UCL DEPARTMENT OF CIVIL, ENVIRONMENTAL
AND GEOMATIC ENGINEERING

DEVELOPING LOW-CARBON TRANSPORT POLICIES IN PERU WITH CAPACITY BUILDING FOR THEIR IMPLEMENTATION

DRAFT TRANSPORT NAMA

NICK TYLER CBE, CLAUDIA RAMIREZ

MARCH 2012

Embajada Británica
Lima

swisscontact

ARUP

Table of Contents

EXECUTIVE SUMMARY **6**

INTRODUCTION **9**

CHAPTER 1 - NATIONALLY APPROPRIATE MITIGATION ACTIONS (NAMAS) **10**

NAMAs Context 10
The importance of Transport in the Climate Change Framework 10
Expected Benefits from a Transport NAMA 11
Examples of Transport NAMAs from other Countries 12
International Voluntary communication by Peru 13
Peru's National Framework on Climate Change 16
Needs identified *20*

CHAPTER 2 – TOOLS TO SUPPORT THE DEVELOPMENT OF A NAMA **21**

Mobility Context and the need for 'Mobility Reform' 21
The hierarchy of Mobility *21*
Modal Retention *22*
Energy efficiency of transport modes *24*
Analytical and Technical Tools 26
The RED Strategy approach *27*
Analytical Tools *28*
Outcome-based decision making *28*
Cost Benefit Analysis vs Multi Criteria Analysis *31*
Establishing a base line *33*

CHAPTER 3 - DEVELOPMENT OF A DRAFT TRANSPORT NAMA **35**

Peru and the Transport Context 35
Current Transport Issues 38
Peru's competitiveness and business opportunities 39
Prioritising Measures 40
Urban Mobility *41*
Energy Efficiency *41*
Land Use planning *41*

CHAPTER 4 – DRAFT TRANSPORT NAMA MEASURES **43**

Measure 1 - Integrated Mobility 43
Aim *43*
Objectives: *43*
Proposed Interventions *51*
Time frame for implementation of the draft NAMA *59*
Risks or limitations *65*
Measure 2 – Energy Efficiency 66
Aim *66*
Objectives *67*
Proposed Interventions *68*
Time Frame *69*
Risks or limitations *70*
Measure 3 - Green Zones 71

Aim *71*
Objectives *71*
Proposed Interventions *76*
Time Frame *78*
Co-benefits *81*

CHAPTER 5 - CONCLUSIONS AND RECOMMENDATIONS 82

APPENDIX I – NAMAS CONTEXT 85

APPENDIX II - TOOLS TO SUPPORT THE DEVELOPMENT OF A NAMA 88

APPENDIX III DEVELOPING A NAMA 98

APPENDIX IV TABLE SUMMARY OF PROPOSED ACTIONS 99

APPENDIX V EFICIENCIA ENERGÉTICA PARA VEHÍCULOS LIGEROS EN EL PERÚ 104

APPENDIX VI LIMA GREEN ZONES 191

APPENDIX VII IMPACTO AMBIENTAL DE UNA ZONA DE ACTIVIDAD LOGÍSTICA (ZAL) 236

BIBLIOGRAPHY 241

Tables

Table 1 Expected benefits matrix from a successful Transport NAMA 12
Table 2 Overview and comparison of Transport NAMAs 14
Table 3 Possible CO_2 emission reductions (tonnes) for the Proposed NAMAs from the Second National Communication 16
Table 4 Ministerial Framework relevant to Transport 18
Table 5 Proposed Interventions for Integrated Mobility 52
Table 6 Actions within intervention 1: Creation of (UTA for transport in Lima and Callao 60
Table 7 Actions within intervention 2 - Mobility Reform for Lima and Callao 61
Table 8 Actions within intervention 2 - Mobility Reform for Lima and Callao (Continue) 62
Table 9 Actions within intervention 3 - Institution of an Inter-Institutional Transport NAMA Committee (IITNC) 62
Table 10 Actions within intervention 4 - Development of a Transport NAMA 62
Table 11 Actions within intervention 5: Development of Travel Plans 63
Table 12 Actions within intervention 6: Development of an Energy-efficient Mobility Plan 63
Table 13 Actions within intervention 7 - Support for Education and Training 64
Table 14 Actions within intervention 8 - Devise new infrastructure plan for city and national infrastructure 64
Table 15 Actions within intervention 9 - Seek Financial support for the Implementation of the NAMA 65
Table 16 Proposed Intervention for Energy Efficiency 68
Table 17 Actions within intervention 10 – Vehicle Labelling 69
Table 18 Actions within intervention 11 - Cleaner Fuels 69
Table 19 Actions within intervention 12– Mechanism to achieve 120g CO_2 per km travelled 70
Table 20 Cost and benefit estimation for light vehicles (15,000km) 71
Table 21 Potential zones for the development of Green Zones 75
Table 22 Proposed Interventions for Green Zones in Lima 76
Table 23 Actions within intervention 13 - Design and Planning 78
Table 24 Actions within intervention 14 - Governance and Delivery 78
Table 25 Actions within intervention 15 - Carbon accounting and sustainability 79
Table 26 Actions within intervention 16 - Tendering and feasibility studies 79
Table 27 Impacts on Health from actions 93
Table 28 Summary of all actions within interventions 99

Figures

Figure 1 Global Transport emissions....10
Figure 2 Transport System flow model - Benefits....11
Figure 3 Sectoral Distribution of NAMAs.....12
Figure 4 Total GHG emissions in Peru....13
Figure 5 GHG emission distribution by sector....13
Figure 6 Hierarchy of Mobility (L.O.V. = Low Occupancy Vehicles (e.g. private car))....21
Figure 7 The RED Strategy, showing general principles for implementation....28
Figure 8 Outcome-based decision model from Quality of life to Integrated Mobility....30
Figure 9 Cost Benefits Analysis *vs*. Multi-Criteria Analysis....33
Figure 10 Panamericana Avenue....37
Figure 11 Daily trips by region....37
Figure 12 Metropolitano and Electric Train in Lima)....38
Figure 13 Overall Transport NAMA....42
Figure 14 Illustrates the mitigation interventions suggested within the measures....42
Figure 15 Orbital, radial and interconnectivity network principles in London. We would expect economic activity to increase around the strategic interchanges (evident in London, for example at West Hampstead, Stratford and Clapham Junction).....45
Figure 16 Trips by mode Lima and Callao....54
Figure 17 Capacity Training Pyramid....58
Figure 18 Proposed training time frame....58
Figure 19 Final consumption structure of hydrocarbons and biofuels by sectors....67
Figure 20 Potential areas for the development of Green Zones in Lima....74
Figure 21 Proposed time frame for Green Zones....80
Figure 22 Strategic Actions suggested by MINAM under the PLANAA....86
Figure 23 Vehicles vs Bus – Taken from Non-Motorised Transport (Municipality of Lima presentation)....88
Figure 24 Impact on Health....93
Figure 25 Scores for the three actions considered against all seven criteria....94
Figure 26 Holistic Multicriteria Analysis....94

Executive Summary[1]

Transport has been identified as one of the biggest sectors that contribute to climate change (23%) due to its energy demand and polluting emissions and therefore one of the sectors that needs to take action to mitigate its impact. A few countries in Latin America (Brazil, Chile, Mexico and Colombia) have started their transport NAMA development and are at different stages in the process. Peru has started this process more recently and this report aims at facilitating the NAMA development and a strategy for its implementation. A key issue in the Peruvian case is the need to set a wave of change in the way transport is usually perceived and addressed in Peru. Thus this report considers both the requirements and changes needed in order to implement a successful and appropriate transport NAMA.

What is a NAMA?

A NAMA (Nationally Appropriate Mitigation Actions) is a concept that originated under the Conference of the Parties (COP) in Bali 2007, as a mechanism to engage "*Nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner;*" [2]. With two years of application; NAMAs have managed to attract transport sector decision-makers due to their alignment with national priorities and potential large financial and technical support to implement them.

Overall Vision of a Transport NAMA in Peru

The overarching aim for the transport NAMA in Peru is the achievement of the minimum optimum **mobility** required to stimulate **economic growth** and thus improve the **quality of life**. This report suggests that three areas of priority should be tackled in order to achieve the overarching aim – *Urban Mobility, Energy Efficiency* and the role of *land use and planning* – in the development and implementation of carbon emissions targets.

In order to reduce emissions by any significant amount, it is necessary to devise measures for each of these priorities. For Urban Mobility, the measure to be adopted is the development of an integrated mobility system; for Energy Efficiency, the measure is the development of a programme to increase the energy efficiency of vehicles; for Land use and planning, the measure is to develop demonstrator Green Zones to show how low carbon living might work in reality. Each measure amounts to a set of interventions and each intervention has a set of Actions. The Actions are measurable, reportable and verifiable. In the draft NAMA, there are 16 Interventions and 51 Actions explained in Chapter 4 and some suggestions for indicators of successful outcomes (See chapter 4 intervention time frame tables).

The dominance of the capital city of Lima and Callao in relation to the rest of the country means that significant effort needs to be made in the capital in order to influence the success of the policy at the

[1] This draft transport NAMA is the final product of a project commissioned by the UK Foreign & Commonwealth Office via the British Embassy in Lima, together with the Ministry of Transport and Communications, Ministry of Environment, the Municipality of Lima and Municipality of Callao The project has been carried out by University College London, who besides this report has achieved three more outcomes; a capacity needs assessment report, and two training events; one Media Mobility workshop and one international seminar on urban transport decision making.

[2] The Bali Action Plan included as a priority enhanced mitigation action by all developed country Parties "*under measurable, reportable and verifiable nationally appropriate mitigation commitments or actions, including quantified emission limitation and reduction objectives, while ensuring the comparability of efforts among them".*

national level. Many of the actions will therefore apply to and be developed in Lima and Callao. Most can be repeated elsewhere in the country as appropriate.

A major finding is that to achieve the aim, it is crucially important to ensure coherent, consistent and comprehensive governance over the transport system, without which environmental and operational actions will fail. Therefore a major **Mobility Reform** must be put in place – some initial steps have already been taken but the path is longer than the political cycle; therefore in the case of Lima and Callao this reform could be facilitated by the creation of a Unified Technical Authority (UTA). This will incorporate all government bodies involved in transport in the capital city; to oversee the overall transport system in the city in order to have a low carbon means to provide the urban mobility required by the community.

The UTA can then develop actions to optimise mobility for the population and improve the energy performance of the transport system by implementing the interventions. Some of the Actions suggested in the draft transport NAMA are 'substantive' – designed to achieve the NAMA objectives. Other Actions are 'facilitative' – intended to set up the governance and contextual situations required for successful implementation of the substantive actions. The report presents the arguments to support the choice of these outcomes, objectives, measures, interventions and actions and a suggested initial timescale for implementation.

The 16 Interventions are (Please see Table 28 in appendix IV for summary of all actions):

1. Creation of a Unified Technical Authority
2. Mobility Reform for Lima and Callao
3. Creation of a Multi-institutional Transport NAMA Committee
4. Revision of draft Transport NAMA
5. Development of Travel Plans for commercial activity and employees
6. Development of an energy-efficient Mobility Plan
7. Support for education and training
8. Development, design and implementation of new infrastructure to encourage low energy mobility
9. Seek international finance for the implementation of the transport NAMA
10. Implement a vehicle labelling system and a compulsory system to achieve energy efficiency in light duty vehicles
11. Ensure that fuel quality is improved
12. Adopt mechanisms to achieve the declared emissions target
13. Design and Planning
14. Governance and Delivery
15. Carbon accounting and sustainability
16. Tendering and Feasibility

Key Concepts

Institutional Structure

The overarching aim for the future of the world's citizens is the improvement in the quality of life – and Peru is no exception in this respect. This aim is so overarching that it extends beyond the limitations of political ideas and preferences: it is hard to imagine a political party not wishing to improve the quality of life of the population. It therefore extends beyond the political cycles of elections and terms of office, but requires commitment from all parties so that the initial actions are

started immediately and there is a continuity of purpose – even if the methods and priorities change as one political philosophy is exchanged for another. The nature and scale of the problem (long term) transcends political differences, therefore it is necessary to have the right institutional structures in place in order to ensure that the technico-political discussions can take place in a meaningful way. A decision to implement a transport NAMA will require actions which will only return results beyond the current political cycle and this requires bold political action.

Technical Leadership

Politicians have a duty to bring the societal consensus to the heart of government decision-making but sometimes this will conflict with the practical, technological and methodological requirements of the implementation of their decisions. However important and beneficial the political desire might be, the occasion does arise when it is simply not possible to put it into practice. Therefore there is a need to ensure that there is a body of technical wisdom at the disposal of the politicians. This wisdom includes the knowledge of what is possible, what happened before and an understanding of how to improve the predictions of what could happen in the future. This wisdom needs to be independent of political influence because its role is to provide advice that is independent of political wishes and, in effect, to provide the knowledgeable intelligence that enables politicians to be able to act in a responsible way with society's resources. It should be the norm that a politician turns to the technical leadership for objective advice of the highest order so that all decisions are made on the basis of the best evidence, advice and support. This requires technical leadership that is independent of the political process and therefore free from the changes that often occur as a result of the political cycle. Therefore continuity and leadership is also required at the technical level.

Analytical Tools

Three main tools have been selected to support the draft NAMA process; (1) the Outcome-based Strategy (OBS) which is a tool that formalises and facilitates the decision-making process; (2) the RED (*Reduce, Exchange and Decarbonise)* strategy which aims to drive and guide priorities increasing carbon reduction and improving quality of life; and (3) Multi-Criteria Analysis (MCA) which is an alternative method to cost-benefit analysis (CBA) enabling more effective assessments of strategic actions.

