LFBE	BERGERAC/ROUMANIERE	France
LFBH	LA ROCHELLE ILE DE RE	France
LFBI	POITIERS BIARD	France
LFBL	LIMOGES BELLEGARDE	France
LFBP	PAU PYRENEES	France
LFBT	TARBES LOURDES PYRENEES	France
LFBZ	BIARRITZ BAYONNE ANGLET	France
LFCR	RODEZ AVEYRON	France
LFGJ	DOLE/TAVAUX	France
LFJL	METZ NANCY LORRAINE	France
LFJR	ANGERS MARCE	France
LFKB	BASTIA/PORETTA	France
LFKC	CALVI STE CATHERINE	France
LFKF	FIGARI SUD CORSE	France
LFKJ	NAPOLEON BONAPARTE	France
LFLB	CHAMBERY AIX LES BAINS	France
LFLC	CLERMONT-FERRAND AUVERGNE	France
LFLP	ANNECY MEYTHET	France
LFLS	GRENOBLE ISERE	France
LFLX	CHATEAUROUX DEOLS	France
LFLY	LYON BRON	France
LFMD	CANNES MANDELIEU	France
LFMH	ST ETIENNE BOUTHEON	France
LFMI	ISTRES/LE TUBES	France
LFMK	CARCASSONNE SALVAZA	France
LFMP	PERPIGNAN RIVESALTES	France
LFMT	MONTPELLIER MEDITERRANEE	France
LFMU	BEZIERS VIAS	France
LFMV	AVIGNON CAUMONT	France
LFOB	BEAUVAIS-TILLE	France
LFOH	LE HAVRE OCTEVILLE	France
LFOK	CHALONS/VATRY	France
LFOT	TOURS VAL DE LOIRE	France
LFPB	PARIS LE BOURGET	France
LFPN	TOUSSUS LE NOBLE	France
LFQQ	LILLE/LESQUIN	France
LFRB	BREST-GUIPAVAS	France

LFRD	DINARD PLEURTUIT SAINT-MALO	France
LFRG	DEAUVILLE NORMANDIE	France
LFRH	LORIENT LANN BIHOUE	France
LFRK	CAEN CARPIQUET	France
LFRN	RENNES SAINT JACQUES	France
LFRO	LANNION	France
LFRQ	QUIMPER PLUGUFFAN	France
LFRS	NANTES ATLANTIQUE	France
LFRZ	SAINT NAZAIRE MONTOIR	France
LFSD	DIJON LONGVIC	France
LFSL	BRIVE SOUILLAC	France
LFST	STRASBOURG ENTZHEIM	France
LFTH	HYERES LE PALYVESTRE	France
LFTW	NIMES/GARONS	France
LIBC	CROTONE	Italy
LIBD	BARI/PALESE	Italy
LIBF	FOGGIA/GINO LISA	Italy
LIBG	TARANTO/GROTTAGLIE	Italy
LIBP	PESCARA	Italy
LIBR	BRINDISI/CASALE	Italy
LICA	LAMEZIA TERME	Italy
LICC	CATANIA/FONTANAROSSA	Italy
LICD	LAMPEDUSA	Italy
LICG	PANTELLERIA	Italy
LICJ	PALERMO/PUNTA RAISI	Italy
LICR	REGGIO CALABRIA	Italy
LICT	TRAPANI/BIRGI	Italy
LIEA	ALGHERO/FERTILIA	Italy
LIEE	CAGLIARI/ELMAS	Italy
LIEO	OLBIA/COSTA SMERALDA	Italy
LIMA	TORINO/AERITALIA	Italy
LIMF	TORINO/CASELLE	Italy
LIMG	ALBENGA	Italy
LIMJ	GENOVA/SESTRI	Italy
LIMP	PARMA	Italy
LIMZ	CUNEO/LEVALDIGI	Italy
LIPB	BOLZANO	Italy
LIPE	BOLOGNA/BORGO PANIGALE	Italy
LIPH	TREVISO/S.ANGELO	Italy
LIPK	FORLI'	Italy
LIPO	BRESCIA/MONTICHIARI	Italy
LIPQ	TRIESTE/RONCHI DEI LEGIONARI	Italy
LIPR	RIMINI/MIRAMARE	Italy
LIPU	PADOVA	Italy
LIPV	VENEZIA/LIDO	Italy
LIPX	VERONA/VILLAFRANCA	Italy
LIPY	ANCONA/FALCONARA	Italy
LIQN	RIETI	Italy
LIRA	ROMA/CIAMPINO	Italy
LIRI	SALERNO/PONTECAGNANO	Italy

LIRN	NAPOLI/CAPODICHINO	Italy
LIRP	PISA/S.GIUSTO	Italy
LIRQ	FIRENZE/PERETOLA	Italy
LIRS	GROSSETO	Italy
LIRU	ROMA/URBE	Italy
LIRZ	PERUGIA/S.FRANCESCO	Italy
LJMB	MARIBOR/OREHOVA VAS	Slovenia
LJPZ	PORTOROZ/SECOVLJE	Slovenia
LKKV	KARLOVY VARY	Czech Republic
LKMT	OSTRAVA/MOSNOV	Czech Republic
LKTB	BRNO/TURANY	Czech Republic
LOWG	GRAZ	Austria
LOWI	INNSBRUCK	Austria
LOWK	KLAGENFURT	Austria
LOWL	LINZ	Austria
LOWS	SALZBURG	Austria
LPAZ	SANTA MARIA	Portugal
LPFL	FLORES	Portugal
LPFR	FARO	Portugal
LPHR	HORTA	Portugal
LPMA	MADEIRA	Portugal
LPPD	PONTA DELGADA	Portugal
LPPR	PORTO	Portugal
LPPS	PORTO SANTO	Portugal
LRBS	BUCURESTI / BANEASA-AUREL VLAICU	Romania

IFR air transport movements

2011	2012	2013	Average	Category
228,056	218,003	211,108	219,056	1
487,020	482,167	472,704	480,630	1
148,930	144,539	136,751	143,407	1
127,736	122,807	117,299	122,614	1
221,196	216,770	210,386	216,117	1
407,061	395,297	379,212	393,857	1
123,891	120,053	114,179	119,374	1
167,012	168,926	172,801	169,580	1
36,321	45,238	34,456	38,672	2
192,255	172,005	168,097	177,452	1
90,921	90,900	91,697	91,173	1
166,810	168,506	168,925	168,080	1
98,798	98,255	97,075	98,043	1
251,399	246,933	250,528	249,620	1
68,202	70,554	73,680	70,812	1
481,223	475,395	471,901	476,173	1
75,830	77,506	77,823	77,053	1
112,238	109,405	110,073	110,572	1
146,839	141,839	143,113	143,930	1
431,355	433,678	435,918	433,650	1
160,378	162,286	169,301	163,988	1
253,690	243,019	244,934	247,214	1
56,025	56,472	57,544	56,680	2
96,180	96,985	99,911	97,692	1
228,572	235,545	241,058	235,058	1
71,045	75,625	78,913	75,194	1
140,721	138,205	142,063	140,330	1
212,946	210,049	219,838	214,278	1
71,547	68,360	67,237	69,048	2
27,107	29,488	31,994	29,530	2
109,123	98,759	93,900	100,594	1
46,603	42,941	39,683	43,076	2
51,214	46,496	40,568	46,093	2
38,998	35,983	34,823	36,601	2
302,923	289,885	276,407	289,738	1
429,204	373,079	333,027	378,437	1
106,523	100,738	100,421	102,561	1
179,779	173,307	169,401	174,162	1
92,491	96,642	91,447	93,527	1
121,132	119,490	116,102	118,908	1
102,038	106,933	102,903	103,958	1
137,572	142,449	140,249	140,090	1
513,966	497,739	478,296	496,667	1
231,937	234,065	233,644	233,215	1
71,729	70,846	72,727	71,767	1
169,431	149,418	135,455	151,435	1
109,651	87,364	83,563	93,526	1
191,569	175,110	165,013	177,231	1
71,224	73,830	71,265	72,106	1
119,899	118,202	111,800	116,634	1
86,722	84,028	80,934	83,895	1
328,531	313,900	301,989	314,807	1
32,550	28,867	27,271	29,563	2
146,930	128,030	124,791	133,250	1
33,445	33,119	35,565	34,043	2
264,301	261,604	247,628	257,844	1
143,040	144,142	145,934	144,372	1
74,210	86,296	87,515	82,674	1
176,096	180,627	177,646	178,123	1
268,466	261,605	255,210	261,760	1
22,156	19,451	18,366	19,991	2
17,742	14,752	14,081	15,525	3
43,701	48,302	49,967	47,323	3
32,466	29,074	28,502	30,014	3
7,700	6,541	5,875	6,705	3
71,086	69,228	63,201	67,838	3
27,633	25,611	22,251	25,165	3
6,291	4,531	4,867	5,230	3
24,430	19,655	16,317	20,134	3
57,413	53,515	51,781	54,236	3
61,956	60,376	59,438	60,590	3
12,148	10,231	9,794	10,724	3
69,949	67,118	63,904	66,990	3
36,686	35,338	34,821	35,615	3
1,567	1,613	1,111	1,430	3
13,708	12,619	9,851	12,059	3
15,748	13,854	13,187	14,263	3
24,713	23,149	26,482	24,781	3
53,661	56,653	56,449	55,588	3
4,298	4,903	5,027	4,743	3
30,922	37,276	32,947	33,715	3
34,288	40,683	40,851	38,607	3
27,178	27,181	25,184	26,514	3
0	48	1,674	861	3
4,046	5,357	4,117	4,507	3
0	6,721	2,753	4,737	3
20,826	22,902	17,822	20,517	3
327	378	639	448	3
7,283	7,733	8,432	7,816	3
4,280	6,046	4,441	4,922	3
23,845	26,482	23,733	24,687	3
655	842	937	811	3
69,378	60,795	60,625	63,599	3