Final remarks

Further work is required in order to transform this draft transport NAMA into a NAMA proposal and this entails firstly the adoption and, if necessary, adjustment of the suggested interventions, followed by assessment of financial and incremental costs, development of appropriate metrics of success (including measurement, calculation, reporting and verification) and achievement of suitable GHG projections.

Peru is currently recognised as a very promising emerging economy attracting international investment and the transport system plays a vital role in this economic development (transporting goods and people). Initial steps have already been taken to improve Mobility in the Metropolitan city (Lima and Callao), however more work needs to be done to ensure Peru's growth reaches its maximum potential. The large technical and financial support available and the potential social co-benefits that can be achieved, make a Transport NAMA the ideal tool to facilitate this goal.

Introduction

This draft Transport NAMA (Nationally Appropriate Mitigation Actions) is the final product of a project commissioned by the UK Foreign & Commonwealth Office via the British Embassy in Lima, together with the Ministry of Transport and Communications and the Municipality of Lima, in order to establish how the United Kingdom could help in Peru's efforts to meet low carbon targets as established under the Bali Action Plan (2007) Copenhagen Accord (2009) and the Cancun Agreements (2010), and the subsequent expressions of intent contained within this Transport NAMA. Accordingly University College London examined the current capacity within the national and local government to deliver a low carbon transport policy, and the extent to which the UK was able to provide some of any education and training to fill any identified gaps.

During the project, a Capacity Needs Assessment Report was developed and submitted and two training sessions were executed, a Media workshop and a high level Transport Seminar, as part of the initial capacity building process. During the development of the project, several interviews, meetings and exchanges were accomplished which enabled the formation of better understanding of the common vision, current capacity and potential enhancement of this capacity to optimise the further development and implementation of a transport NAMA for Peru.

This report is therefore a summary of the possibilities that Peru could take advantage of for a NAMA in terms of transport, energy efficientcy and land use planning, and how these opportunities could be made possible. This report is structured into five chapters and seven appendices and seven appendices. Chapter one briefly highlights the background of the NAMA, its terms of reference, the importance of NAMAs in the transport sector and some examples in other countries. This chapter also indicates the NAMA communications submitted by Peru to the Commission's Executive Secretary of the United Nations Framework Convention on Climate Change, the current climate change policy framework regarding transport and the gaps identified. Chapter two describes the mobility context and key analytical and technical tools that have been employed for the development of this draft transport NAMA. Chapter three describes how the draft transport NAMA has been developed, sets the Peruvian transport context and discusses the three main areas prioritised. Chapter four postulates the set of measures with interventions and actions proposed for on-going development of the NAMA and Chapter five draws conclusions and makes recommendations for further work. Among the appendices there are three full reports that contributed to the development of this draft NAMA; ´Eficiencia Energética para vehículos ligeros en el Perú (Energy efficiency for light vehicles in Peru) by Swisscontact´, ´Lima Green Zones´ by Arup and ´Impacto ambiental de una zona de Actividad Logística (Logistics Activites Zones (ZAL) Environmental Impact)´by Alberto Ruibal.

Chapter 1 - Nationally Appropriate Mitigation Actions (NAMAs)

NAMAs Context

The Nationally Appropriate Mitigation Actions (NAMAs) concept originated during the thirteenth Conference of the Parties (COP) in Bali in 2007; where within the Bali Action Plan, Parties agreed to implement NAMAs by Developing Country Parties in the context of mitigation of sustainable development, supported and empowered by technology, capacity building and financial support and designed in a way that they can be *Measurable, Reportable and Verifiable (MRV)*. The Cancun Agreement (Decision 1/CP.16) added 'achieving the deviation in emissions relative to *business as usual* emissions' in 2010.

Therefore a NAMA is a combination of two facets: (1) *Nationally Appropriate aspects* which are aligned within the National policies and country's objectives such as poverty reduction, health improvement, reduction of air pollution, etc., usually referred to as co-benefits, and (2) *Mitigation Actions* aimed at the reduction of Green House Gases (GHG) stated in a measurable, reportable and verifiable manner.

The importance of Transport in the Climate Change Framework

Transport is a major source of global carbon emissions (23% from fossil fuel consumption[3]) and therefore it is not surprising that many NAMAs are addressing transport. Figure 1 shows the growth of transport projected to 2050 which indicates that all countries need to address their surface road growth in order to reduce CO_2 emissions. For example IDB 2010 suggests that OECD countries should reduce their emissions by 25-40% below 1990 levels by 2020, and non-OECD countries will need to deviate their emissions by 15-30% below business as usual for the same period (IDB, 2010). In terms of CO_2 emissions, this reduction will mean 0.6-1.3GtCO_2-eq/year.

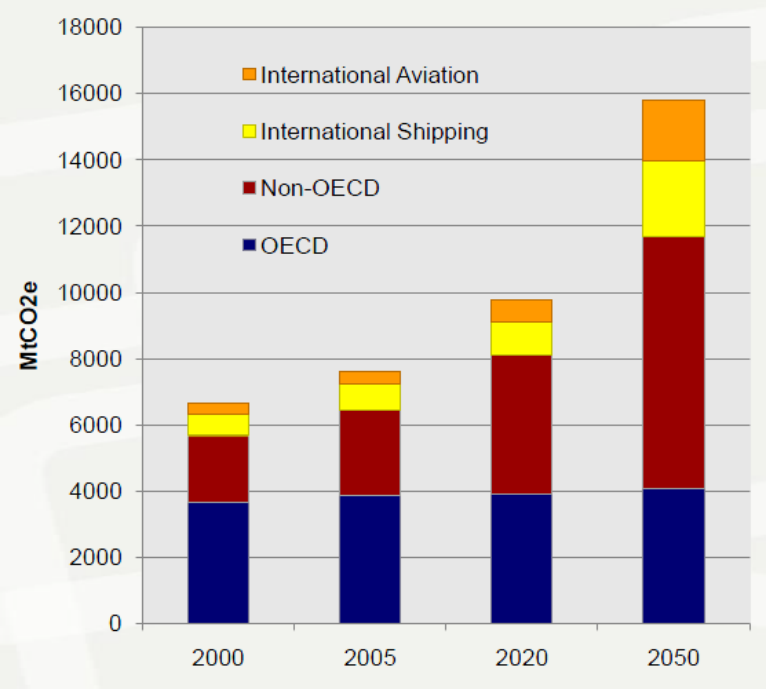


Figure 1 Global Transport emissions

[3] Tip of Iceberg. Ko Sakamoto, Asian Development Bank pdf presentation. [Accessed on: 28/02/2012] Retrieved from: http://cleanairinitiative.org/portal/sites/default/files/presentations/Sakamoto_ADB_Tip_of_the_Iceberg_0.pdf

The development of NAMAs in the transport sector has shown a dramatic improvement and more active support compared to CDMs (Clean Development Mechanisms) and this is because it involves developing policies, there is opportunity for international financial and technical support and, as the actions are nationally appropriate, they are aligned with national priorities and led by the government. Furthermore the potential availability of larger financial support available in the coming years makes NAMAs excellent facilitative tools to develop win-win strategies in transforming the transport sector.

Expected Benefits from a Transport NAMA

In order to achieve a successful transport NAMA is it necessary to have a coherent transport system in place, and if it is not coherent then a reform of the transport system is essential. The benefits that a coherent transport system on its own will yield relate directly to transport benefits such as travel time savings, congestion reduction and reliability, etc. Similarly, developing a NAMA will reduce polluting emissions and improve air quality, yielding climate change benefits, however, integrating both: coherent Transport System and NAMA development will yield important co-benefits in three main areas: Environmental, Social and Economic. The transport system flow model shown in Figure 2 indicates that the coherent transport system is a pre-requisite for the development of a NAMA and in turn, these two are pre-requisites for obtaining the overall co-benefits.

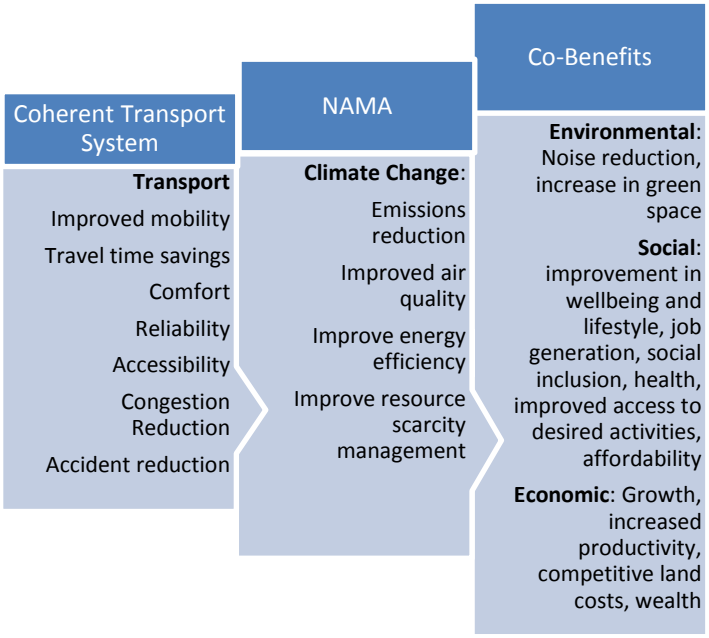


Figure 2 Transport System flow model - Benefits

There are two important barriers in identifying the co-benefits, one is the time scale at which the outcome can be seen and the other is quantifying the benefits to see the improvement. Table 1 categorises the expected co-benefits into a *matrix* that classifies them into short, medium and long term and also into quantifiable and difficult to measure. The importance of this matrix is that it aids the measuring, reporting and verification process by listing potential indicators of success from the quantifiable benefits whilst indicating a time range. Similarly, it provides a clear list of benefits that require clear definition to allow them to be measured. Overall, the development of a successful transport NAMA has been identified as a win-win strategy and the co-benefits listed in Table 1 are the potential results of its success.

Table 1 Expected benefits matrix from a successful Transport NAMA

Difficult to quantify	• Social impact on lifestyle • Social acceptance • Travel time reliability • Congestion reduction	• Equitable accessibility • Inclusive growth • Increased sense of ownership of the city • Improved labour conditions in the transport sector • Improved in the quality of the service • Improved inter-institutional coordination	• Increased active longevity • Change in environmental awareness of subsequent generations • Peru is seen as a source of sustainable mobility expertise
		• Increased competitiveness • Increased productivity	
Quantifiable	• Reduction of GHG emissions • Reduction air pollution • Reduction of noise • Reduction of accidents • Travel times savings • Job generation • Lower costs of economic production	• Reduction of health problems • Reduction of transport costs • Increase in Green areas and public space	• Enhanced sustainable economic growth rate • City regions realigned on the basis of reductions in movement and development of economically viable suburbs • Improvement in rural economy to reduce desire for migration
		• Competitive land costs	
Short tern (1-3 years)		Medium (4-6 years)	Long term (6 years onwards)

Examples of Transport NAMAs from other Countries

Since the start of the NAMA process, a number of countries have taken proactive action in developing and submitting them officially to the UNFCCC Secretariat. The annual report highlights the diversity of these submissions; with 19 NAMAs classified as concepts and 11 as proposals (Ecofys, 2011). Figure 3 shows that the highest submission sector is transport with 12 NAMAs followed by Energy with 6. This shows that there is great scope for the transport sector and some countries are already seeing the benefits.

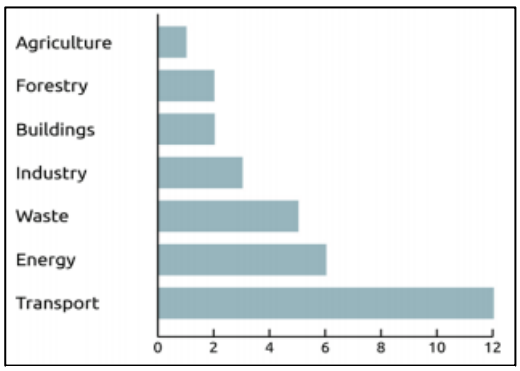


Figure 3 Sectoral Distribution of NAMAs. Source: (Ecofys, 2011)

Chile submitted a proposal for an 'E mobility Readiness' NAMA, which involves the development and implementation of a plan that can facilitate the introduction of grid-enabled vehicles in the greater Santiago area. The goal is to introduce 70,000 of these vehicles by 2020 which will reduce emissions

by an estimated 2.7 million tonnes of CO_2 by 2035. The development of this exemplary NAMA was made with technical support from Ecofys and the financial support from the International Climate Initiative of the German Government and it involved extensive stakeholder engagement at all levels. The proposal is scheduled to be published early in 2012 and the work is due to start in mid-2012 subject to availability of financial support.

Table 2 (next page) is an overview of four countries' transport NAMA proposals, reviewed by the International Development Bank, the Asian Development Bank and Slocat (IDB, 2010). The lack of capacity to develop and implement the NAMAs is seen as a common barrier among these four countries and therefore a key aspect to address globally.

International Voluntary communication by Peru

Peru has shown active support for the NAMA initiatives and has submitted official communications regarding their commitment to reducing CO_2 emissions. (See all communications in appendix I)

The **first voluntary** communication regarding mitigation actions was submitted on the 20th of June 2010[4]. Where among other issues; energy was underlined with the intention of modifiyng the energy grid so that at least 33% of the energy used will come from renewable sources by 2020.

The **Second communication** was submitted on the 28th of September 2010 under the '*Peruvian Second National Communication*'. The document contains a general overview of the country, provides a breakdown on policies, institutional framework and inventory summary of GHG emissions among different sectors. Figure 4 shows the breakdown of the GHG emissions in Peru where energy has been identified as the second largest source of GHG emissions (21.2%) in Peru after forest and grassland conversions (47.5%). Figure 5 shows the split of the energy category into use of energy by the various sectors including transport, which, at 39.8%, is the largest sector within this category.

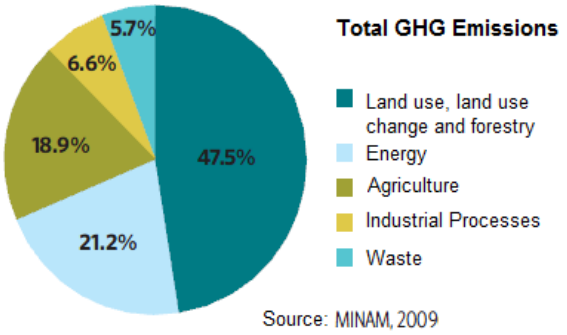


Figure 4 Total GHG emissions in Peru

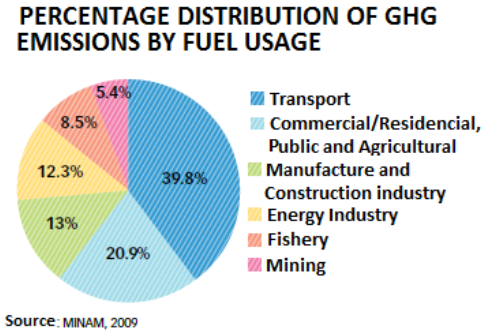


Figure 5 GHG emission distribution by sector

[4] Nationally Appropriate Mitigations Actions of Developing Country Parties. United Nations Framework Convention on Climate Change (UNFCCC). [Accessed on 6/3/2012). Retrieved From: http://unfccc.int/meetings/cop_15/copenhagen_accord/items/5265.php

Table 2 Overview and comparison of Transport NAMAs

	Context	Proposed NAMA	Barriers/Costs	Methodological Issues	Benefits
MEXICO (Mexico City) Optimization of Public Transport **Institutional Involvement**: Ministry of Transport (Implementation and MRV)	Low fuel prices Poor regulation Lack of system planning, Poor quality of public transport (network of more than 28,000 privately owned, single-owner-operated buses)	Optimization of the conventional bus system including expansion of BRT systems. Aims: 1) Establishment of the appropriate institutional and regulatory framework needed for the optimization of the bus system; 2) Implementation of changes in the bus system (reorganization of routes and concession management) 3) Public awareness and outreach 4) Implementation of a transport monitoring system	1) lack of information and data 2) Lack of the necessary institutions and regulations 3) Long term costs returns 4) Social (Bus drivers fear losing their jobs).	Monitoring, Reporting and Verifying (MRV) the success of the initiatives is not clear because emission reductions of the NAMA derive from efficiency gains. Therefore the MRV will not be metric but will provide certainty based on indicators.	• Less congestion • Time savings • Transport quality • Positive health effects • Cost savings • Decrease in accidents
INDONESIA (Jakarta) Transport Demand Management **Institutional Involvement**: A large number of national a local level institutions will be involved	Transport sector contributes to 23% of Total CO_2 in the Energy Sector. Rapid growth of car ownership	Developed Transport Demand Management (TDM) policies, with a study that gave a working example on how a local-level NAMA can mitigate transport emissions. Focused on three main elements: • Electronic road pricing • Parking restraint • Bus Rapid Transit This study was used to set priorities and was included in the Jakarta Master Plan.	Limitations in the quality of input data (large number of assumptions.) and capacity building Transfer of key technologies Technical assistance, and capacity building on MRV to implement this NAMA	Quantifying CO_2 emissions: the study suggested combining transport demand models with vehicle fleet information. This model provided the following outputs: • Traffic volumes • Congestion levels • Air Quality pollutant Emissions	Combination of three policies will lead to up to 40% reduction in total transport demand when focusing in the Central Business District (CBD), Potential sustained CO_2 reduction of between 20-30% compared to BAU for an area within the Jakarta Outer Ring Road, and even larger levels for the CBD.

	Context	Proposed NAMA	Barriers/Costs	Methodological Issues	Benefits
BRAZIL (Belo Horizonte), Comprehensive Urban Mobility **Institutional Involvement**: Large number of institutions involved at different stages and playing different roles	The city of Belo Horizonte developed a Mobility plan 'PlanmobBH' which involves extensive data collection and modelling. Therefore, the urban transport NAMA is designed to help remove barriers for implementation of comprehensive urban mobility plans.	The proposed NAMA framework aims for an integrated approach to: Increase active (i.e., non-motorized transportation (NMT)) and public transport modal share. Enhancement of public transport (BRT and metro), metropolitan fare integration, construction of infrastructure, promotion of NMT and combined land use and parking policies, with a total investment of US$ 4.2 billion. By 2020, this integral mobility plan is projected to achieve 27% reductions in GHG emissions and reach 36% by 2030 which is when it is planned to end.	Shortage of funding and permanence over time. Financial barriers managed in three ways: general funding, international financial flows and specific climate funding mechanisms. Problems in MRV process: data collection, modelling and lack of technical expertise on data analysis. Public Acceptance	MRV: A city-wide survey is proposed to monitor the activity data. At the city level, reporting could be assigned to a joint committee City reports would be collected and reviewed by the national authority in charge of submitting, monitoring and reporting NAMAs to the UNFCCC.	The net cumulative GHG emission savings over the 22-year period 2008-2030 are estimated at 9 MtCO2-eq. NAMA will provide continuity over several election terms. Public health benefits for the community due to reduced air pollutant Emissions, less accidents, and increased on physical activity.
PR CHINA (Hefei) Standardized Baselines **for Public Transport in** **Institutional Involvement:** Not specified	Transport demand is growing, population of 4.87million (2million in urban centre). Increased on daily bus journeys from 700,000 (2003) to 1.8million (2010). Vehicle ownership increasing too. There are 3 lines of BRT.	The proposed NAMA for Hefei is to create a 'walkable city' and therefore restructure the transit system and improve the city's accessibility. One of the elements of the NAMA is a study on the development of standard baselines to simplify the MRV system.	Very difficult to develop in the transport sector due to high diversity factors. Complex data gathering Applicable to small regions only. Capacity-building to gather data and develop the system.	Only partial standardization can be possible through default assumptions. These can introduce considerable uncertainties.	It could reduce transaction costs in the long term; facilitate the development of Transport NAMAs and in turn MRV systems. This could improve GHG inventories. It could enable comparability among homogeneous sectors.

Regarding transport mitigation; Table 3 highlights the suggested measures with their relevant impact in terms of tonnes of CO_2 emissions with and without implementation of the proposed actions (MINAM, 2010). The communication specifies that the aim of these actions should be to control road transport emissions (94% of total Transport) and that the coordination should be led by the Ministry of Transport and Communications and by the Ministry of Environment.

Table 3 also shows the planned dates for achievement; as can be seen, many of these are yet to be achieved and could be regarded – with the benefit of hindsight – as being rather ambitious in such a timescale. For example, renewing the vehicle fleet so that no vehicle is older than 10 years of age by 2012 would be a very hard target to achieve. This illustrates a need to ensure that the ambitions contained within a NAMA need to be realistic and based on sound technical evaluation of the available scientific evidence and an interpretation that is reasonable and defensible.

Table 3 Possible CO_2 emission reductions (tonnes) for the Proposed NAMAs from the Second National Communication

Measures	tCO_2 Emissions	
	Without implementation	With implementation
Transport		
1. Vehicle fleet renewal not older that 10years (2012)	11,879,898	7,542,383
2. Daily efficiency in the Public Transport System (2012)	11,979	10,218
3. 5% hybrid vehicle fleet (by 2012)	10,168,540	9,187,125
4. Efficiency in National Freight transport (by 2017)	2,293,612	1,803, 645
5. Efficient driving (10% energy savings in 5 years)	Reduction of 3,000,000 tCO_2/5 years	

The **final communication** so far was submitted on the 25th of July 2011[5] where Peru reaffirmed its national commitment and among further clarification on the reduction actions; it specified its commitment to reduce at least 28% of the energy-based emissions by 2021 (including transport).

Peru's National Framework on Climate Change

Peru has developed a range of organizations, plans, policies, laws and regulations at a National level to address climate change since the first assessment report of the Intergovernmental Panel on Climate Change (IPCC) in 1990. Although this report was important in starting the environmental process, it seems to have had very little other influence in Peru. However, following the submission of the first National Communication in 2000, the past decade has seen a much greater response and more active commitment. After developing the **National Agreement** aimed at developing guidelines to address the Millennium Goals for the short and long term; the **National Strategy on Climate Change (ENCC)** was developed in 2003 based on two aspects of the National Agreement, poverty reduction and sustainable development/environmental management.

There have been some initiatives that have promoted mitigation in the transport sector, although, as reported in MINAM (2010) the main barrier to success has been their enforcement. These initiatives are:

In 2007

- Selective tax adjustment on fuel consumption depending on the level of noxious emissions for each fuel type
- Vehicle fleet renewal regime to encourage the use of compressed natural gas (CNG)

In 2008

- Implementation of the National System of technical vehicle tests
- Registration of car manufacturers for new vehicles
- Temporary regime for scrapping of diesel vehicles

In 2008, the Ministry of Environment (**MINAM)** was created as the highest Environmental authority in Peru, with one of its main objectives as the focal point of the United Nations Framework Convention on Climate Change among other environmental tasks.

In 2009, the National Strategic Planning Centre (**CEPLAN**) and the National Strategic Planning System (**SINAPLAN**) were created as a technical governmental and public management body. CEPLAN has a range of plans from different government bodies at different levels (national, regional and local).[6] Following various national agreements made both prior to and after the creation of MINAM, the **National Environmental Policy** was developed in 2009 with the aim of combining all the public guidelines, objectives, strategies, goals and projects that guided the government's actions at different local, regional and national levels. To enable the implementation of the National policy, the Environmental National Action Plan (**PLANAA)** was established in July 2011 as a national planning tool for the long term (2011-2021) based on Peru's National Environmental Policies.

Table 4 shows a brief summary of the various actions expected of various governmental (national, regional and municipal) bodies.

[6] Planes (Internacionales, sectoriales, temáticos, interregionales, regionales, Municipales). CEPLAN [Accessed on 17/3/2012] Retireved from: http://www.ceplan.gob.pe/planes1

Table 4 Ministerial Framework relevant to Transport

MINEM Referential Plan for the efficient use of energy (MINEM, 2009)	**MINAM**	**MTC**	**Regional Government of Lima (Plan de Desarrollo Regional Concertado)**	**Municipality of Lima and Municipality of Callao**
1. Promote cultural change and in particular efficient driving: • Licensing (freight, private and public vehicles) • Capacity training for all (drivers, staff, managers, etc.) • Media campaigns and marketing material 2. Capacity building for vehicle maintenance • Workshop Technicians and in the technicians Training Curriculum 3. Traffic and Congestion Management • Optimization studies to enable easy flow • Radio stations dedicated to update about the network • Establishment of virtual offices and Introduce day without car during term time • Technical checks to be compatible at a national level reporting road status and impact. 4. Technological Substitution • Determining and reporting the energy usage per km	PLANAA has prioritized goals to achieve in the next 10 years, **Air Quality** is the only goal relevant to Transport. The Objective is '100% implementation of action plans by the prioritised cities (Arequipa, Chiclayo, Chimbote, Cusco, Huancayo, Ilo, Iquitos, La Oroya, Lima - Callao, Pisco, Piura, Trujillo y Cerro de Pasco) and compliance with Environmental Quality Standards (ECA Spanish acronym)' Strategies to achieve the goals: 1. Prevent and control atmospheric pollution 2. Improve the mechanisms to control noise	**Currently developing a Framework for**: • Technical vehicle revisions • Regulation for import of Vehicles • Driving schools **Institutional Strategic Plan[9] - Priorities**: • Organised development of Infrastructure with priority of transport infrastructure in different modes. • Promote development in safety and quality • Support national and international integration • Expansion of communications services to reduce infrastructure gap. • Encouragement of	**Prioritized Lines of Action for the Transport Sector [10]** • Prioritize the conservation of transport infrastructure in all modes and maintain in good condition. • Outsource maintenance using consistent mechanisms in accordance to transport infrastructure. • Develop transport infrastructure in line with economic demand from different sectors, population needs and efficient use of resources. • Promote investment in	**Principles of Mobility Policy for Metropolitan Lima**[11] 1. Public transport is the fundamental system of mobility of the city. 2. Redirection to improve safe and efficient mobility of people, especially children, elderly and people with disabilities. 3. The use of cleaner alternative fuels (CNG or other) is mandatory. 4. Technical proposals must conform to the demand, integration of transport modes and maximum use of existing infrastructure. 5. The restructuring of the system should consider the inclusion of existing operators (companies, owners, drivers and conductors) that offer the service.