36	18	45	33	3
21	20	4	15	3
8,767	8,242	6,852	7,954	3
2,666	2,699	2,519	2,628	3
1,350	1,474	1,962	1,595	3
18,849	18,508	18,244	18,534	3
229	246	169	215	3
1,467	1,401	1,069	1,312	3
11,178	10,646	11,332	11,052	3
12,346	15,064	14,151	13,854	3
2,281	1,763	1,481	1,842	3
4,456	4,677	4,911	4,681	3
57,974	56,698	56,492	57,055	3
4,970	4,103	4,872	4,648	3
6,345	6,693	6,266	6,435	3
5,475	5,561	5,311	5,449	3
8,672	8,241	7,915	8,276	3
12,156	12,225	11,390	11,924	3
7,609	7,389	7,029	7,342	3
12,650	12,949	12,634	12,744	3
6,246	6,663	6,117	6,342	3
2,845	3,460	3,831	3,379	3
6,646	6,842	5,751	6,413	3
1,995	1,892	1,630	1,839	3
13,448	13,028	14,303	13,593	3
6,204	6,275	6,138	6,206	3
9,002	9,571	9,345	9,306	3
14,988	14,812	16,602	15,467	3
7,101	6,874	6,729	6,901	3
15,568	14,678	14,715	14,987	3
3,674	3,504	3,204	3,461	3
6,450	6,407	6,344	6,400	3
2,615	2,376	2,437	2,476	3
9,129	9,498	9,028	9,218	3
14,160	13,310	13,365	13,612	3
3,136	3,156	2,980	3,091	3
6,218	3,231	3,514	4,321	3
6,270	6,106	5,928	6,101	3
8,842	8,494	8,390	8,575	3
31,890	32,161	31,489	31,847	3
5,441	5,312	5,499	5,417	3
6,318	6,305	5,776	6,133	3
25,878	26,801	27,398	26,692	3
2,551	2,509	1,824	2,295	3
3,121	3,094	3,072	3,096	3
2,702	3,197	3,006	2,968	3
58,368	55,572	53,519	55,820	3
11,859	12,075	11,457	11,797	3
21,767	20,715	22,997	21,826	3
15,018	15,157	14,689	14,955	3

4,290	3,938	3,725	3,984	3
4,052	3,599	3,738	3,796	3
7,499	7,855	6,975	7,443	3
5,534	4,819	4,800	5,051	3
16,708	15,686	15,299	15,898	3
1,928	1,964	1,785	1,892	3
3,240	3,186	3,276	3,234	3
49,654	51,654	50,478	50,595	3
2,695	2,831	2,906	2,811	3
4,848	4,708	3,794	4,450	3
3,024	3,027	3,066	3,039	3
27,339	27,380	25,935	26,885	3
11,480	11,031	10,559	11,023	3
3,768	3,525	3,632	3,642	3
2,651	2,617	410	1,893	3
34,920	34,522	31,766	33,736	3
2,070	158	126	785	3
771	632	512	638	3
6,562	6,660	6,058	6,427	3
17,557	17,339	15,856	16,917	3
19,534	18,498	17,296	18,443	3
61,931	53,558	55,329	56,939	3
3,511	3,005	3,860	3,459	3
4,031	4,044	3,661	3,912	3
49,445	43,375	40,723	44,514	3
6,393	5,900	5,552	5,948	3
15,585	13,676	16,051	15,104	3
14,378	14,411	13,732	14,174	3
36,381	34,431	31,792	34,201	3
28,038	25,976	26,149	26,721	3
219	169	229	206	3
48,893	46,830	38,754	44,826	3
1,064	829	876	923	3
22,725	21,991	19,165	21,294	3
5,469	3,400	3,283	4,051	3
3,145	2,975	3,363	3,161	3
4,581	4,327	3,176	4,028	3
68,887	67,167	64,877	66,977	3
9,455	19,131	17,075	15,220	3
6,360	4,820	1,554	4,245	3
6,265	5,891	5,326	5,827	3
13,347	13,077	11,814	12,746	3
11,204	9,265	6,063	8,844	3
666	333	352	450	3
251	198	237	229	3
37,864	36,188	31,673	35,242	3
12,186	11,351	10,223	11,253	3
1	0	0	1	3
58,358	51,743	51,304	53,802	3
2,564	1,529	823	1,639	3

63,613	61,074	55,784	60,157	3
44,697	43,448	41,416	43,187	3
30,706	29,832	29,681	30,073	3
1,817	1,596	1,816	1,743	3
789	658	647	698	3
3,641	3,745	3,660	3,682	3
1,452	1,343	1,292	1,362	3
1,306	1,409	1,278	1,331	3
2,208	2,245	2,094	2,182	3
7,743	6,624	5,498	6,622	3
8,351	7,882	6,712	7,648	3
20,806	19,425	18,843	19,691	3
20,979	18,562	17,812	19,118	3
10,781	9,115	8,338	9,411	3
18,726	18,278	16,763	17,922	3
30,132	28,157	28,770	29,020	3
3,188	2,630	2,472	2,763	3
1,343	1,202	1,123	1,223	3
42,194	40,829	42,918	41,980	3
4,385	4,113	3,957	4,152	3
21,750	20,366	21,059	21,058	3
12,062	11,903	11,764	11,910	3
61,114	58,621	59,477	59,737	3
2,991	2,715	2,521	2,742	3
23,258	8,163	3,870	11,764	3

EoSM State level

	2015 Target	2016 Target	2017 Target	2018 Target	2019 Target
Union-wide targets at State level	-	-	-	-	C
Union-wide targets at ANSP level (for Safety Culture MO)	-	-	-	-	C
Union-wide targets at ANSP level (for all other MOs)	-	-	-	-	D

Application of RAT

Ground Score (State)	2015 Target	2016 Target
Union-wide targets SMIs	-	-
Union-wide targets Ris	-	-
Union-wide targets ATM-S	-	-

Overall Score (ANSP)	2015 Target	2016 Target
Union-wide targets SMIs	-	-
Union-wide targets Ris	-	-
Union-wide targets ATM-S	-	-

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Appendix 4: Pilot Survey questionnaire

Marina Efthymiou

Andreas Papatheodorou

Delphi survey

Thank you for agreeing to participate in this Delphi survey on the interrelations and dynamics between Functional Airspace Blocks and European Union Emissions Trading Scheme in aviation.

Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem.

This questionnaire round is the first of up to three rounds of the survey. Please try to answer all questions, even though we do not expect you to have in depth knowledge of all of them. You will have the opportunity to revise your answers with subsequent rounds of the survey.

In these surveys, you will be asked to contribute by developing ideas and statements for the two notions, FABs and EU ETS. Some of the questions can be answered with only a single selection. Where appropriate, a space is also provided for you to comment on the underlying reasons for your responses.

Specifically, the research study investigates the four following domains:

- RD1. The contribution of FABs and EU ETS on emissions' reduction
- RD2. The interrelation and dynamics of the two parallel regulating and deregulating schemes, ETS and FABs
- RD3. Recommendations and suggestions for issues relating to FABs and EU ETS
- RD4. The states and views of the involved stakeholders and the dynamics that are developed among them

Once we have received responses from all panellists, we will collate and summarise the findings and formulate the second questionnaire.

We assure you that your participation in the survey and your individual responses will be strictly confidential to the research team and will not be divulged to any outside party, including other panellists.

Kind regards,

Project Description

Introduction to the two notions, Functional Airspace Blocks and European Union Emissions Trading Scheme

A. Functional Airspace Blocks (FABs)

The Single European Sky is a European Commission initiative. Its aim is to de-fragmentize the European airspace, reduce delays, increase safety standards and flight efficiency to reduce the aviation environmental footprint and reduce costs related to service provision. In the context of the Single European Sky (SES), Functional Airspace Blocks (FABs) will reorganize the European airspace in a more sufficient and operational way.

A FAB means an airspace block based on operational requirements and established regardless of State boundaries, where the provision of air navigation services and related functions are performance-driven and optimized with a view to introducing, in each functional airspace block, enhanced cooperation among air navigation service providers or, where appropriate, an integrated provider.

Nine FAB initiatives are established:

1) NEFAB (North European FAB): Estonia, Finland, Latvia, Norway.
2) Denmark-Sweden: Denmark, Sweden
3) BALTIC FAB Poland, Lithuania
4) FABEC (FAB Europe Central): France, Germany, Belgium, Netherlands, Luxembourg, and Switzerland
5) FABCE (FAB Central Europe): Czech Republic, Slovak Republic, Austria, Hungary, Croatia, Slovenia, Bosnia and Herzegovina
6) DANUBE Bulgaria, Romania
7) BLUE MED Italy, Malta, Greece, Cyprus, (and Egypt, Tunisia, Albania, Jordan as observers)
8) UK- IRELAND FAB United Kingdom, Ireland
9) SW FAB (South West FAB) Portugal, Spain

B. European Union Emissions Trading System (EU ETS)

The European Union Emissions Trading System (EU ETS), also known as the European Union Emissions Trading Scheme, was the first large emissions trading scheme in the world, and remains the biggest. In 2008 the EU passed legislation to include aviation in the EU-ETS. This means that from 2012, overall CO 2 emissions of the aviation industry are capped: initially at 97% of 2005 emissions levels, and from 2013 onwards at 95%. All operators flying to and from the EU will have to surrender one allowance for every tonne of CO 2 emitted on a flight to and from (and within) European Economic Area.