[9] Plan Estratégico Institucional 2007 – 2011, Ministerio de Transportes y Comunicaciones. CEPLAN. [Accessed on 20/3/2012] Retrieved from: http://www.ceplan.gob.pe/documents/10157/98984e3c-0118-4668-9046-e4dca26132fd

[10] Plan de Desarrollo Regional Concertado 2008-2021, Gobierno Regional de Lima. CEPLAN. [Accessed on 20/3/2012] Retrieved from: http://www.ceplan.gob.pe/documents/10157/a1337151-edd2-42a2-84e9-1b358d5229fb

[11] Mayor's Resolution No. 332, Ordinance No.954. PDF Presentation. [Accessed on 19/3/2012]

MINEM Referential Plan for the efficient use of energy (MINEM, 2009)	**MINAM**	**MTC**	**Regional Government of Lima (Plan de Desarrollo Regional Concertado)**	**Municipality of Lima and Municipality of Callao**
• Replacement of traffic lights bulbs for LED • Substitution of fuel • Study on the energy impact from using trains instead of freight trucks particularly in Peruvian coast 5. Regulation • Energy efficiency labels • Regulations to avoid the entry of low efficiency vehicles 6. Establishment of an organism that can coordinate between MTC, MINAM, MINEM, MEF and Municipalities 7. Studies and results reporting	3. Extension of green areas in urban environments ------- MINAM has two tools for environmental management; Environmental Quality Standards (ECA) and Maximum Permissible Limits (LMP - Spanish acronym). For the transport sector there are maximum permissible limits for polluting emissions of vehicles[7] and under ECA there are standards for noise and air pollution[8].	technologic innovation, integral digitalization of networks. • Strengthening of socio-environmental management in the sector • Contribution to the decentralization within the country • Update and strengthen the institutional management capacity of the sector.	the development of transport infrastructure within legal secure and stable framework. • Increase the levels of safety in the transport infrastructure. • Promote the development and optimization of services related to transport infrastructure	The management committee of the Clear Air initiative for Lima-Callao has the following programmes[12]: • II Integral Plan for Atmospheric Sanitation Lima Callao 2011-2012 • Programme to stop and reverse atmospheric contamination by PM_{10} and $PM_{2.5}$ • Air contamination prevention and control programme • Air contamination research programme

[7] Establecen Límites Máximos Permisibles de emisiones contaminantes para vehículos automotores que circulen en la red vial. El Peruano, MINAM. [Accessed on 20/3/2012] Retireved from: http://www.minam.gob.pe/dmdocuments/DS_047-2001-MTC.pdf

[8] Reglamento de Estándares Nacionales de Calidad Ambiental del Aire. MINEM. Accessed on 23/3/2012] Retrieved from: http://intranet2.minem.gob.pe/web/archivos/dgaam/publicaciones/compendio99/D.S%20074-2001-PCM.pdf

[12] Plan Integral de Saneamiento Atmosférico Lima Callao 2011-2012, draft. Scribd. [Accessed on 23/3/2012] Retrieved from: http://www.scribd.com/doc/60864107/II-PISA-Plan-Integral-de-Saneamiento-Atmosferico-Lima-Callao-2011-2015-Junio-2011-para-Taller. For more information about PISA LC, visit: http://www.comitelc.airelimpio.org.pe/creacion.html

Needs identified

The needs perceived thus far in addressing this NAMA suggest the following initial conclusions:

A clear aim for emission reduction in transport: Table 4 shows that on a sectoral level, different governmental bodies have developed plans of actions to reduce emissions and some of these have addressed the transport sector. However, the level of inclusion of transport varies between the national strategies so it seems that the transport sector has not been given its due importance in terms of developing GHG emissions reduction in a consistent way across all the strategies. Therefore it is clear that a specific environmental strategy for the transport sector should be developed to reduce this gap.

An integrated approach: several authorities are involved in one way or another in the transport sector, but there is a lack of integration and coordination between them. This, results in an inconsistent approach, a duplication of actions, suggestions that are never considered, and a lack of clarity about who is responsible for what or who is going to implement suggested actions. This can be seen for instance in the case of monitoring emissions (where three authorities are involved – Ministry of Health, Ministry of Environment and Protransporte (Municipality of Lima) – but there is little coordination between them).

Capacity within the sector to understand what is needed to address the issue: This is an example of a more general lack of technical capacity which is discussed in the capacity needs assessment report and briefly in Chapter 4. However, it is important to realise that the needs resulting from the gaps discussed above do require adequate technical expertise in order to determine how to close the gaps and therefore the development of technical capacity is crucially important for progress to be made.

Chapter 2 – Tools to support the development of a NAMA

To improve the transport performance and redirect it to a more sustainable and low carbon sector, it is important to discuss the essential aspects that will make this approach possible. This chapter provides an overview of the tools and philosophy identified as essential in the development of the NAMA with more detailed context found in Appendix II.

Mobility Context and the need for 'Mobility Reform'

When considering carbon reduction in the transport sector, it is important to recognise that people are looking for 'mobility' – the ability to reach the activities they wish to follow – and not 'transport'. The 'transport' system is just the means by which they achieve this mobility. Mobility can be delivered by a transport system which does not involve the use of motors (Non-motorised transport (NMT)) – or even travel (if goods and services can be delivered to the point of origin or electronically instead of physically). So a major element of reducing energy use and thus carbon emissions in the transport system is to reduce the need to travel at all and to prioritise NMT modes of transport if travel is necessary. It is therefore essential to consider mobility as the prime objective of a transport system so that the emphasis is placed on what the transport system delivers rather than what it looks like or how it works. This shift in emphasis is important because it makes the energy consumption subservient to the delivery of a 'livable life' and thus opens up possibilities for developing low-energy transport systems which deliver the required mobility. Unless mobility is considered as the overall objective, measures to reduce carbon emissions in the transport sector will be doomed to fail.

The hierarchy of Mobility

An elementary principle when considering mobility is the understanding of its hierarchy (Figure 6) which is defined on the basis of social fairness, democracy and equity, social inclusion, health and economy. It is crucial that this hierarchy is understood to facilitate prioritising actions and low carbon objectives at a later stage. Description of the each component of the hierarchy can be found in Appendix II.

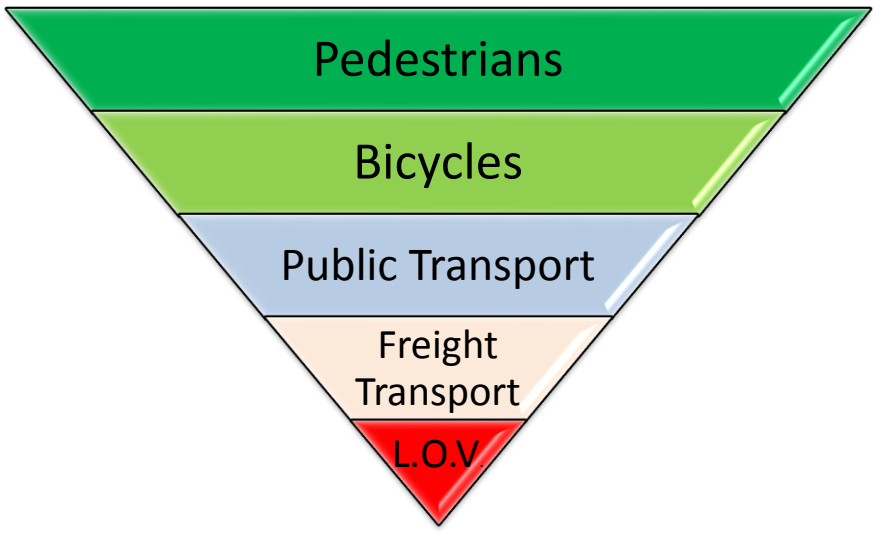


Figure 6 Hierarchy of Mobility (L.O.V. = Low Occupancy Vehicles (e.g. private car))

Modal Retention

Peru, and Lima/Callao in particular, has a great advantage over many countries with growing economies – namely that at present its rate of motorisation is relatively low. Lima, for example, has around 900,000 private vehicles and around 9 million inhabitants. 'Modal shift' is therefore not really the issue – it is more one of 'modal retention': how to ensure that the number of private vehicles does not increase whilst ensuring that the appropriate level of mobility is obtained for the citizens. This will be a key factor in any Transport NAMA. In the main, this is going to be a matter of making the alternative to the private car sufficiently attractive that it is used as the default means of travelling around the city.

The first consideration to make here is that buying a car is not an economic decision. It is made for a combination of reasons such as perceived convenience and enhanced status-image (prestige): the costs associated with the purchase and operations of a private car are thus penalties that are tolerated in order to gain the convenience and image. The first issue for any transport mode that is to be an alternative to the private car is therefore to address convenience and image. Of the two, convenience is the first issue (i.e. image can be attained in other ways).

Convenience becomes an issue of access in space and time, so in terms of a mobility network the issue is about network density in space – where transport systems are available and where they go – and in time – when they are available. It is necessary to have high density in both space and time in order to satisfy the mobility needs of a population. In order to estimate just how high these densities need to be, we need to review the transport system as a whole, but from the perspective of availability of mobility.

Mobility, not transport, is the need. Although it is true to say that mobility is not of itself a requirement for survival, and one extreme of mobility is not to have to move at all in order to live a full life, the likelihood is that people need to move in order to live their lives – they need to buy food, work, go to school and so on – and the duty placed on society is to enable them to do so. Every journey in a city – even one made in a private car – requires a pedestrian element. Pedestrian facilities are thus the most important – the easier it is to walk, the less need there is to maintain the very highest density of transport provision in order to maintain the required mobility. Pedestrian facilities are therefore the first consideration in the determination of the transport provision in a city – the most ubiquitous transport technology is thus a pair of shoes. Depending on issues such as the climate, it is possible to consider a suitable maximum distance which society considers appropriate for a person to have to walk in order to be able to live their lives as fully as possible. In London, for example, Transport for London aims to ensure that there is a bus stop within 400m of everyone's home. Another form of non-motorised transport is cycling. Suitable facilities for cycling are therefore required for 'livable mobility', i.e. not just as a leisure/sport opportunity (important though these are), but as a means of carrying out one's daily life.

If more mobility is required than can be provided by non-motorised modes, it is necessary to consider the provision of public transport, including buses, trains and taxis and the various subdivisions of each of these modes of transport. As mobility is the objective, the important characteristic is that the public transport system's network density is as high as possible, integrated between the subsystems of bus, rail and taxi. Each of these subsystems has a range of technologies

available to it, making variations in terms of size, capacity and availability almost continuous – especially where the subsystems are integrated to form a continuous whole.

The key concept is capacity and this needs to be understood properly. Transport is one of the few world systems in which capacity of the system is not constant. Transport is dynamic and has an associated characteristic that the level of demand affects the level of capacity available to it: as demand increases, so capacity reduces. This is true of any transport system – a motorway for cars, a port operation, an airport – and, most especially of all perhaps, in a public transport system. It is not possible to calculate the capacity of a public transport system without knowing and incorporating the dynamic characteristics of the demand. Capacity links the two densities – of space and time – and is thus the key to successful provision of mobility in a city. So it is important to understand the difference between 'static capacity' and 'dynamic capacity' (see Box 1 next page).

The need to work with Dynamic rather than Static Capacity means that it is important to consider how these function within the context of a city. The description in Box 1 suggests that the number of passengers wishing to board or alight from a train/bus in each station/stop is a crucial parameter for the number of people who can achieve their mobility needs using a public transport system. Therefore thought needs to be given to the design of the network. The traditional view is that people wish to access the centre of a city. This presents a major problem for city and transport planners.

To explain the difference between – and importance of – Static Capacity and Dynamic Capacity, it is easiest to illustrate it with a simple example.

Static Capacity is basically the simple mathematical calculation of how many people it is possible to put in a vehicle and how many vehicles can be accommodated safely in the system. So if a train can carry 1,200 people and we can safely operate 30 trains per hour, the static capacity would be 36,000 passengers per hour per direction.

However, this does not take into account the time the train needs to spend stationary in order to pick up and set down these passengers, so the Dynamic Capacity, which includes this, needs to calculate the effects of the stationary time in the stations. This will deliver a maximum time for a train to be stationary in each station before it starts to affect the ability of the system to deliver the train frequency. Research in London for its new rail lines suggests that, to maintain a frequency of 30 trains per hour, the maximum stationary time is about 30 seconds. To achieve a 30 second maximum stationary time with 30 trains per hour given the passenger demand at those stations and with the given station, track layouts and train design in this case, to enable sufficiently high boarding/alighting rates it is necessary to have the trains operating with an internal passenger density of less than 2.5 people/m^2 and that suggests a total train occupancy of maybe 60% of its theoretical physical carrying capacity. Thus the Dynamic Capacity of such a system would be nearer to 21,600 passengers per hour. This is highly system-dependent so needs to be calculated for every station on every line and every operating period. It is a feature of line-based systems and thus applies to buses as well.

Box 1 Static and Dynamic Capacity of a public transport line

Bringing large numbers of people into the centre of a city, especially at peak hours, is inevitably a huge problem for both the transport system and the planning of the city. Thus it is sensible to design the transport system to facilitate journeys which do not require access to the centre. The construction of an orbital line – possibly more than one – is essential for a major city and should be a major element of the design of a transport system for a city. An orbital line helps to spread the demand around the city centre, rather than bring demand inside it. This (a) reduces the density required inside the centre, reduces congestion and thus reduces the cost of doing business in the centre, and (b) provides opportunities for the area of the city just outside the centre to thrive. They provide a strong incentive to the economic development of suburbs. Orbital lines are useful at various distances from the city centre and provide clear economic and environmental benefits by reducing the need to travel into the city centre in order to satisfy so many mobility needs.

Energy efficiency of transport modes

Even so, the importance of the capacity constraint is not such that we can ignore the implications for energy use (and thus carbon emissions). Building a system with a larger apparent (static) capacity will not necessarily yield the desired dynamic capacity and might well increase the energy requirement.

If the objective is to reduce energy use and thus carbon emissions, then it is important to understand the use of energy in transport systems. In the main, energy is consumed in acceleration and dissipated in braking. If the motor is required to operate whilst the vehicle is stationary (as is typical with conventional internal combustion engines), then there will also be energy use and emissions in congested areas. Therefore best use of energy is in maintaining movement rather than in accelerating, slowing down or stopping. This suggests, for example, that stations should be far apart – but this would not be good for purposes of providing access to the system. One way of dealing with this paradox is to make use of express services which do not stop at all stations. These can carry people on the longer journeys without the need for these people to be accelerated and decelerated at each intermediate station. If the express bus or train can make use of coasting (when movement, having been established after acceleration, is unpowered, resulting in slow deceleration as friction and air resistance combine to reduce speed), this would save a considerable amount of energy. However, such a system would require additional infrastructure – passing lines or even a complete doubling of the track – which would increase the initial cost. Careful calculation would need to be undertaken to determine the best energy-saving from such a system, but if it were a means of reducing energy consumption this could be of interest – even though it would mean the construction of what would appear to be a system with a higher capacity than might be required if only working on the basis of dynamic passenger capacity.