Under the 'cap and trade' principle, a cap is set on the total amount of greenhouse gases that can be emitted by all participating installations. 'Allowances' for emissions are then auctioned off or allocated for free, and can subsequently be traded. Installations must monitor and report their CO_2 emissions, ensuring they hand in enough allowances to the authorities to cover their emissions. Non-complying aircraft operators face a penalty of € 100 per missing allowance on top of the obligation to procure and surrender missing allowances. If emission exceeds what is permitted by its allowances, an installation must purchase allowances from others. Conversely, if an installation has performed well at reducing its emissions, it can sell its leftover credits. This allows the system to find the most cost-effective ways of reducing emissions without significant government intervention.

Focus

A particular emphasis is to investigate the states and views of the involved stakeholders and the dynamics that are developed among them. The In-depth and confidential interviews with the participants will provide the data for the qualitative part of the study and contribute to the development of a model about the convergence of the emissions diminution resulted from FABs and EU ETS.

The Questions

In the questionnaire below, you will find the question categorised in the 4 domains mentioned above. There are xx questions and it will take you xx minutes approximately to answer them.

Please respond to those questions you feel comfortable with, for each addressing their probability and consequences. You may leave any of the questions unanswered, if you wish. When you return to the study at a later time, you will be able to change or edit your prior answers, as well as add others.

You can also submit additional text on a separate page. Explain further issues with the online tool.

Time requirements

It is expected to take you xx minutes approximately to answer all the questions. You are kindly asked to send fill the questionnaire until xxxx.

The next phase

Once we have received responses from all experts, we will collate and summarise the findings and formulate the second questionnaire. In the second round, each Delphi participant receives a second questionnaire and is asked to review the items summarized by the investigators based on the information provided in the first round. As a result of round two, areas of disagreement and agreement will be identified

The research team

Ms Marina Efthymiou works as trainee at EUROCONTROL at the Directorate Pan-European Sky/Support to States and Regional Initiatives (DPS/SSR). She is a PhD candidate at the Department of Business Administration, University of the Aegean, Greece. She holds a Master in Planning, Management and Policy of Tourism with specialization in Strategic Development and a bachelor in Business Administration, University of Patras, Greece.

Dr. Andreas Papatheodorou is Associate Professor in Industrial and Spatial Economics with Emphasis on Tourism at the Department of Business Administration, University of the Aegean, Greece. He is also a Fellow of the UK Tourism Society and a member of the German Aviation Research Society (GARS) and the international Air Transport Research Society (ATRS).

Questionnaire

RD1. The contribution of FABs and EU ETS on carbon offsetting

RQ1.1 Can you please compare the NextGen with the SES?

………
………
………………………………………………………………………………………………..

RQ1.2 What is your opinion about the observers and the associate partners in FABs?

………
………
………………………………………………………………………………………………..

RQ1.3 Evaluate, please, the following factors according to their contribution to emissions' reduction

Factors	Evaluation*	Comment
Flexible Use of Airspace	Choose an item.	
Free Route Airspace	Choose an item.	
Shortest feasible routes	Choose an item.	
Implementing continuous descent approaches	Choose an item.	
Use of Bio fuels	Choose an item.	
Use of Eco-friendly engines	Choose an item.	
Improving load factors	Choose an item.	
Reduced traffic because of economic crisis	Choose an item.	
Trading Certified Emissions Reductions (CERs)	Choose an item.	
Trading Verified or Voluntary Emissions Reductions (VERs)	Choose an item.	
Airlines develop offsetting programs	Choose an item.	
EU Emissions Trading Scheme	Choose an item.	
Single European Sky	Choose an item.	
Other …	Choose an item.	

**Higher numbers indicate higher contribution to emissions reduction*

RQ1.4 Can you please give your opinion about the effectiveness of the current charging scheme? Do you think that the present charging scheme is enough to avoid fragmentation because of intra and inter FAB competition? What do you propose?

………
………
…………………………………………………………………………………………………..

RQ1.5 Please write the problems the FABs face, their importance and their possible solutions

FABS	Problems and solutions	Importance*
Uk-IR	P:	Choose an item.
	S:	
Blue Med	P:	Choose an item.
	S:	
Baltic FAB	P:	Choose an item.
	S:	
NEFAB	P:	Choose an item.
	S:	
FABEC	P:	Choose an item.
	S:	
FABCE	P:	Choose an item.
	S:	
SW FAB	P:	Choose an item.
	S:	
Danube	P:	Choose an

		item.
	S:	
Denmark-Sweden	P:	Choose an item.
	S:	

**Higher numbers indicate higher importance*

RQ1.6 Do you believe that the inclusion of aviation in the EU ETS will influence the development of non-European airlines? If yes please explain how.

……
……
………………………………………………………………………………………………..

RQ1.7 Do you think that the EU ETS will lead to airline mergers in order to obtain more emissions allowances? What do you think about the market scenery considering competition issues?

……
……
………………………………………………………………………………………………..

RQ1.8 Do you think that in the future it would be possible to link the different Emissions Trading schemes and have a global ETS? Please explain why.

……
……
………………………………………………………………………………………………..

RQ1.9 Do you think that the monitoring, reporting and verification of emissions in EU ETS is sufficient? If no, please explain.

……
……
………………………………………………………………………………………………..

RD2. The interrelation and dynamics of the two parallel regulating and deregulating schemes, ETS and FABs

RQ2.1 Can you please describe the landscape of stakeholders' dynamics in FABs and EU ETS?

………
………
…………………………………………………………………………………………………..

RQ2.2 In your opinion can the optimization of air routes through FABs substitute the effects of the EU ETS in carbon offsetting?

………
………
…………………………………………………………………………………………………..

RQ2.3 Do you think that there is a connection between the ETS and FABs

………
………
…………………………………………………………………………………………………..

RD3. Recommendations and suggestions for issues relating to FABs and EU ETS

Do you have any recommendations or suggestions on FABs and EU ETS related issues?

………
………
…………………………………………………………………………………………………..

RD4. The states and views of the involved stakeholders and the dynamics that are developed among them?

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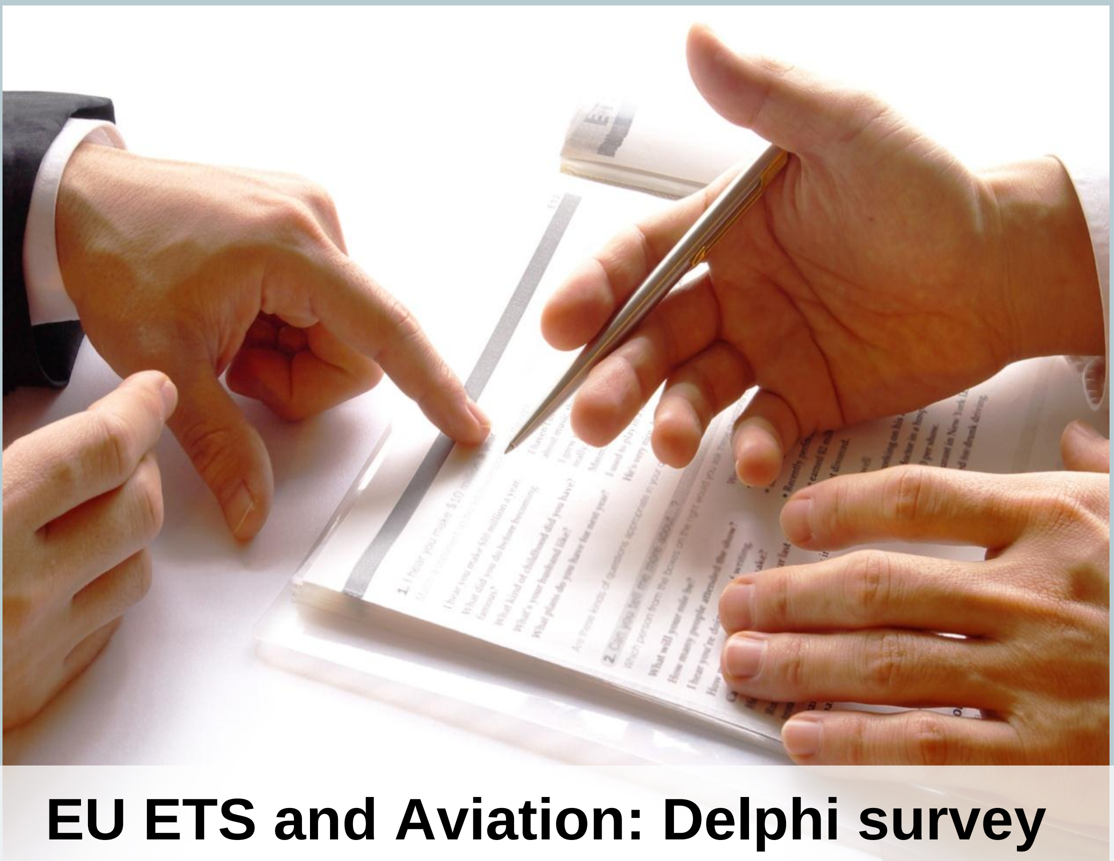
Appendix 5: 1st round Questionnaire: EU ETS and Aviation



EU ETS and Aviation: Delphi survey

Marina Efthymiou

Dr. Andreas Papatheodorou

Delphi survey

Thank you for participating in this Delphi survey that is part of my PhD entitled "Functional Airspace Blocks and European Union Emissions Trading Scheme in aviation".

Delphi is a method for structuring a group communication process effective in allowing a group of individuals, to deal with a complex problem, as a whole.

This questionnaire round is the first of up to three rounds of the survey. Thanks for answering to all the questions, even when you do not have in depth knowledge of some of them. You will have the opportunity to revise your answers during the next rounds of the survey.

In these surveys, you will be asked to contribute by developing ideas and statements. Some of the questions need to be answered with a single selection. Where appropriate, a space is provided to argument on the reasons for your responses.

Once the responses from all panellists are received, the main findings will be collated and summarised to feed the formulation of the second questionnaire.

Your participation in the survey and your individual responses will be strictly confidential to the research team and will not be divulged to any outside party, including other panellists.

This research is for academic purposes only, the outcome of which is the attainment of a doctoral degree and the publishing of articles in accredited scientific journals.

Please send your feedback to the following address emtm10014@emt.aegean.gr

Many thanks for your kind co-operation.

Marina Efthymiou

Dr. Andreas Papatheodorou

Project Description

Introduction to the notion of

European Union Emissions Trading Scheme

European Union Emissions Trading System (EU ETS)

The European Union Emissions Trading System (EU ETS), also known as the European Union Emissions Trading Scheme, was the first large emissions trading scheme in the world, and remains the biggest. In 2008 the EU passed legislation to include aviation in the EU-ETS. This means that from 2012, overall CO_2 emissions of the aviation industry are capped: initially at 97% of 2005 emissions levels, and from 2013 onwards at 95%. All operators flying to and from the EU will have to surrender one allowance for every tonne of CO_2 emitted on a flight to and from (and within) European Economic Area.

Under the 'cap and trade' principle, a cap is set on the total amount of greenhouse gases that can be emitted by all participating installations. 'Allowances' for emissions are then auctioned off or allocated for free, and can subsequently be traded. Installations must monitor and report their CO_2 emissions, ensuring they hand in enough allowances to the authorities to cover their emissions. Non-complying aircraft operators face a penalty of € 100 per missing allowance on top of the obligation to procure and surrender missing allowances. If emission exceeds what is permitted by its allowances, an installation must purchase allowances from others. Conversely, if an installation has performed well at reducing its emissions, it can sell its leftover credits. This allows the system to find the most cost-effective ways of reducing emissions without significant government intervention.

Focus

A particular emphasis is to investigate the opinions of the involved individual stakeholders, ANSPs, NSAs, Organisations, Academia and Airlines and the dynamics that are developed among them.

The focus of the questionnaire is to collect the opinions of the individuals involved stakeholders, ANSPs, NSAs, Organisations, Academia and Airlines on the inclusion of aviation in EU ETS.

The Questions

The in-depth and confidential interviews with the participants aim to provide the data for the qualitative part of the study and contribute to the development of a model explaining the convergence of the diminution of emissions resulted from FABs and EU ETS initiatives.

Time requirements

To address the 6 questions of the present questionnaire will take approximately 15 minutes You may leave any of the questions unanswered, if you wish. When you return to the study at a later time, you will be able to change or edit your prior answers, as well as add others.

You can also submit additional text on a separate page.

You are kindly asked to send fill the questionnaire until 27/07/2014.

The next phase

As said earlier as soon as the responses from all experts are received the main findings will be used to in formulating the second questionnaire. As a result of round two, areas of disagreement and agreement will be identified.

The research team

Ms Marina Efthymiou works as trainee at EUROCONTROL at the Directorate Pan-European Sky/Support to States and Regional Initiatives (DPS/SSR). She is a PhD candidate at the Department of Business Administration, University of the Aegean, Greece. She holds a Master in Planning, Management and Policy of Tourism with specialization in Strategic Development and a bachelor in Business Administration, University of Patras, Greece.

Dr. Andreas Papatheodorou is Associate Professor in Industrial and Spatial Economics with Emphasis on Tourism at the Department of Business Administration, University of the Aegean, Greece. He is also a Fellow of the UK Tourism Society and a member of the German Aviation Research Society (GARS) and the international Air Transport Research Society (ATRS).

Q1. Please assess the extent to which you agree with the following statements

1 stands for strong disagreement, 2 for disagreement, 3 for neutral position, 4 for agreement and 5 for strong agreement.

Statements	Scale	Comments
The inclusion of aviation in the EU ETS will influence negatively the development of non-European airlines if they are included in EU ETS.		
The EU ETS will lead the airlines to merge in order to obtain more emissions allowances.		
The EU ETS is causing competition issues to airlines		
It is possible to link the EU ETS and the other Emissions Trading schemes and have a global ETS.		
The monitoring, reporting and verification of emissions in the EU ETS is effective.		
The EU ETS is vulnerable to frauds, for instance VAT fraud and 'phishing' scams.		
The cap of EU ETS is too generous.		
The carbon market's stability is vulnerable because of the continuous changes in legislation.		
The carbon market stability is vulnerable because of the low prices of the allowances.		
Postponing the auctions can force the prices of allowances to increase.		
The free allocation of allowances to the airlines must be stricter.		
Using biofuels is a promising solution for carbon offsetting.		
The creation of carbon as a "financial instrument" can lead to sufficient carbon offsetting.		
Additional fuel savings will also be achieved owing to better fuel predictability.		
Route optimisation is sufficient enough for carbon neutral growth.		
The EU ETS can cause carbon leakage.		
The economic scale of the EU ETS drives heavy lobbying around allocation.		
The EU ETS is source of profit-making incentives unprecedented in the history of environmental policy		
There are small cutbacks relative to 'business-as-usual' and this leads to instabilities in the EU ETS.		
The corresponding large proportion of free allocation underlies legal stresses and the scope for distortions.		
The multi-period nature of allocations drives dependence both upon post-2012 decisions and		

creates risk of perverse incentives		

Q2. Please assess the impact of different allowances allocation methods to the aviation sector

1 stands for strong disagreement, 2 for disagreement, 3 for neutral position, 4 for agreement and 5 for strong agreement.

	Auctioning	**Grandfathering**	**Repeated benchmarking**	**One off benchmarking**
The cost of EU ETS is passed to ticket or freight prices				
Airlines have windfall profits				
Airlines demands more allowances				
Technical improvements and industry measures are implemented				

Q3. Please divide 100 points over the different allowance allocation methods that you deem as appropriate for the allocation of allowances to the airlines, where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.

Allocation methods	**Points**	**Comments**
Grandfathering		
Benchmarking		
Auctioning		
Total points	*100*	

Q4. In order to link the difference ETSs (like New Zealand or Shanghai ETS), the following factors should be applied to the same degree. Please assess the extent to which you agree with the following statements.

1 stands for strong disagreement, 2 for disagreement, 3 for neutral position, 4 for agreement and 5 for strong agreement.

Parameters	**Scale**	**Comments**
There are the same Monitoring, Reporting and Verification (MRV) rules for allowances		
There are the same banking provisions		
There are the same registries' rules		
There are the same rules governing new entrants and closures		
There are the same compliance periods		
The same allocation methods are applied		
There is the same stringency of targets		
There is the same stringency of enforcement		
There is the same eligibility of offset credits		
There are the same intensity targets		
There are the same cost-containment measures		

Q5. Please divide 100 points over the different factors that lead to carbon neutral growth, where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.

Factors		Points	Comments
The EU ETS leads to carbon neutral growth.			
Individual carbon offsetting programs from airlines lead to carbon neutral growth.			
Individual carbon offsetting programmes from states lead to carbon neutral growth.			
Horizontal en route flight efficiency	**Direct routes lead to carbon neutral growth**		
	Wind optimal routes lead to carbon neutral growth		
	Flexible Use of Airspace (FUA) leads to carbon neutral growth		
	Free Route Airspace (FRA) leads to carbon neutral growth		
Other,			
Total points		*100*	

Q6. Do you think that there is a connection between EU ETS and Functional Airspace Blocks (FABs)[11]? If yes why?

……

……

Thank you very much for your contribution

[11] A FAB means an airspace block based on operational requirements and established regardless of State boundaries, where the provision of air navigation services and related functions are performance-driven and optimized with a view to introducing, in each functional airspace block, enhanced cooperation among air navigation service providers or, where appropriate, an integrated provider. In the context of the Single European Sky (SES), the nine Functional Airspace Blocks (FABs) that were established will reorganize the European airspace in a more sufficient and operational way. The goal is to de-fragment the European airspace, reduce delays, increase safety standards and flight efficiency to reduce the aviation environmental footprint and reduce costs related to service provision. For more info please visit http://ec.europa.eu/transport/modes/air/single_european_sky/fab/.

Appendix 6: 1st round Questionnaire: SES/FABs and the Environment

Marina Efthymiou

Dr. Andreas Papatheodorou

FABs and Environment: Delphi survey

Delphi survey

Thank you for participating in this Delphi survey that is part of my PhD entitled “Functional Airspace Blocks and European Union Emissions Trading Scheme in aviation”.

Delphi is a method for structuring a group communication process effective in allowing a group of individuals, to deal with a complex problem, as a whole.

This questionnaire round is the first of up to three rounds of the survey. Thanks for answering to all the questions, even when you do not have in depth knowledge of some of them. You will have the opportunity to revise your answers during the next rounds of the survey.

In these surveys, you will be asked to contribute by developing ideas and statements. Some of the questions need to be answered with a single selection. Where appropriate, a space is provided to argument on the reasons for your responses.

Once the responses from all panellists are received, the main findings will be collated and summarised to feed the formulation of the second questionnaire.

Your participation in the survey and your individual responses will be strictly confidential to the research team and will not be divulged to any outside party, including other panellists.

This research is for academic purposes only, the outcome of which is the attainment of a doctoral degree and the publishing of articles in accredited scientific journals.

Please send your feedback to the following address emtm10014@emt.aegean.gr

Many thanks for your kind co-operation.