The bus system in Lima/Callao is based on a large number of private operators, working nearly independently of each other. This does not provide for an effective design of a public transport network and there is an important and immediate need to consider how to bring the network under the 'ownership' of the municipalities working together. The network needs to be designed on the basis of providing the required mobility and energy reductions. This concept separates the ownership and operation of the network from the ownership and operation of the vehicles that use it to provide the required capacity. Thus the city requires a certain network density, which is best determined by the city authorities who have an overall view of the city's needs. The actual operation of the service could be left to private or public operators who are contracted to contribute to the provision of the required level of service on the network.

There is a clear case for shifting the bus fleet to a more carbon-friendly fuel system. Hybrid buses would be a good start for this. However, the market in Lima/Callao is not one in which the purchase of new vehicles is the norm. It would be necessary to find a way to finance the purchase *en masse* of high quality hybrid vehicles and associated infrastructure and then set up a suitable process for ensuring that these vehicles are used in the new bus network. The high quality engines involved in hybrid vehicles will, however, require a suitable quality of fuel.

A crucial element of the energy efficiency and emissions reduction issue is that of the quality of fuel. The message is very simple: if poor quality fuel is fed into a motor, low quality emissions and long term damage will emerge. The legal requirements and standards in Peru are in place for a satisfactory fuel quality to be the norm. However, it is clear that the law is being defied and poor quality fuel is being supplied to the public and commercial operators. This act alone makes the attainment of a reduction in harmful emissions an unachievable dream for two reasons. First, the emissions are highly dependent on the quality of fuel being fed into the motor and secondly the poor quality fuel makes the use of better-performing motors impossible – the fuel will simply damage them and render them first inefficient and later damaged beyond repair.

Neither the network design nor the vehicle provision necessarily implies that the public transport system should be owned and operated by the public sector. A more clearly defined separating line between the parts played by each is important though: ownership of the network (including its design and schedules) is a clear public sector duty; operation of the vehicles might be a private sector activity. The provision of vehicles might be easier to manage through the public sector in the short term in order to establish consistency and the need for a fast change in fleet means that a central provision might be required at first. The operation itself is done best by the private sector according to well-established quality and performance measures which are monitored by the public sector on behalf of the citizens of the city.

One of the main reasons why Lima/Callao has such a low level of car ownership is the immediacy of the availability of taxis. Almost available on demand, taxis provide a near-private transport supply, but at a considerable cost. The one saving grace is that the cost of replacing the taxis with private cars would result in far worse congestion, especially at peak hours. Simply reducing the number of taxis is unlikely to be successful without a hugely costly enforcement regime. The reason for this is twofold. First there is clearly a demand for this level of provision: taxi-driving is a near-free-market-entry system so drivers are clearly managing to earn enough to satisfy their economic needs. This suggests that an arbitrary reduction will simply result in other illegal taxis seeking to come into operation. Secondly, the availability of taxis is significant in reducing the need to purchase a private car. So there is an opportunity to improve the taxi system by changing its fuel and increasing the quality of both the vehicles and drivers, and to introduce other near-taxi measures, such as rentable cars which provide point-to-point transport. The taxi fare in Lima and Callao is generally very low (the fare for each trip is negotiated in advance with the driver – there are no taximeters) so there is a potential for a market distortion because the fare is highly unlikely to include external costs such as road use, emissions etc. In addition Natural Gas use is subsidised so it is even cheaper for gas-powered taxis to operate. If a formal taxi system were put in place, the fare could be controlled and such costs included. A controlled fare would have an impact on the competition between taxis and buses because the taxi fare would rise considerably if external costs were included, whereas now they are comparatively cheap.

The reform of the way in which mobility is seen – reprioritising the network in terms of reducing the amount of movement required in order to achieve the required access to activities, favouring modes of transport with lower impacts on the energy inputs and emissions outputs and ensuring that it will be possible to move to 21st century fuels and 21st century fuel quality – is an essential prerequisite for the establishment of a successful NAMA and its implementation. Mobility Reform is therefore a major element of the draft NAMA.

Analytical and Technical Tools

A range of technical tools is required in order to implement a policy change of the size and type of a transport NAMA. The following discussion shows how such tools could help the Mobility Reform process at different levels and stages of the process. There are four main components:

1. An overarching strategy which provides a context in terms of how quality of life objectives could be met with the help of a contribution from the transport NAMA process by being quite clear about the priority for actions and their outcomes;
2. A way by which the strategy can be implemented using an outcome-based decision model;

3. A shift in the way the strategies are usually analysed by comparing cost-benefit analysis with multi-criteria analysis
4. An approach to calculating the resulting changes in greenhouse gas emissions, taking into account the detailed actions that would be implemented as a result of the adoption of the strategy.

The RED Strategy approach

The real objective in terms of the transport sector is not actually transport but the mobility that is required to live a satisfactory daily life. The transport system is the means of providing that mobility and the mobility hierarchy shown above illustrates how the mobility can be provided by a hierarchy of transport provision, starting with what can be provided by means of pedestrian facilities through to that which requires low occupancy vehicles. The transport sector and its associated system allows for failures to be dealt with in each level of the hierarchy – if sufficient mobility cannot be provided by pedestrian means, then it is necessary to devise bicycle schemes, then public transport systems to cope, and so on.

When considering the carbon impact of the transport system, it is necessary to consider from where and how the greatest energy savings and carbon reductions might be obtained. The single greatest reduction can be delivered by cutting motorised journeys altogether. This is the main 'carbon-related' reason for advocating the pedestrian and cycling modes at the top of the hierarchy. A journey which is made on foot instead of by car removes entirely the energy consumption and carbon emissions that would have been made by the car. It also reduces the need to provide city centre parking and thus reduces congestion for those journeys that have to be made in vehicles. If a motorised journey has to be made, then it should be made using modes of transport that are low impact in terms of energy use and carbon emissions. Using a bus, taxi or metro train would each be better than using a car in this respect and the use of freight vehicles which are more appropriate for the city centre operation (i.e. smaller vehicles) would also contribute to better energy consumption and lower emissions. Finally, if motorised modes have to be used, then changing the energy source away from fossil fuels is the most appropriate way forward. This means moving to electricity from gas (especially given the proportion of Peru's electricity supply that is produced by hydro systems). However, it is essential to proceed in this order – changing the fuel will only scratch the surface of the problem if the journeys have not already been minimised and the most appropriate vehicles have not been selected for the motorised journeys that have to be made at all. Thus we have three basic concepts that drive the carbon reduction strategy in the transport system:

I. **Reduce** the number and length of journeys;
II. **Exchange** high-carbon-impact (HCI) modes in favour of low carbon impact (LCI) modes;
III. **Decarbonise** the energy used to provide the remaining transport provision.

We can call this the 'RED Strategy' (See Figure 7 next page).

The RED Strategy shifts attention from the transport system to the activities that occur at the end of the journeys and thus highlights the importance of non-motorised modes of transport – in particular, walking (every journey includes pedestrian elements). In addition it highlights the need to ensure that the various elements of the transport system are linked in an integrated way so that journeys are seamless. This requires a level of overarching consideration of the whole mobility system – the way in which people reach their chosen activities – so that delivery of mobility

becomes the priority and the best practice operation of the integrated transport system becomes the means to achieve the desired outcome.

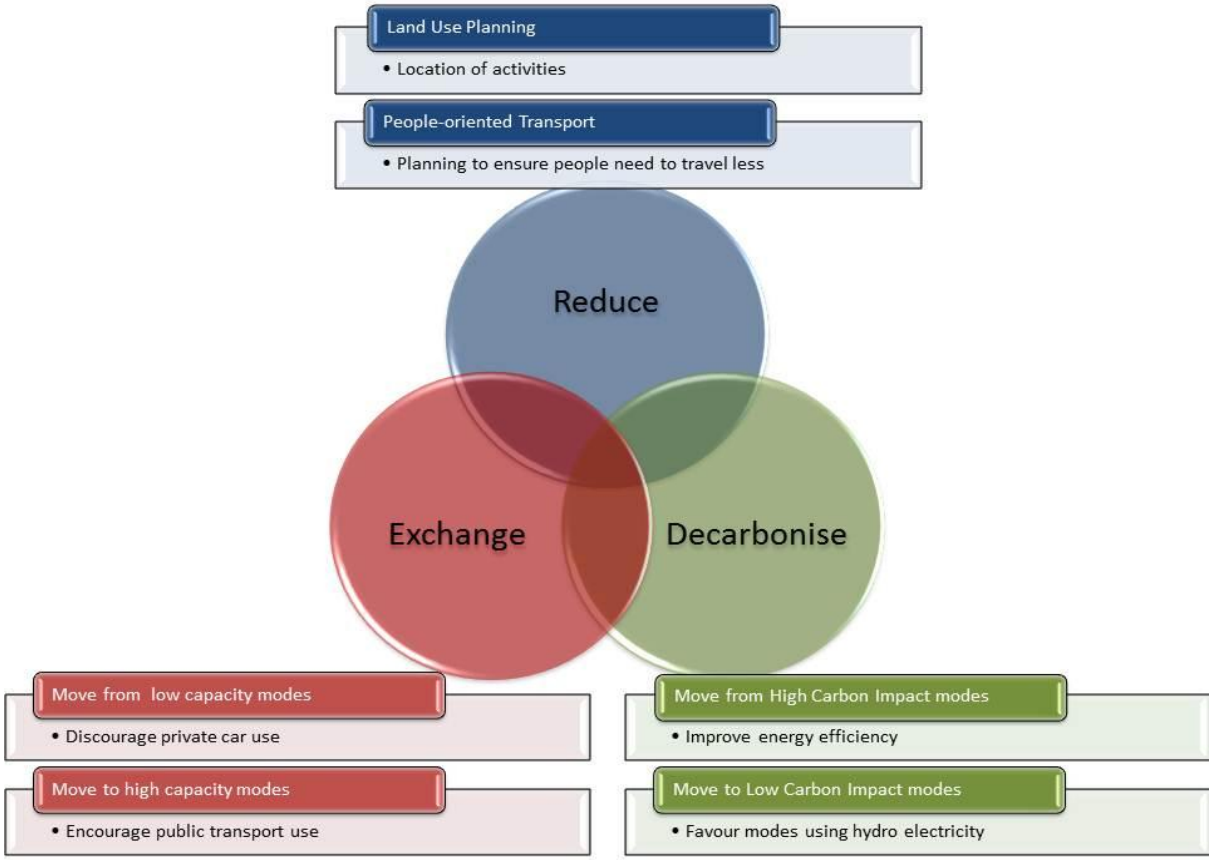


Figure 7 The RED Strategy, showing general principles for implementation

With this in mind, the approach adopted in the project has been to define a set of areas that can:

1. Contribute towards the integration of the city and the mobility of its inhabitants, and
2. Enhance its sustainability and resilience to a continuous changing environment.

These areas have been selected as follows:

- Land use planning,
- Energy efficiency and
- Urban mobility.

Chapter 3 will describe the actions prioritised within these areas.

Analytical Tools

A number of tools are required in order to ensure that appropriate care is taken to develop and analyse the transport actions in a NAMA. We consider first the process of outcome-based decision-making, cost benefit analysis, multi-criteria analysis and the calculation of greenhouse gas savings so that actions can be monitored, measured, reported and verified.

Outcome-based decision making

In order to analyse the issues and the needs required for a Transport NAMA, it is important to have a clear strategy in mind that can provide a way for the problem to become resolved. An Outcomes-Based Strategy (OBS) starts by defining the desired outcomes from a decision so that the decision is

driven by the need to attain those defined outcomes. The tool to develop this strategy is called the Outcome-based decision model. This analysis tool establishes the desired outcomes first, followed by the identification of the factors that will lead to successful attainment of the desired outcome (Success Factors) and those factors which will work against attainment of the desired outcome (Constraints) (See Figure 8). The analysis then determines what can be done in order to take most advantage of the Success Factors whilst acknowledging and dealing with the Constraints. This method is particularly apposite where the problem in question is likely to be intractable to a single solution and/or where compromises will be required.

The Outcome-based model enables leaders to design a more thought-through plan that will formulate a clear strategy to tackle specific problems. It will enable leaders to identify a long-term vision and, based on that vision, determine the steps to get there. The OBS theory can be found in Appendix III

An example of how the Outcomes-Based decision model works is shown in a sequence of diagrams, seen in Figure 8, where stage 1 starts with the overarching Desired Outcome of improving the quality of life. The Success Factors include improvements in the health sector, reduction of poverty and air pollution as well as an improvement in the access to activities so that people can have a realistic choice about the activities they wish to follow. Example Constraints are identified as an Economic Downturn (which could reduce the disposable income of both people and the country as a whole), the disruption caused by changes in political power and policies (most large-scale investments will take longer to implement than the normal political cycle, so are at risk of cancellation or demotion in priority as new politicians take power) and the issue of the aspirations of the people being rather greater than can be supported by the existing infrastructure (thus leading to a potential lack of credibility, trust or support for the measures being adopted before they can be fully realised). In this very simple example, the Strategic Actions following from the analysis associated with these factors and constraints leads to the development of a transport NAMA, which could, if so designed, address all the Success Factors (and would have to in order to meet the desired outcome) and could be designed to take the constraints into account.

The second stage involves a new analysis based on the strategic action from stage 1 which becomes the desired outcome for stage 2, the same process is carried out in this stage, leading to a set of strategic actions which become the desired outcomes for stage 3.