,

Marina Efthymiou

Dr. Andreas Papatheodorou

Project Description

Introduction to the notions of Functional Airspace Blocks and European Union Emissions Trading Scheme

Functional Airspace Blocks (FABs)

The Single European Sky is a European Commission initiative. Its aim is to de-fragment the European airspace, reduce delays, increase safety standards and flight efficiency to reduce the aviation environmental footprint and reduce costs related to service provision. In the context of the Single European Sky (SES), Functional Airspace Blocks (FABs) will reorganize the European airspace in a more sufficient and operational way.

A FAB is an airspace block based on operational requirements and established regardless of State boundaries, where the provision of air navigation services and related functions are performance-driven and optimized with a view to introducing, in each functional airspace block, enhanced cooperation among air navigation service providers or, where appropriate, an integrated provider.

Nine FAB initiatives are established:

1) NEFAB (North European FAB): Estonia, Finland, Latvia, Norway.
2) Denmark-Sweden: Denmark, Sweden
3) BALTIC FAB Poland, Lithuania
4) FABEC (FAB Europe Central): France, Germany, Belgium, Netherlands, Luxembourg, and Switzerland
5) FABCE (FAB Central Europe): Czech Republic, Slovak Republic, Austria, Hungary, Croatia, Slovenia, Bosnia and Herzegovina
6) DANUBE Bulgaria, Romania
7) BLUE MED Italy, Malta, Greece, Cyprus, (and Egypt, Tunisia, Albania, Jordan as observers)
8) UK- IRELAND FAB United Kingdom, Ireland
9) SW FAB (South West FAB) Portugal, Spain

European Union Emissions Trading System (EU ETS)

The European Union Emissions Trading System (EU ETS), also known as the European

Union Emissions Trading Scheme, was the first large emissions trading scheme in the world, and remains the biggest. In 2008 the EU passed legislation to include aviation in the EU-ETS. This means that from 2012, overall CO_2 emissions of the aviation industry are capped: initially at 97% of 2005 emissions levels, and from 2013 onwards at 95%. All operators flying to and from the EU will have to surrender one allowance for every tonne of CO_2 emitted on a flight to and from (and within) European Economic Area.

Under the 'cap and trade' principle, a cap is set on the total amount of greenhouse gases that can be emitted by all participating installations. 'Allowances' for emissions are then auctioned off or allocated for free, and can subsequently be traded. Installations must monitor and report their CO_2 emissions, ensuring they hand in enough allowances to the authorities to cover their emissions. Non-complying aircraft operators face a penalty of € 100 per missing allowance on top of the obligation to procure and surrender missing allowances. If emission exceeds what is permitted by its allowances, an installation must purchase allowances from others. Conversely, if an installation has performed well at reducing its emissions, it can sell its leftover credits. This allows the system to find the most cost-effective ways of reducing emissions without significant government intervention.

Focus

A particular emphasis is to investigate the opinions of the involved individual stakeholders, ANSPs, NSAs, Organisations, Academia and Airlines and the dynamics that are developed among them.

The focus of the questionnaire is to collect the opinions of the individuals involved stakeholders, ANSPs, NSAs, Organisations, Academia and Airlines on the inclusion of aviation in EU ETS.

The Questions

The in-depth and confidential interviews with the participants aim to provide the data for the qualitative part of the study and contribute to the development of a model explaining the convergence of the diminution of emissions resulted from FABs and EU ETS initiatives.

Time requirements

To address the xx questions of the present questionnaire will take approximately xx minutes You may leave any of the questions unanswered, if you wish. When you return to the study at a later time, you will be able to change or edit your prior answers, as well as add others.

You can also submit additional text on a separate page.

You are kindly asked to send fill the questionnaire until 10/07/2014.

The next phase

As said earlier as soon as the responses from all experts are received the main findings will be used to in formulating the second questionnaire. As a result of round two, areas of disagreement and agreement will be identified

The research team

Ms Marina Efthymiou works as trainee at EUROCONTROL at the Directorate Pan-European Sky/Support to States and Regional Initiatives (DPS/SSR). She is a PhD candidate at the Department of Business Administration, University of the Aegean, Greece. She holds a Master in Planning, Management and Policy of Tourism with specialization in Strategic Development and a bachelor in Business Administration, University of Patras, Greece.

Dr. Andreas Papatheodorou is Associate Professor in Industrial and Spatial Economics with Emphasis on Tourism at the Department of Business Administration, University of the Aegean, Greece. He is also a Fellow of the UK Tourism Society and a member of the German Aviation Research Society (GARS) and the international Air Transport Research Society (ATRS).

Q1.Please evaluate the major FAB Improvement Areas (FIAs) that have been identified as the most promising areas according то the degree of the potential benefit coming from the establishment of FABs[12].

1 stands for strong disagreement, 2 for disagreement, 3 for neutral position, 4 for agreement and 5 for strong agreement.

FIAs	Scale	Comments
Common Routes Network design		
Common Sector Design		
Common Operational Procedures		
Airspace consolidation		
Synergies in ATFCM		
Common R&D		
Harmonised ATM system		
Common Procurement		
Common AIS & MET		
Surveillance Data sharing		
Communication Data Sharing		
Sharing of navigation aids		
Improved cooperation with Militaries		
Common Flight Inspection		
Common Safety Management System		
Common ATCO Training		
Reduction of emissions		
Other,		

Q2. Please assess the extent to which you agree with the following statements

1 stands for strong disagreement, 2 for disagreement, 3 for neutral position, 4 for agreement and 5 for strong agreement.

Statements	Scale	Comments

[12] http://ec.europa.eu/transport/modes/air/studies/doc/traffic_management/evaluation_of_fabs_final_report.pdf

The airspace before SES didn't need to be changed.		
FABs bring routes closer to the optimum "Great Circle" route and reduce extended flight paths.		
The European airspace network today can benefit from a significant level of dynamism through the application of the Flexible Use of Airspace (FUA) concept.		
The reorganisation of the European Sky was necessary.		
The horizontal component is of higher economic and environmental importance than the vertical component of the Flight efficiency.		
Due to inherent safety (minimum separation requirements between aircraft) requirements, the level of "inefficiencies" cannot be reduced to zero at system level.		
Due to capacity (organisation of traffic flows) requirements, the level of "inefficiencies" cannot be reduced to zero at system level.		
The main environmental KPI should be the estimated economic value of CO_2 emissions due to route extension.		
All FABs are fully operational.		

Q3. Please divide 100 points over the different factors that affect horizontal en route flight efficiency[13], where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.

Factors	Points	Comments
Route structure and availability affect horizontal en route flight efficiency.		
Availability of airspace (utilisation of civil military structures) affects horizontal en route flight efficiency.		
Flight planning capabilities (use of software, repetitive flight planning) affect horizontal en route flight efficiency.		
User preferences regarding time affect horizontal en route flight efficiency.		
User preferences regarding fuel affect horizontal en route flight efficiency.		
Tactical ATC routings affect horizontal en route flight efficiency.		
Special events such as ATC strikes affect horizontal en route flight efficiency.		
Other,		
Total points	*100*	

Q4. Please divide 100 points over the different factors that affect the use of the civil/military airspace structures (Free Route Airspace, Flexible use of Airspace), where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.

Factors	Points	Comments
Political issues		
Flight planning capabilities (use of software, repetitive flight planning)		
Special events		
Existing ICAO ATM procedures		
Aspects related to position information		

[13] Horizontal en route flight efficiency compares the length of flight trajectories (L) to the "achieved" reference distance (H). The achieved distance apportions the Great Circle Distance between two airports within European airspace. If the origin/ destination airport is located outside of European airspace, the entry/exit point into the airspace is used for the calculation.

and radar vectoring		
Other,		
Total points	*100*	

Q5. Please evaluate the following factors according to their contribution to emissions' reduction.

1 stands for strong disagreement, 2 for disagreement, 3 for neutral position, 4 for agreement and 5 for strong agreement.

Factors	Scale	Comment
Flexible Use of Airspace		
Free Route Airspace		
Shortest feasible routes		
Implementing continuous descent approaches		
Use of Bio fuels		
Use of Eco-friendly engines		
Improving load factors		
Reduced traffic because of economic crisis		
Trading Certified Emissions Reductions (CERs)		
Trading Verified or Voluntary Emissions Reductions (VERs)		
Airlines develop offsetting programs		
EU Emissions Trading Scheme		
Single European Sky		
Other,		

Q6. Please divide 100 points over the different factors that lead to carbon neutral growth, where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.

Factors		Points	Comments
The EU ETS leads to carbon neutral growth.			
Individual carbon offsetting programs from airlines lead to carbon neutral growth.			
Individual carbon offsetting programmes from states lead to carbon neutral growth.			
Horizontal en route flight efficiency	Direct routes lead to carbon neutral growth		
	Wind optimal routes lead to carbon neutral growth		
	Flexible Use of Airspace (FUA) leads to carbon neutral growth		

	Free Route Airspace (FRA) leads to carbon neutral growth		
Other,			
Total points		*100*	

Q.7 Do you think that the present charging scheme is enough to avoid fragmentation because of intra and inter FAB competition? What do you propose?

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Q8. Do you think that there is a connection between FABs and Emissions Trading Scheme (EU ETS)[14]? If yes, why?

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[14] The European Union Emissions Trading System (EU ETS), also known as the European Union Emissions Trading Scheme, was the first large emissions trading scheme in the world, and remains the biggest. In 2008 the EU passed legislation to include aviation in the EU-ETS. This means that from 2012, overall CO_2 emissions of the aviation industry are capped: initially at 97% of 2005 emissions levels, and from 2013 onwards at 95%. All operators flying to and from the EU will have to surrender one allowance for every tonne of CO_2 emitted on a flight to and from (and within) European Economic Area. Under the 'cap and trade' principle, a cap is set on the total amount of greenhouse gases that can be emitted by all participating installations. 'Allowances' for emissions are then auctioned off or allocated for free, and can subsequently be traded. Installations must monitor and report their CO_2 emissions, ensuring they hand in enough allowances to the authorities to cover their emissions. For more info please visit http://ec.europa.eu/clima/policies/transport/aviation/index_en.htm

Appendix 7: 2nd round Questionnaire: EU ETS and Aviation

Thank you for participating in the 1st round of the Delphi survey that is part of my PhD entitled "Functional Airspace Blocks and European Union Emissions Trading Scheme in aviation". Delphi is a method for structuring a group communication process effective in allowing a group of individuals, to deal with a complex problem, as a whole.

Thank for continuing to the 2nd round!

This questionnaire round is the second and last round of the survey. Thanks for answering as many questions as possible. In this round you will have the opportunity to revise your answers and take under consideration what the rest of the participants have answered (You will find their answer in a separate column next to yours)

Your participation in the survey and your individual responses will be strictly confidential to the research team and will not be divulged to any outside party, including other panellists.

This research is for academic purposes only, the outcome of which is the attainment of a doctoral degree and the publishing of articles in accredited scientific journals.

Please send your feedback to the following address emtm10014@emt.aegean.gr or marina.efthymiou@aegean.gr

Many thanks for your kind co-operation.

Introduction to the notion of the 2nd and last round of Delphi

Focus

A particular emphasis is to investigate the opinions of the involved individual stakeholders, ANSPs, NSAs, Organisations, Academia and Airlines and the dynamics that are developed among them. The focus of the questionnaire is to collect the opinions of the individuals involved stakeholders, ANSPs, NSAs, Organisations, Academia and Airlines on the EU ETS Scheme.

Questions and Time requirements

To revise the questions of the present questionnaire will take less than 10 minutes You may leave any of the questions as you scored them in the first round, if you wish. One of the questions that you answered in the first round is replaced with another question and an additional one is added. You are kindly requested to answer them.

You can submit additional text on a separate page if you wish.

You are kindly asked to send your answers **until 01/09/2015.**

The research team

Ms Marina Efthymiou works as at EUROCONTROL at the Directorate Pan-European Sky/Support to States and Regional Initiatives (DPS/SSR) and she is looking for her next career step in aviation industry. She is a PhD candidate at the Department of Business Administration, University of the Aegean, Greece. She holds a Master in Planning, Management and Policy of Tourism with specialization in Strategic Development and a bachelor in Business Administration, University of Patras, Greece.

Dr Andreas Papatheodorou is Associate Professor in Industrial and Spatial Economics with Emphasis on Tourism at the Department of Business Administration, University of the Aegean, Greece. He is also a Fellow of the UK Tourism Society and a member of the German Aviation Research Society (GARS) and the international Air Transport Research Society (ATRS).

Q1/Q6. Please assess the extent to which you agree with the following statements. 1 stands for strong disagreement, 2 for disagreement, 3 for neutral position, 4 for agreement and 5 for strong agreement.

Statements	Your opinion in the 1st round	Others (n=31)	Your opinion in the 2nd round	Comments
The inclusion of aviation in the EU ETS will influence negatively the development of non-European airlines if they are included in EU ETS.				
The EU ETS will lead the airlines to merge in order to obtain more emissions allowances.				
The EU ETS is causing competition issues to airlines				
It is possible to link the EU ETS and the other Emissions Trading schemes and have a global ETS.				
The monitoring, reporting and verification of emissions in the EU ETS is effective.				
The EU ETS is vulnerable to frauds, for instance VAT fraud and 'phishing' scams.				
The cap of EU ETS is too generous.				
The carbon market's stability is vulnerable because of the continuous changes in legislation.				
The carbon market stability is vulnerable because of the low prices of the allowances.				
Postponing the auctions can force the prices of allowances to increase.				
The free allocation of allowances to the				

Statements	Your opinion in the 1st round	Others (n=31)	Your opinion in the 2nd round	Comments
airlines must be stricter.				
Using biofuels is a promising solution for carbon offsetting.				
The creation of a carbon market as a "financial instrument" can lead to sufficient carbon reduction.				
Additional fuel savings will also be achieved owing to better fuel use predictability.				
Route optimisation is sufficient enough for carbon neutral growth.				
The EU ETS can result in carbon leakage.				
The economic dimension of the EU ETS drives heavy lobbying around allocation of EU ETS allowances.				
The EU ETS is source of profit-making incentives unprecedented in the history of environmental policy				
There are small emissions reductions relative to 'business-as-usual' and this leads to instabilities (related to economics, policies and time frames) in the EU ETS.				
The corresponding large proportion of free allocation underlies legal stresses and gives a scope for distortions.				
The multi-period nature of allocations(i.e. banking and borrowing flexibility) drives dependence both upon post-2012 decisions and creates risk of perverse incentives				

Q2/Q6: Please divide 100 points over the different allowance allocation methods that you deem as appropriate for the allocation of allowances to the airlines, where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.

Allocation methods	Your opinion in the 1st round	Others (n=24)	Your opinion in the 2nd round	Comments
Grandfathering (free allocation)				
Benchmarking				
Auctioning				
Total points	*100*	*100*	*100*	

Q3/Q6: In order to link the different ETSs (like New Zealand or Shanghai ETS) with entire scheme and not only in aviation, the following factors should be applied to the same degree. Please assess the extent to which you agree with the following statements. 1 stands for strong disagreement, 2 for disagreement, 3 for neutral position, 4 for agreement and 5 for strong agreement.

Parameters	Your opinion in the 1st round	Others (n=27)	Your opinion in the 2nd round	Comments
There are the same Monitoring, Reporting and Verification (MRV) rules for allowances				
There are the same banking provisions				
There are the same registries' rules				
There are the same rules governing new entrants and closures				
There are the same compliance periods				
The same allocation methods are				

Parameters	Your opinion in the 1st round	Others (n=27)	Your opinion in the 2nd round	Comments
applied				
There is the same stringency of targets				
There is the same stringency of enforcement				
There is the same eligibility of offset credits				

Q4/Q6 Please divide 100 points over the different factors that lead to carbon neutral growth in aviation, where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.

Factors		Your opinion in the 1st round	Others (n=26)	Your opinion in the 2nd round	Comments
The EU ETS leads to carbon neutral growth.					
Individual carbon offsetting programs from airlines lead to carbon neutral growth.					
Individual carbon offsetting programmes from states lead to carbon neutral growth.					
Horizontal en route flight efficiency	Direct routes lead to carbon neutral growth				
	Wind optimal routes lead to carbon neutral growth				
	Flexible Use of Airspace (FUA) leads				

	to carbon neutral growth				
	Free Route Airspace (FRA) leads to carbon neutral growth				
Other					
Other					
	Total points	*100*	*100*	*100*	

<u>Into for the last section of the questionnaire:</u> Search and information, bargaining and decision, monitoring and enforcement of the EU ETS scheme create transaction costs (TC) for the stakeholders. This is because there are legislative and regulatory enactment costs related to the ETS such as implementation costs to meet the targets; monitoring costs to check the progress of the states/Aircraft operators; and enforcement costs to make the scheme work.

Q5/Q6: In the following table, please allocate 100 points over the various factors associated with transaction costs for policymakers/regulators emerging from the aviation EU ETS scheme. The most important factor gets the highest number of points and the least important factor gets the lowest number of points. You are allowed to allocate points to as many factors as you wish.

TC Factors	Areas within Factors	Points	Comments
Application	– Quantification of historic emissions – Development of emission outlooks – Decision for an application rule – Compilation of an application – Where necessary, compilation of a benchmark – Verification of the application – Fees for annual allocation – Fees for emissions register		
Implementation of Emissions Management	– Information, training – Assessment of obligation to participate in the EU ETS – Set up of organizational structures and assignment of responsibilities – Adaptation or purchase of software – Material costs		
Monitoring	– Design of a monitoring concept		

TC Factors	Areas within Factors	Points	Comments
	– Implementation of an internal monitoring system – Ongoing monitoring		
Reporting and verification	– Quantification of annual emissions – Compilation of an emissions report – Verification of an emissions report – Delivery of data for ex-post-control		
Abatement measures	– Identification of abatement measures – Decision about abatement measures		
Trade	– Transactions fees (exchange fees, broker fees, clearing) – Trade and negotiation – Market observation		
Strategy	– Design of a risk strategy – Design of a trade strategy – Design of an abatement strategy		
Other (please explain)	– Please explain		
	Total Points:	100	

Q6/Q6: Overall, how important do you consider transactions costs to be for the effective functioning of the aviation inclusion in the EU ETS scheme? Please mark the box.

Very unimportant	Unimportant	Neither Important or Unimportant	Important	Very Important

Email for contacting for the final results dissemination:

Thank you very much for your contribution!

Marina Efthymiou (marina.efthymiou@aegean.gr)

Appendix 8: 2nd round Questionnaire: SES/FABs and the Environment

Thank you for participating in the 1st round of the Delphi survey that is part of my PhD entitled "Functional Airspace Blocks and European Union Emissions Trading Scheme in aviation". Delphi is a method for structuring a group communication process effective in allowing a group of individuals, to deal with a complex problem, as a whole.

Thank for continuing to the 2nd round!

This questionnaire round is the second and last round of the survey. Thanks for answering as many questions as possible. In this round you will have the opportunity to revise your answers and take under consideration what the rest of the participants have answered (You will find their answer in a separate column next to yours)

Your participation in the survey and your individual responses will be strictly confidential to the research team and will not be divulged to any outside party, including other panellists.

This research is for academic purposes only, the outcome of which is the attainment of a doctoral degree and the publishing of articles in accredited scientific journals.

Please send your feedback to the following address emtm10014@emt.aegean.gr or marina.efthymiou@aegean.gr

Many thanks for your kind co-operation.