The embedded nature of the Outcome-based decision model means that even in the development of the integrated mobility system (for example), the original desired outcome – the improvement in the quality of life – is still the key goal to be attained. The strategic actions are therefore progressed further in stage 3 but the original high level desired outcome remains. This is important so that focus is applied correctly and difficult choices are made on the basis of achievement of the higher level goals rather than to satisfy particular low level problems. Chapter 4 expands on the justification of the factors of success, their respective constrains and the strategic actions (regarding facilitative and substantive actions) proposed for the Integrated Mobility Strategy.

OUTCOME-BASED STRATEGY SEQUENCE

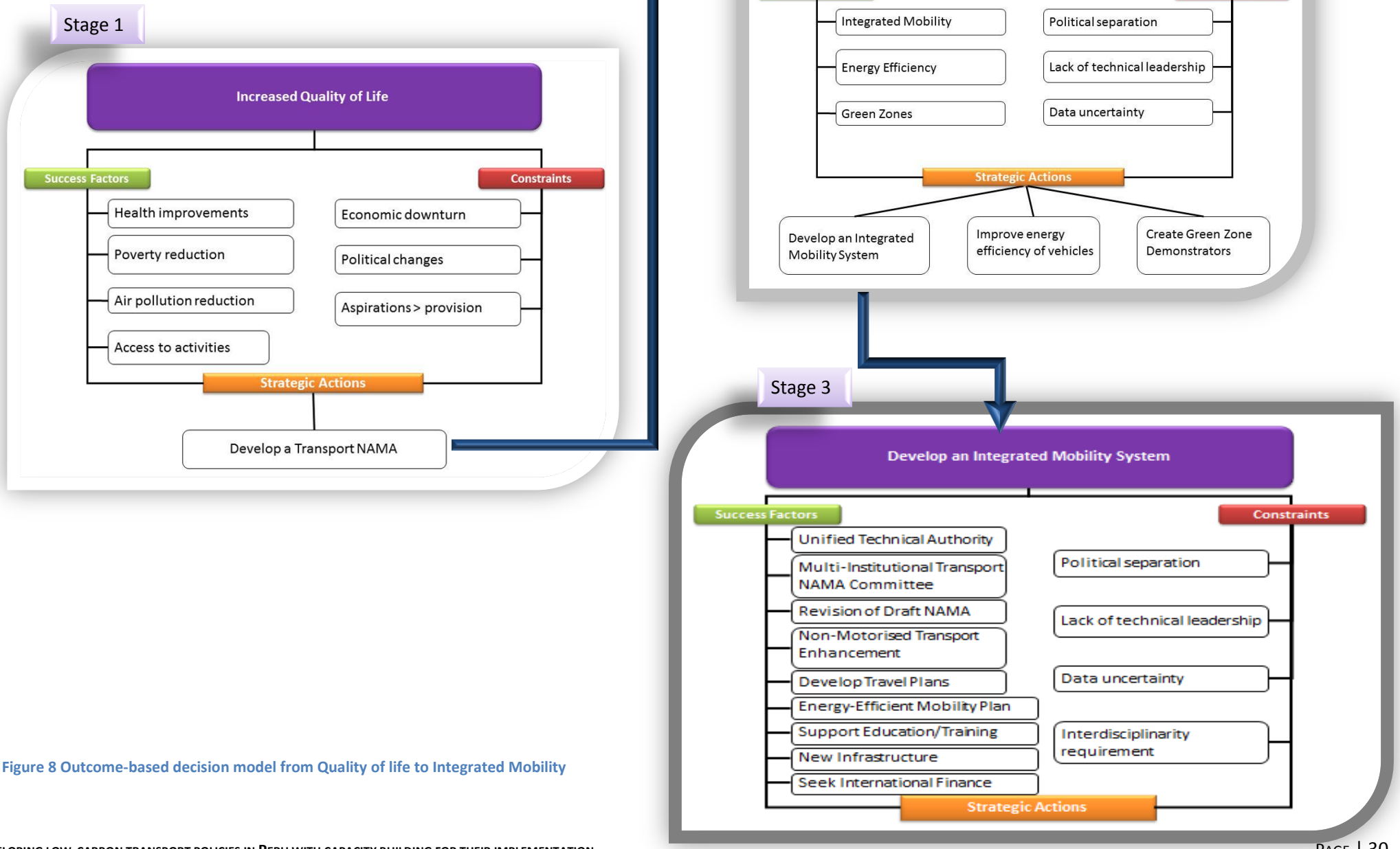


Figure 8 Outcome-based decision model from Quality of life to Integrated Mobility

Cost Benefit Analysis vs Multi Criteria Analysis

All decisions need to be analysed and evaluated so that their economic and financial impacts can be assessed. We consider two types of analysis for such complex decisions, Cost Benefit Analysis and Multi-Criteria Analysis with a view to determine which should be used in the case of a transport NAMA.

Cost Benefit Analysis

The type of analysis that has driven transport (and many other) planning decisions in the last few decades is Cost Benefit Analysis (CBA). This typically consists of a valuation of benefits arising from the implementation of a decision and comparing these with the costs. This is often summarised in the form of a benefit-cost ratio (BCR). In many countries (including the UK) BCR is seen as a strong element of the decision process, with a BCR of a certain value being at least one of the key elements in the evaluation leading to a decision.

However, the CBA/BCR approach has many problems.

First, although the costs are mainly (but not exclusively) financial and thus represented fairly easily in the form of a quantitative value, the benefits are not so easily characterised. Thus the cost and quantity of concrete required to build a certain piece of infrastructure can be quantified, but the improvement to the change in quality of life that might result from its construction is mainly qualitative. It is therefore necessary to have methods to convert qualitative values into quantitative ones and these methods are, at best, speculative. For example, even something as simple as a time saving (which is of course quantitative in nature) needs to be converted to a financial value and this is fraught with difficulties: What is the value of time? Is this the same whatever the quantity of time involved (i.e. is one person saving 1 hour the same as 60 people saving 1 minute?)? Does everyone in society have the same value of time? Is the value of time the same at all times of day/week/month/year?

Secondly, what costs and benefits should be included in the evaluation? Some – such as time savings – are fairly obvious candidates for inclusion, but others are more questionable. What about health benefits, noise reduction, visual intrusion, social exclusion, differential outcomes for people in different categories – e.g. employment, age, gender) – and how do we compare differences between these?

Thirdly, the outcomes of CBA/BCR analysis tend to steer the inputs. Thus, it is quite typical to find that time savings constitute the major benefit in a transport case. There is considerable advantage to be gained therefore in devising schemes that will save time and ensuring that all associated benefits are included. A net result is that many transport schemes are driven by time savings to the dis-benefit of all other factors. An analysis which is truly independent of its outcomes is very rarely, if ever, performed.

Finally, the nature of transport infrastructure means that investments are long-term. It is therefore necessary to calculate the costs and benefits over a considerable time period. A common approach to this is to use a technique based on discounting financial values on the basis of time – e.g. discounted cash flow – and then comparing different investments, with, for example, investing the money in a bank with a given interest rate. The problem with this approach is that the nature of the mathematics related to discounting means that after not very many years, the discounting effect is

around zero so no difference can be determined. This works against long term investments, especially those with a high initial capital cost as the initial cost is included in full but the longer term benefits are almost completely ignored.

So CBA/BCR, rather than deliver an independent objective analysis of investment, has a tendency to distort the decision process to favour schemes with low initial costs and higher short term quantifiable benefits. An analytical method which carries such distortions within its method is not an appropriate way to evaluate schemes, especially those, like those related to environmental concerns, which are likely to require significant short term change (and thus investment) with less quantifiable long term outcomes.

Carbon reduction investments would be a good example of the case where CBA/BCR would seem to be inappropriate. This is because the short term changes required will require significant investment – e.g. change in refinery practice, investment in new energy sources, changes in human behaviour, investment in new transport infrastructure, vehicles and operations – which all need to be made as a concerted programme, need to be undertaken in the short term, are expensive and the benefits are likely to emerge only in the long term and to be difficult to quantify.

Multi-Criteria Analysis

An alternative approach to CBA is to relax the need to quantify and/or monetise all aspects of cost and benefit. This approach requires that each element of the cost and benefit system is appraised in terms most appropriate for its own nature. Thus, financial outgoings and incomes could be evaluated in financial terms, but air quality, for example, could be evaluated in terms of the change in quality of air obtained as a result of the actions taken in the project. This approach results in a set of non-commensurate elements, or criteria, i.e. one criterion could be financial, another could be a change in particulates in the air, another could be a change in passenger density in the peak hour, another could be a change in health outcomes and so on. This is called Multi-Criteria Analysis (MCA). MCA is therefore quite different from CBA because it does not attempt to make the components become somehow equivalent in financial terms, but instead it allows each criterion to be tested in ways that are fully appropriate to its needs. The issue then becomes how to combine the information obtained from the MCA analyses to advise a decision-maker.

The answer is actually quite simple. The decision-maker is now faced with appropriate analyses of each component of the decision and thus has the best available information to hand. The question is therefore one of how to choose between competing factors and which to favour, which to mitigate, which to include and which to set aside. These decisions are essentially 'socio-technico-political': Whether to take account of health issues in a transport decision is, for example, a question of combining the societal needs and desires of the population affected by the decision, the access by the decision-maker to technical competence and knowledge of the transport and health issues of interest but the choice of how to include them in the decision is essentially political. This requires the inclusion at a high level in the decision-making process of social and technical discussion and inputs with an equivalent mature political consideration of the issues that pertain. This requires a maturity in the politicians and access to credible high quality technical leadership so that a high quality discussion can take place about what the analysis really means in social, technical and political terms in order to inform the final decision – which, because of the cost and pan-societal

implications, will inevitably be political. The explicit involvement of technically competent and independent people at this point in the decision process is crucial.

The benefit of using MCA in the evaluation of a NAMA is that a strong and credible evaluation can be made of the Actions and the comparison between them in a way that lends force to the final decisions made on the basis of the analysis. We therefore recommend the use of Multi-Criteria Analysis for the NAMA.

Figure 9 shows the summary of the comparison described above. Please see appendix III for detailed explanation of how to apply the MCA analysis.

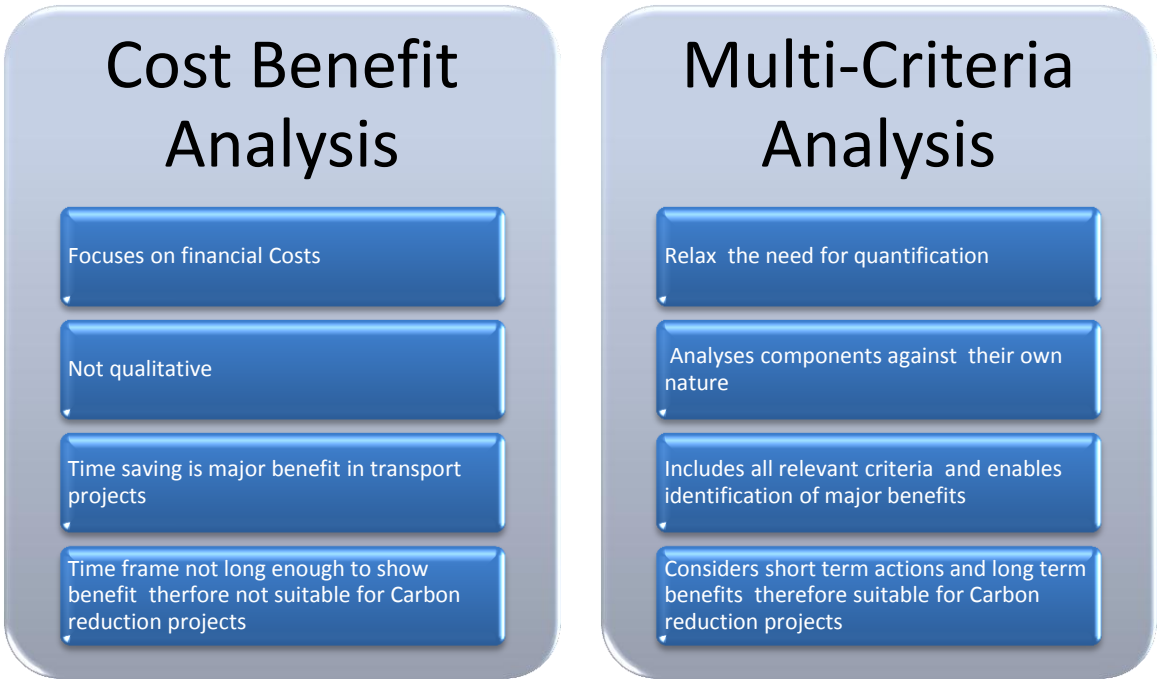


Figure 9 Cost Benefits Analysis *vs*. Multi-Criteria Analysis

Establishing a base line - Calculation of Greenhouse Gas Emissions savings

Another important aspect in the development of the NAMA is to establish a baseline on transport emissions to enable measuring the progress as the actions get implemented. Furthermore, it would be very useful to be able to calculate the amount of GHG reduction that would be possible under various styles of transport provision. Although estimates have been made of future GHG emissions (and thus reductions/increases in comparison with present levels), these are problematic and should only be used with a great deal of care about the assumptions upon which they are based.

Nevertheless, a good example of such an approach is that adopted for Belo Horizonte (Brazil) by Hidalgo *et al.* (2010)[13]. Hidalgo *et al.* adopt a framework approach which incorporates a series of calculations to establish the GHG effects of different types of fuel, based on vehicle-kilometres, with different representations of different modes of transport such as individual motorised transport,

[13] Hidalgo D, Lindau L., Faccini D., Carrigan A. (2010) Scoping Post 2012 Climate Instruments: Nationally Appropriate Mitigation Actions NAMAs Case Study for Opportunities in Urban Transport in Brazilian Cities, EMBARQ – The WRI Center for Sustainable Transport, World Resources Institute

public transport and 'active' transport (walking, cycling etc.). However, the assumption is that although there could be a change in fuel type and/or distribution of trips between modes in the model, there is no scope in the framework for including consideration of different types of network design which encourage different styles of performance, such as the issues of acceleration, express vehicles and better management of frequency discussed above. Given the discussion in relation to Lima and Callao, these are important so it is helpful to consider how the good work of Hidalgo *et al.* might be adapted to enable a reasonable assessment of the GHG reductions that might be expected from the sort of wholesale approach being recommended in this NAMA. The technical representation of the adjustment of the emissions' calculations can be found in Appendix III.

The tools described in this chapter have been selected to assist in the development of the Peruvian transport NAMA and have been described briefly in this report with some-what expansion in the appendix. However, it is estimated, that further stakeholder engagement and capacity building will enable developing these tools further to ensure their appropriate application.

Chapter 3 - Development of a draft Transport NAMA

The draft NAMA selection and development process has been accomplished following an extensive stakeholder consultation and literature review process. It therefore has been established based on the TNA (Training Needs Assessment) participatory study carried out by the UCL team and the conclusions of two stakeholder training events executed as part of the capacity building process. Initially semi-structured interviews with stakeholders were performed as well as participatory theme workshops to enable understanding of the overall transport issues and the current initiatives implemented (Minutes available on request). Following the submission of the TNA report (Available on request), a Media training workshop was implemented at a wider stakeholder level and an International Seminar on Urban Mobility Decision Making was executed at the technical leadership level with the aim of instigating high level dialogue between Political authorities and technical leaders. Appendix III highlights the organisations involved to date in the development of the draft Transport NAMA taking part on discussions, interviews and training activities.

The UCL team has also taken careful consideration of the review of the lessons learnt from the Annual Status Report on Nationally Appropriate Mitigation Actions (NAMAs)[14] where three organisations (Ecofys, Centre for Clear Air Policy (CCAP) and Environmental Research Centre of the Netherlands (ECN)) shared their experience on the development of a NAMA and the factors that influence its success. Aspects such as political ownership and leadership, coordinated inter-governmental processes, involvement of local experts and data and technical capacity availability have been addressed in the proposed actions. The UCL team has also emphasised the development of stakeholder participation, building on existing initiatives and using best practice guidance to ensure the appropriateness of the draft transport NAMA.

Regular and open communication has been achieved with the stakeholders involved to date and a technical leader's network has been set up to maintain their involvement. Further work will be done to continue their capacity building to develop realistic goals and timeframes, and encourage flexibility to manage the stakeholders' expectations.

Peru and the Transport Context

Peru is the third largest country (by area) in South America (after Brazil and Argentina) and one of the ten most diverse countries in the world. It is divided by the Andes into three geographical areas; coast, mountains and jungle and its population is estimated at 28.3 million (MINAM, 2010). The proportion of people living in urban areas is 76% of which nearly 33% live in the Metropolitan capital (Lima and Callao, 9.5 million) and to put it into context, the second and third largest cities in Peru (Arequipa and Trujillo) comprise just over 800,000 people each. In terms of economic activity, in 2010 Peru had a GDP growth rate of 8.8%[15], following a growth between 2002 and 2010 of 65%[16], placing it behind China, India, Vietnam and Singapore and ahead of all other Latin American countries. 50% of the country's GDP is produced in the Metropolitan capital (ECLAC, 2011), making this region the Peruvian economic backbone, particularly in relation to freight transport and the

[14] Annual Status Report on Nationally Appropriate Mitigation Actions (NAMAs) 2011. Ecofys. [Accessed on 15/3/2012] Retrieved from: http://www.ecofys.com/files/files/namas_annualstatusreport_2011.pdf

[15] Banco Central de Reserva del Perú and Ministerio del Empleo y Promoción de Empleo, quoted in PWC (2011) "Doing Deals in Peru" [Accessed on 8/3/2012]

[16] International Monetary Fund, quoted in PWC (2011) "Doing Deals in Peru". [Accessed on 8/3/2012]

country's international relations through its major port and international airport. Undoubtedly, the biggest transport demand lies in this metropolitan region (66% of National Vehicle fleet (SwissContact, 2010)) and although there are clear interprovincial issues related to transport and low carbon, focussing on actions within this area will represent significant national carbon emission reductions. Furthermore, after obtaining successful results from initial mitigations in this area, it will be easier to address national and interprovincial issues.

Metropolitan capital

The Metropolitan capital (Lima and Callao) has a combined population of approximately 9.5 million people, 1 million of whom live in Callao. Lima has a highly centralised structure and, although it covers a considerable area squeezed between the Andes mountain range and the Pacific Ocean, much of the main activity is concentrated in the centre. Several transport studies have identified the 'hourglass' shape – they refer to the two cones (north and south) of the city, where a lot of transport demand requires travel from one end to the other; much of this has to pass through or near to the city centre. Traffic passing through Lima with no intention to service the city can avoid the main city centre by using the Panamericana, which bypasses the city on the eastern side (See Figure 10 next page).

The high volume of traffic in the centre (See Figure 11 next page) results in low traffic speeds (3-4km/h in peak-times[17]), considerable delay and congestion – and thus contributes to the level of greenhouse gas emissions (GHG) delivered by the transport sector (39.8% of all GHG emissions).

Despite the impacts on congestion and delay in the city, there are, according to the IMP (Instituto Metropolitano de Planificación), just 900,000 private vehicles and 220, 000 taxis; which is nearly 1 private car per 10 people. This is extremely low by current standards (London, which has a similar population, has approximately 2.5 million cars[18]) and it makes good sense in the current climate to try to retain (or even reduce) this ratio as reducing car ownership once it attains higher levels is a very difficult process. The low rate is an advantage for public transport demand.

Another key aspect of the metropolitan city is the proximity to the port of Callao which is located nearly 15 kilometres away from the centre of Lima (See figure 10). The port is the largest and most important port of Peru because of its strategic location between the inter-oceanic routes for vessels traversing the continent via the Panama Canal or the Straits of Magellan[19]. Callao is therefore well-placed as a potential regional hub between western Latin America and the western Pacific, especially to China, Korea and Japan. More than 50% of Peru's maritime freight goes through the port of Callao, which is currently able to handle 1.2million TEU per year[20] and is expanding rapidly due to new investment in the port infrastructure.

[17] Minutes of the *Diálogo Político sobre Ciudades, Transporte y Cambio Climático*. ´Planificación de Ciudades, Transporte y Cambio Climático´ Seminar, November 2010. British Embassy, Lima. [Accessed on 10/11/2011]

[18] Department for Transport Table NTS9002 Household car ownership by region and area type: Great Britain, 1995/97 and 2009/10. [Accessed on 17/3/2012] Retrieved from: http://www.dft.gov.uk/statistics/tables/nts9902 and Greater London Authority (2010) Intelligence Update November 2010. [Accessed on 17/3/2012] Retrieved from: http://data.london.gov.uk/documents/Update%2027-2010%20CLG%202008-based%20Household%20Projections.pdf

[19] Port of Callao, World Port Source. [Accessed on 16/4/2012] Retrieved from: http://www.worldportsource.com/ports/PER_Port_of_Callao_1477.php

[20] Ventajas competitivas, Empresa Nacional de Puertos S.A. ENAPU. [Accessed on: 19/11/2011] Retrieved from: http://www.enapu.com.pe/spn/ventajas_compet2.htm

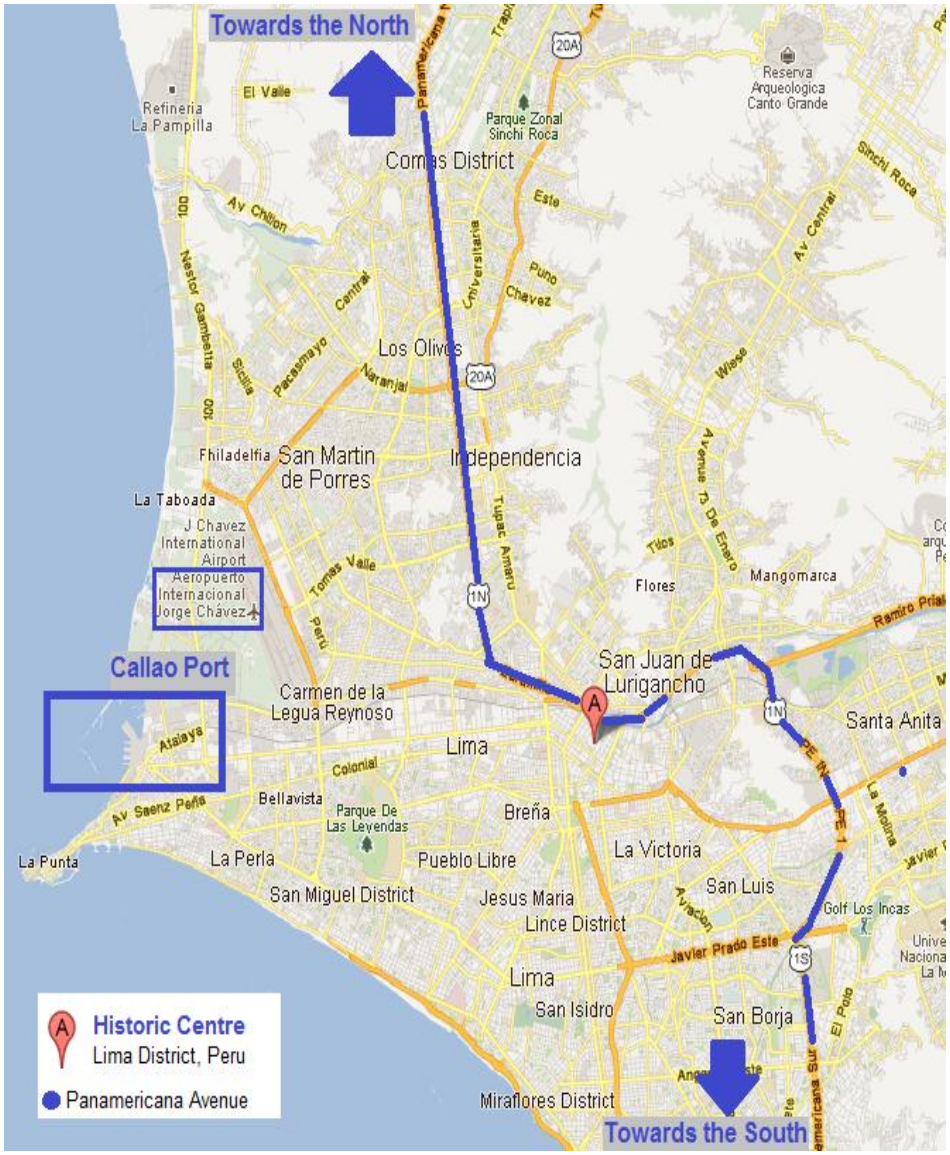


Figure 10 Panamericana Avenue

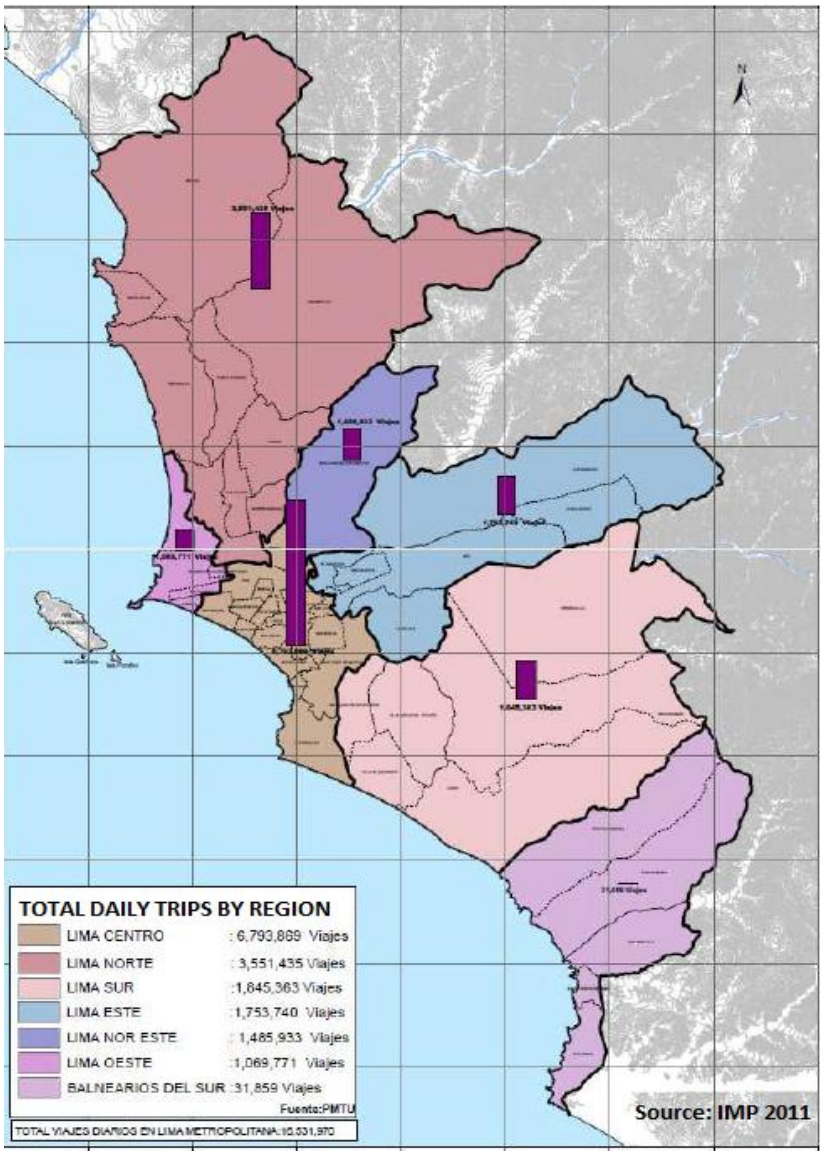


Figure 11 Daily trips by region

As seen in figure 10, the port is connected to the north and south of the country through a network of interprovincial highways and it is located four kilometres away by road from the Jorge Chavez International Airport. The port is also linked by the Ferrovias Central railway connecting it with mining regions such as Huancayo and Cerro de Pasco. This very important port brings enormous pressure to the traffic in Lima and Callao as the freight transport requires egress from the port through Lima in order to reach the Panamericana towards the north, south or east of the country.