Introduction to the notion of the 2nd and last round of Delphi

Focus

A particular emphasis is to investigate the opinions of the involved individual stakeholders, ANSPs, NSAs, Organisations, Academia and Airlines and the dynamics that are developed among them. The focus of the questionnaire is to collect the opinions of the individuals involved stakeholders, ANSPs, NSAs, Organisations, Academia and Airlines on the SES Scheme.

Questions and Time requirements

To revise the questions of the present questionnaire will take less than 10 minutes You may leave any of the questions as you scored them in the first round, if you wish. Two of the questions that you answered in the first round are replaced with another 2 short questions, that you are kindly invited to answer.

You can submit additional text on a separate page if you wish.

You are kindly asked to send your answers **until 01/09/2015.**

The research team

Ms Marina Efthymiou works as at EUROCONTROL at the Directorate Pan-European Sky/Support to States and Regional Initiatives (DPS/SSR) and she is looking for her next career step in aviation industry. She is a PhD candidate at the Department of Business Administration, University of the Aegean, Greece. She holds a Master in Planning, Management and Policy of Tourism with specialization in Strategic Development and a bachelor in Business Administration, University of Patras, Greece.

Dr Andreas Papatheodorou is Associate Professor in Industrial and Spatial Economics with Emphasis on Tourism at the Department of Business Administration, University of the Aegean, Greece. He is also a Fellow of the UK Tourism Society and a member of the German Aviation Research Society (GARS) and the international Air Transport Research Society (ATRS).

Q1/Q8.Please evaluate the major FAB Improvement Areas (FIAs) that have been identified as the most promising areas according to the degree of the potential benefit coming from the establishment of FABs. 1 stands for totally unimportant, 2 for unimportant, 3 for neutral position, 4 for important and 5 for very important.

FIAs	Your opinion in the 1st round	Others (n=28)	Your opinion in the 2nd round	Comments
Common Routes Network design				
Common Sector Design				
Common Operational Procedures				
Airspace consolidation				
Synergies in ATFCM				
Common R&D				
Harmonised ATM system				
Common Procurement				
Common AIS & MET				
Surveillance Data sharing				
Communication Data Sharing				
Sharing of navigation aids				
Improved cooperation with Militaries				
Common Flight Inspection				
Common Safety Management System				
Common ATCO Training				
Reduction of emissions				
Other,				

Q2/Q8. Please assess the extent to which you agree with the following statements. 1 stands for strong disagreement, 2 for disagreement, 3 for neutral position, 4 for agreement and 5 for strong agreement.

Statements	Your opinion in the 1st round	Others (n=29)	Your opinion in the 2nd round	Comments
The airspace before SES didn't need to be changed.				
FABs bring routes closer to the optimum "Great Circle" route and reduce extended flight paths.				
The European airspace network today can benefit from a significant level of dynamism through the application of the Flexible Use of Airspace (FUA) concept.				
The reorganisation of the European Sky was necessary.				
The horizontal component is of higher economic and environmental importance than the vertical component of the Flight efficiency.				
Due to inherent safety (minimum separation requirements between aircraft) requirements, the level of "inefficiencies" cannot be reduced to zero at system level.				
Due to capacity (organisation of traffic flows) requirements, the level of "inefficiencies" cannot be reduced to zero at system level.				
The main environmental KPI should be the estimated economic value of CO_2 emissions				

Statements	Your opinion in the 1st round	Others (n=29)	Your opinion in the 2nd round	Comments
due to route extension.				
All FABs are fully operational.				

Q3/Q8. Please divide 100 points over the different factors that affect horizontal en route flight efficiency, where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.

Factors	Your opinion in the 1st round	Others (n=24)	Your opinion in the 2nd round	Comments
Route structure and availability affect horizontal en route flight efficiency.				
Availability of airspace (utilisation of civil military structures) affects horizontal en route flight efficiency.				
Flight planning capabilities (use of software, repetitive flight planning) affect horizontal en route flight efficiency.				
User preferences regarding time affect horizontal en route flight efficiency.				
User preferences regarding fuel affect horizontal en route flight efficiency.				
Tactical ATC routings affect horizontal en route flight efficiency.				
Special events such as ATC strikes affect horizontal en route flight efficiency.				
Other,				
Total points	*100*	100		

Q4/Q8. Please divide 100 points over the different factors that affect the use of the civil/military airspace structures (Free Route Airspace, Flexible use of Airspace), where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.

Factors	Your opinion in the 1st round	Others (n=27)	Your opinion in the 2nd round	Comments
Political issues				
Flight planning capabilities (use of software, repetitive flight planning)				
Special events				
Existing ICAO ATM procedures				
Aspects related to position information and radar vectoring				
Other				
Total points	100	100	*100*	

Q5/Q8. Please evaluate the following factors according to their contribution to emissions' reduction. 1 stands for totally unimportant, 2 for unimportant, 3 for neutral position, 4 for important and 5 for very important.

Factors	Your opinion in the 1st round	Others (n=30)	Your opinion in the 2nd round	Comments
Flexible Use of Airspace				
Free Route Airspace				
Shortest feasible routes				
Implementing continuous descent approaches				
Use of Bio fuels				
Use of Eco-friendly engines				
Improving load factors				
Reduced traffic because of economic crisis				
Trading Certified Emissions Reductions (CERs)				
Trading Verified or Voluntary Emissions Reductions (VERs)				
Airlines develop offsetting programs				
EU Emissions Trading Scheme				

Factors	Your opinion in the 1st round	Others (n=30)	Your opinion in the 2nd round	Comments
Single European Sky				
Other,				
Other,				

Q6/Q8. Please divide 100 points over the different factors that lead to carbon neutral growth, where the most important factor gets the highest number of points. You are allowed to allocate points to as many factors as you wish.

Factors		Points	Others (n=25)	Your opinion in the 2nd round	Comments
The EU ETS leads to carbon neutral growth.					
Individual carbon offsetting programs from airlines lead to carbon neutral growth.					
Individual carbon offsetting programmes from states lead to carbon neutral growth.					
Horizontal en route flight efficiency	Direct routes lead to carbon neutral growth				
	Wind optimal routes lead to carbon neutral growth				
	Flexible Use of Airspace (FUA) leads to carbon neutral growth				
	Free Route Airspace (FRA) leads to carbon neutral growth				
Other					
Other					

Total points	*100*	100	100	

<u>Into for the last section of the questionnaire:</u> Search and information, bargaining and decision, monitoring and enforcement of the Performance scheme create transaction costs (TC) for the SES stakeholders. This is because there are legislative and regulatory enactment costs related to the KPAs, such as implementation costs to meet the targets; monitoring costs to check the progress of the states/FABs; and enforcement costs to make the scheme work.

Q7/Q8: In the following table, please allocate 100 points over the various factors associated with transaction costs for stakeholders emerging from the environment KPA in the SES Performance scheme. The most important factor gets the highest number of points and the least important factor gets the lowest number of points. You are allowed to allocate points to as many factors as you wish.

TC Factors	Areas within Factors	Points	Comments
Alternative policies	– Develop alternative solutions – Evaluate the alternative solutions – Decision for the implementing policy		
Development and Implementation of the regulatory scheme	– Quantification of historic emissions – Development of emission outlooks – Decision for an application rule – Measures to overcome "frictions" and negotiation with stakeholders – Assessment of participants – Adaptation or purchase of software – Material costs Set up of organizational structures and assignment of responsibilities – Fees for Information, training		
Monitoring	– Design of a monitoring concept – Implementation of an internal monitoring system – Ongoing monitoring		
Reporting and verification	– Quantification of annual emissions – Compilation of an emissions report – Verification of an emissions report – Delivery of data for ex-post-control		
Compliance measures	– Identification of compliance measures – Offering recommendations and support – Decision about imposing non-compliance penalties		
Strategy	– Design of a strategy for NSAs, ANSPs – Design of a regulation enforcement		

TC Factors	Areas within Factors	Points	Comments
	procedure – Design of an abatement strategy		
Other (please explain)	– Please explain		
	Total Points:	*100*	

Q8/Q8: Overall, how important do you consider transactions costs to be for the effective functioning of the environment KPA in the SES Performance scheme? Please mark the box.

Very unimportant	Unimportant	Neither Important or Unimportant	Important	Very Important

Email for contacting for the final results dissemination:

Thank you very much!

Marina Efthymiou (marina.efthymiou@aegean.gr)

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Appendix 9: Permission to use copyright material

Marina Efthymiou

From:	Marina Efthymiou
Sent:	11 August 2016 15:41
To:	Sophie Schlingemann
Subject:	RE: Copyright of IPCC reports for PhD Thesis

Dear Sophie,

Thank you very much!

With kindest regards,
Marina

Marina Efthymiou
Lecturer in Aviation and Tourism
London College of Hospitality and Tourism University of West London
|St Mary's Road | Ealing|W5 5RF |UK

From: Sophie Schlingemann [sschlingemann@wmo.int]
Sent: 11 August 2016 11:49
To: Marina Efthymiou
Subject: Re: Copyright of IPCC reports for PhD Thesis

Dear Marina,

Thank you for your reply. We grant you non-exclusive permission to reproduce the figures in the manner as specified by you, provided that you acknowledge the IPCC as the source of the material with mention of the name of the IPCC report and a reference to the figures.

Thank you again for your interest in the work of the IPCC.

With kind regards,

Sophie

On Wed, Aug 10, 2016 at 7:31 PM, Marina Efthymiou
<Marina.Efthymiou@uwl.ac.uk<mailto:Marina.Efthymiou@uwl.ac.uk>> wrote:
Dear Sophie,

Thank you very much for your reply.

I would like to use in My PhD thesis with your permission the following figures:

- the graphs for the Radiative Forcing from Aircraft in 1992 and 2050 page 7 of the IPCC SPECIAL REPORT AVIATION AND THE GLOBAL ATMOSPHERE, Summary for Policymakers
- the Figure 6-1:
- the figure 6 14b
- the figure7-28
- the figure 9-6

I would appreciate thorough if it is possible to be granted permission to be allowed to use all graph from the IPCC SPECIAL REPORT AVIATION AND THE GLOBAL ATMOSPHERE to paper publications and especially to my lectures in

BA and MA level. Both cases are non commercial cases and are for educational purposes. I guarantee you that I will not amend the graphs and I will reference IPCC.

IPCC has done an incredible work in this report, and despite the 17 years that have passed it is very insightful and educational report. Well done!

Thank you very much in advance.

I am looking forward for your reply.

Kindest regards,
Marina

Marina Efthymiou
Lecturer in Aviation and Tourism
London College of Hospitality and Tourism University of West London
|St Mary's Road | Ealing|W5 5RF |UK

From: Sophie Schlingemann [sschlingemann@wmo.int<mailto:sschlingemann@wmo.int>]
Sent: 10 August 2016 13:40
To: Marina Efthymiou
Subject: Re: Copyright of IPCC reports for PhD Thesis

Dear Marina,

Thank you for your message concerning your permission request. Before we can give you a proper reply, we would like to receive clearer references which IPCC material you would like to reproduce (title of IPCC report(s), figure numbers etc.).

Thank you for your interest in the work of the IPCC.
Kind regards,

Sophie Schlingemann

On Tue, Aug 2, 2016 at 9:33 AM, Marina Efthymiou
<Marina.Efthymiou@uwl.ac.uk<mailto:Marina.Efthymiou@uwl.ac.uk><mailto:Marina.Efthymiou@uwl.ac.uk<mailto:
Marina.Efthymiou@uwl.ac.uk>>> wrote:
Dear Ms Schlingemann,

I am writing to you to request permission to use the IPCC charts, graphs, illustrations in my PhD Thesis about Single European Sky and EU Emissions Trading Scheme in aviation.

Would it be possible to have a letter (please find attached and amend it as you deem appropriate) or even an email mentioning that I can use for non-commercial purposes the material found only in the public domain of IPCC mentioning the author/source of the material?

Please do not hesitate to contact me should you have any queries.

Thank you very much in advance.
I am looking forward for your reply.

Kind regards,
Marina

A9 - 2

Marina Efthymiou
Lecturer in Aviation and Tourism
London College of Hospitality and Tourism University of West London
|St Mary's Road | Ealing|W5 5RF |UK

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Sophie Schlingemann
Legal and Liaison Officer
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Web: www.ipcc.ch<http://www.ipcc.ch><http://www.ipcc.ch/>

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Sophie Schlingemann
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Marina Efthymiou

From:	Marina Efthymiou
Sent:	04 August 2016 13:42
To:	Presse
Cc:	marketdata
Subject:	RE: Copyright for PhD Thesis

Dear Eileen,

Thank you very much for the approval to use the tables in my PhD Thesis.

Best regards,
Marina

Marina Efthymiou
Lecturer in Aviation and Tourism
London College of Hospitality and Tourism University of West London
|St Mary's Road | Ealing|W5 5RF |UK

From: Presse [presse@eex.com]
Sent: 04 August 2016 12:27
To: Marina Efthymiou
Cc: Presse; marketdata
Subject: RE: Copyright for PhD Thesis

Dear Marina,

Thank you very much for sending over the graphics. You can use the displayed data for your master thesis mentioning EEX as a source. Below table 3 there is a small typo in our company name, please use EEX instead of EXX.

As the graphics themselves are not originally from the website, EEX does not assume liability for the accuracy of the graphics.

Best regards,

Eileen Hieke

-----Original Message-----
From: Marina Efthymiou [mailto:Marina.Efthymiou@uwl.ac.uk]
Sent: Tuesday, August 02, 2016 3:58 PM
To: Presse
Cc: marketdata
Subject: RE: Copyright for PhD Thesis

Dear Eileen,

Thank you very much for your prompt reply!

Please find attached the tables that I plan to use in my PhD should I receive your permission.

Thank you very much in advance.

Best regards,
Marina

Marina Efthymiou
Lecturer in Aviation and Tourism
London College of Hospitality and Tourism University of West London
|St Mary's Road | Ealing|W5 5RF |UK

From: Presse [presse@eex.com]
Sent: 02 August 2016 10:08
To: Marina Efthymiou
Cc: marketdata; Presse
Subject: RE: Copyright for PhD Thesis

Dear Marina,

Thank you for your E-Mail.

It would be great if you could send us the charts or screenshots which you would like to use beforehand.

Best regards,

Eileen

-----Original Message-----
From: Marina Efthymiou [mailto:Marina.Efthymiou@uwl.ac.uk]
Sent: Tuesday, August 02, 2016 9:49 AM
To: marketdata; Presse
Cc: marina.efthymi@gmail.com
Subject: Copyright for PhD Thesis

Dear Sir/Madam,

I am writing to you to request permission to use the EEX charts, graphs, illustrations in my PhD Thesis about Single European Sky and EU Emissions Trading Scheme in aviation.

Would it be possible to have a letter (please find attached and amend it as you deem appropriate) or even an email mentioning that I can use for non-commercial purposes the material found only in the public domain of EEX mentioning the author/source of the material?

Please do not hesitate to contact me should you have any queries.

Thank you very much in advance.
I am looking forward for your reply.

Kind regards,
Marina

Marina Efthymiou
Lecturer in Aviation and Tourism
London College of Hospitality and Tourism University of West London

Marina Efthymiou

From: Marina Efthymiou
Sent: 26 July 2016 12:32
To: Hoang.VU-DUC@ec.europa.eu
Subject: RE: Copyright of reports for PhD Thesis

Thank you very much Hoang!!!
Cheers,
Marina

Marina Efthymiou
Lecturer in Aviation and Tourism
London College of Hospitality and Tourism University of West London
|St Mary's Road | Ealing|W5 5RF |UK

From: Hoang.VU-DUC@ec.europa.eu [Hoang.VU-DUC@ec.europa.eu]
Sent: 26 July 2016 11:15
To: Marina Efthymiou
Subject: RE: Copyright of reports for PhD Thesis

Dear Marina;

EC sources are in public domain unless stated otherwise. For your purpose, you can use our sources with all granted privileges.

Best regards

Hoang

[cid:image001.jpg@01D1E737.67091100]

DG MOVE
Unit C2 Research and Innovative Transport Systems

Phone : + 32 (0) 22988042

Mobile:+32 (0)479682055
Address : DM28 07/88; BE-1049 Brussels, Belgium E-mail : hoang.vu-duc@ec.europa.eu<mailto:hoang.vu-duc@ec.europa.eu>

-----Original Message-----
From: Marina Efthymiou [mailto:Marina.Efthymiou@uwl.ac.uk]
Sent: Tuesday, July 26, 2016 11:23 AM
To: VU DUC Hoang (MOVE)

Marina Efthymiou

From: Marina Efthymiou
Sent: 26 July 2016 12:31
To: NERO Giovanni
Subject: RE: Copyright of reports for PhD Thesis

Dear Giovanni,

Thank you very much for your help!

I hope to see you soon!

Best regards,
Marina

Marina Efthymiou
Lecturer in Aviation and Tourism
London College of Hospitality and Tourism University of West London
|St Mary's Road | Ealing|W5 5RF |UK

From: NERO Giovanni [giovanni.nero@eurocontrol.int]
Sent: 26 July 2016 11:04
To: Marina Efthymiou
Subject: RE: Copyright of reports for PhD Thesis

Dear Marina,
Nice to hear from you. I am glad that you are about to finish your PhD thesis. Congratulations.
Please refer to EUROCONTROL/PRU for the copyright, mentioning explicitly the name of the Report, e.g. ATM Cost-Effectiveness (ACE) Benchmarking, Year X.
Make sure that if you use PRR reports than it is EUROCONTROL/PRC.
Finally, I do not know if you are using PRB reference, if you do, let me know precisely. It should mention both EUROCONTROL/EC as on the cover page of the document.
You are welcome to send us a copy of the thesis.
Hope this is helpful.
Best regards,
Giovanni

-----Original Message-----
From: Marina Efthymiou [mailto:Marina.Efthymiou@uwl.ac.uk]
Sent: 26 July 2016 11:22
To: NERO Giovanni
Subject: Copyright of reports for PhD Thesis

Dear Dr Nero,

I hope you are well! It has been some time since I last met you in the European Aviation Conference in Cranfield.

As I mentioned to you when I was at EUROCONTROL working for DPS/SSR, I am writing my PhD Thesis about Single European Sky and EU Emissions Trading Scheme. I will have my viva around October- November 2016 and my university (University of West London) is asking authorization for using copyrighted material, i.e. charts, graphs, illustrations.

I contacted the legal team of EUROCONTROL and they asked me to take authorization from the Head of Unit or team leaders that produced the reports. In my PhD Thesis I have used some tables from ACE reports, the map of FABs and some other graphs that I found in publicly published reports or the public website of EUROCONTROL. Since you the 'mastermind' behind most of the reports, would it be possible to have a letter (please find attached and amend it as you deem appropriate) or even an email mentioning that I can use for non-commercial purposes the material found only in the public domain of EUROCONTROL mentioning the author/source of the material.

Please do not hesitate to contact me should you have any queries.

Thank you very much in advance.
I am looking forward for your reply.

With best regards,
Marina

Marina Efthymiou
Lecturer in Aviation and Tourism
London College of Hospitality and Tourism University of West London
|St Mary's Road | Ealing|W5 5RF |UK