Public Transport

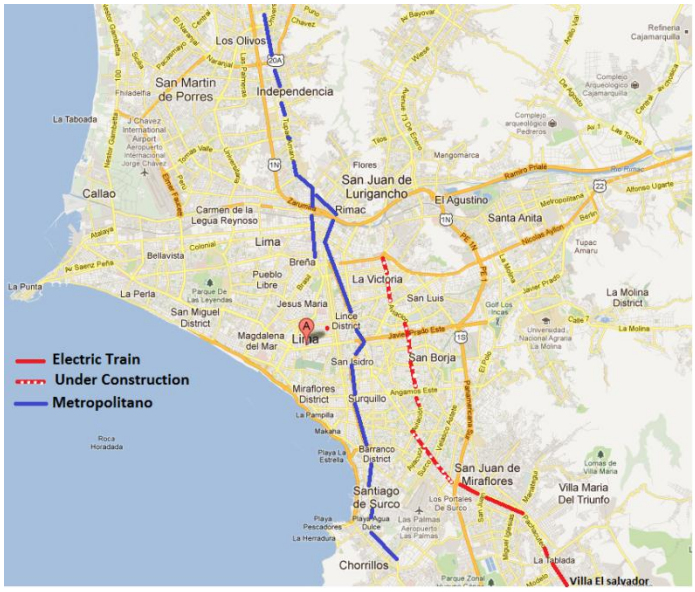


Figure 12 Metropolitano and Electric Train in Lima)

Lima and Callao have a highly informal system of public transport; there are 425 bus routes spread between 307 transport companies, with roughly 26,000 public transport vehicles, from which around 45% average between 15 and 20 years of age and another 40% over 20 years old (IMP, 2011). The fuel type used by these vehicles is in transition from biodiesel 2 to biodiesel 5 (MINAM, 2010). Lima has one line of a planned Bus Rapid Transit (BRT) System (Metropolitano), this line runs across COSAC I (Segregated Corridors for High Capacity Buses (Spanish acronym)) connecting the North and South of the city (Blue line in Figure 12). It has 35 stations within 16 districts and carries an average of 220,000 passengers daily[21], the Metropolitano bus fleet operates on natural gas. Lima also has a surface Metro line (Tren eléctrico, now called MetroLima) which currently has 7 operational stations (9.2km) and it is constructing a further 12.28km that will add 9 stations to the network (Red line in Figure 12).

Current Transport Issues

Following a preliminary analysis TNA (Training Needs Assessment) report and after six months of further research, the UCL team recognises that the transport sector in Peru is suffering from *critical institutional structural* difficulties and that this has led to the situation described above: disorganised and non-systematic public transport, an old vehicle fleet, high level of traffic accidents, lack of regulation and coordination, lack of integration, etc. This institutional structure problem is exacerbated by the *lack of technical leadership* which leaves politicians unsupported in the development of technical and well-structured transport strategies that could help them achieve their vision.

Furthermore, the lack of *continuity* of technical expertise in the government sector is a serious problem which, combined with the lack of technical leadership, creates a technical gap between a decision and its execution. This leads to the chaos currently seen today and does not bode well for future implementation of transport strategies. It is therefore crucial to deal with this issue before

[21] Lima Como Vamos, Current Situation Document submitted for the International Seminar on Urban Transport Decision-Making - February 28th 2012,

any NAMA could be implemented. One of the main aims of the draft Transport NAMA therefore, is to provide capacity-building at specific and wider stakeholder levels with the focus on an overall vision and centred on filling the gaps previously identified.

Peru's competitiveness and business opportunities

The average annual population growth rate of Peru has decreased from 2.6% (1981), 2.0% (2001) to 1.6% (2007) (Richard Webb, 2010) whilst its economy reached historic figures in 2008 with a growth of 9.8% in GDP. This growth was due to the development of the mining, hydrocarbons, manufacturing, commerce and construction. The GDP continues to increase[22] showing growths of 6.6% in the first half of 2011, where the transport sector increased by 12.7%.

Similarly regarding global investments; Latin America increased its participation from 5% to 10% between 2007 and 2010 and Peru was one of the main five countries responsible for this increase (US7.328 billion dollars) (ECLAC, 2010). Peru has attracted investment from China (the second largest world economy) especially in copper extraction; investment from Brazil especially in phosphate mining and attraction from Chilean companies investing 13% of their total US8.744billion Latin American investments.

Furthermore, Peru is part of IIRSA (Initiative for Integration of Regional Infrastructure in South America) formed with the aim of removing the impact of physical barriers between South American countries and integrating connectivity through infrastructure and telecommunications. The IIRSA aims to achieve a steady increase in manufacturing exports in South America and Peru is very well placed in this initiative because of the favourable position of the port of Callao. The potential of this port becoming a hub to connect South America with Asia has started to be identified with the Free Trade Agreements with Singapore, Japan, South Korea and China.

Peru is therefore in an excellent position for investment and business prospects and the transport sector plays an important role in adding to and supporting this economic growth. Thus besides the range of opportunities for investment in mining and agriculture; the transportation industry has numerous opportunities in the development of infrastructure projects, consultancy, and more specifically: renovation of the vehicle fleet, renovation of the networks, business development entrepreneurship among buses and taxis operators, manufacturers, etc., the freight industry and the enhancement of the port of Callao.

The provision of new vehicles for the bus fleet, for example, is a great opportunity for the establishment of vehicle manufacturing in Peru, starting perhaps with assembly but proceeding to full design and manufacture in due course. The establishment of this capability in hybrid and new energy vehicles would place the industry in a strong position within the continent.

The land use implications of rethinking the public transport system will yield several business opportunities not only regarding trade but also increasing land costs. This investment prospects will be notably around stations on the orbital lines, especially where these intersect with the radial routes.

[22] Perú Crecimiento Poblacional, Instituto Nacional de Estadística e Informática. [Accessed on: 19/11/2011] Retrieved from: http://www.inei.gob.pe/perucifrasHTM/inf-dem/cuadro.asp?cod=3643&name=po03&ext=gif

The operation of the bus service could be reordered to consolidate operation of the network so that companies or groups of companies would operate either lines or groups of lines in the city. This would allow greater profitability due to economies of scale and a more controlled public transport provision in terms of quality and consistency. It would allow for a trade-off between more and less profitable lines so that a proper service is available throughout the city. In terms of managing the implementation of carbon emission reduction it provides a much better means for ensuring that public transport provides its due share of contribution to emissions reduction.

Taxi operation could be another source of business opportunity. Rather than see taxis as a sole operator activity, grouping taxi drivers into companies would achieve economies of scale, for example in the procurement of vehicles, purchase of fuel and maintenance and a greater profitability for all.

The port of Callao has great opportunities for development as well not only within the port, but in areas surrounding it. The enhancement and rethinking of the freight network could yield opportunities of the extension and expansion of railway lines, optimisation of the road network, establishment of distribution centres and investment in sustainable and innovative freight initiatives to serve the cities.

Furthermore, with the economy growing, tourism is booming and this means more demand on the accessibility to areas such as the airport, Miraflores and the historical centre. Therefore opportunities are open for *outside of the box* thinking: for example, is there a business case for internal dry ports linked by train with the port of Callao, direct sea links between the airport and port of Callao to the hotel/tourism centre of Miraflores, use of airships for trans-Andean freight journeys and so on?

Peru has countless opportunities to emerge but it is essential that this growth is controlled to guarantee its lasting effects; therefore developing a transport NAMA could be an opportunity to prepare for this important development.

Prioritising Measures

As discussed in Chapter 2, the overall aim driving the need for a draft transport NAMA has quality of life as its prime objective. The consideration of a multi-criteria analysis implies that a major part of the way of achieving this is through the reduction of harmful emissions. In the transport sector the direct link between emissions and energy input means that the main action is going to be the reduction of energy consumption. The NAMA therefore aims to use this reduction as the main indicator of success for any initiatives, policies and projects that might be implemented in the sector.

Making use of the tools specified in chapter 2, especially the decision-making model and the RED strategy, the approach is to prioritise areas that could contribute towards the integration of the city and enhance its sustainability and resilience. Based on the current transport situation of Lima/Callao and the immediate needs, three example areas for a NAMA approach have been prioritised as follows:

1. Urban mobility
2. Energy efficiency
3. Land use planning

The RED Strategy suggests that we consider first the reduction of travel so we need to design for the mobility objective and its associated facilitative actions first. Some of these facilitative actions are also necessary for the implementation of a low carbon energy efficiency policy in transport and the land use planning process that will help to reduce the need for motorised journeys to be made, but their objectives derive from the desire to achieve a satisfactory level of mobility for the city and its inhabitants.

Urban Mobility

Public transport in developing countries represents a very high portion of urban mobility and therefore a very important part of the cities' economy. In cities like Lima and Callao the demand for public transport is high (80% including taxis) and the opportunities induced by this demand are extensive. Therefore, the main aim regarding this area is to maintain this demand and discourage the need for private vehicles, and this is done by improving the current system institutionally, physically and systematically. However, it is not only people who need to move: the goods that people and businesses purchase also need to move around the country and city and therefore the term mobility also applies to freight. The proposed method of achieving this objective and the overall objective of reducing carbon emissions is by providing an *Integrated Mobility System* which is designed, first, to make public transport in all its forms easy to use for every required journey and secondly to make an integrated freight mobility system which can provide the goods to the population at the right time and place.

Energy Efficiency

As mentioned above, transport systems fulfil the deficit caused by the long distances that exist between activities, and therefore the modes of transport used in these systems have a direct impact on the amount of GHG emissions emitted. Transport sector is one of the highest GHG polluting sectors globally and it is estimated that contributes to 22% of the total global CO_2 emissions. In Peru, the transport sector is the highest polluting sector in the energy category, and its hydrocarbon demand reaches nearly 70% of the total national demand. Therefore if it is not possible to reduce the need to travel, it is essential to start making these trips as energy efficient as possible; thus, the proposed measure is to focus on *Energy Efficiency in Vehicles.*

Land Use planning

Land Use Planning is the area that integrates desired activities and the mobility required in order to reach them, the deficit being made up by the transport system. Transport interventions have important effects on the development of future land use and in turn future transport demand; similarly the development of the land plays an important part in the consideration of transport infrastructure and on the travel patterns that it induces. The importance of understanding this two-way relationship is crucial to the sustainable growth of a city and its carbon emissions reduction. Peru's current competitiveness envisions an active growing economy that will lead to new and old land developments. Therefore it is important to have a set of guidelines for measures that will ensure the advancement in the urban areas supported by a well-thought-through framework. Within this framework, *Green Zones* could be established, serving as examples of the guidelines mentioned above and aiming at a holistic approach in favour of accessibility and mobility for its residents.

The overall vision of the draft transport NAMA is represented in Figure 13 and the interventions in Figure 14.

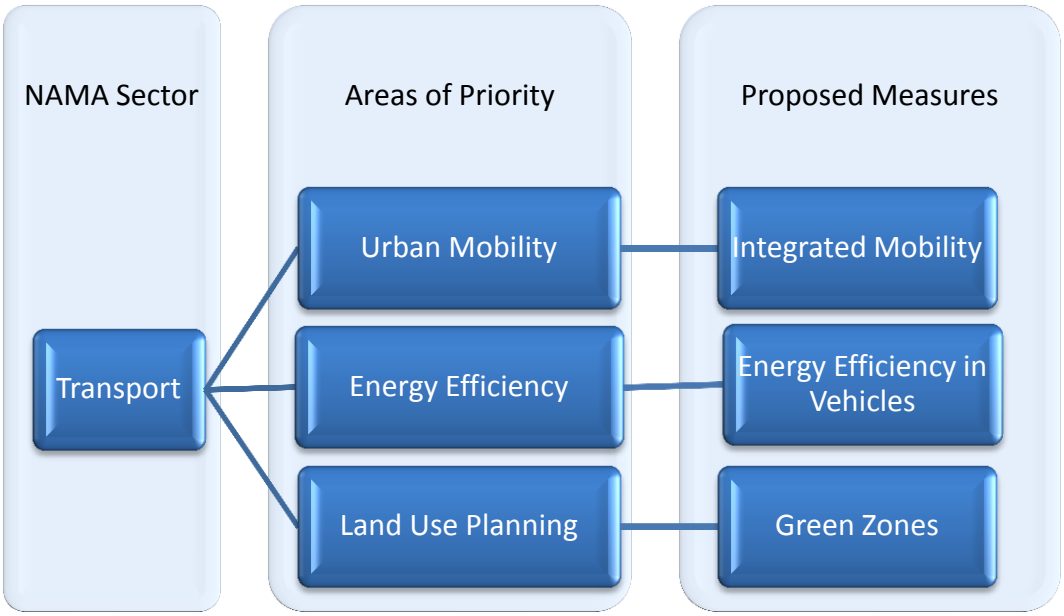


Figure 13 Overall Transport NAMA

Mitigation Interventions within Measures

Measure 1

Integrated Mobility

- Unified Technical Authority
- Mobility Reform for Lima and Callao
- Inter-Institutional NAMA Committee
- Development of Travel Plans
- Development of an Energy-efficient Mobility Plan
- Modal Retention
- Support for Education and Training
- Devise new infrastructure plan for city and national infrastructure
- Seek international finance for the NAMA implementation plan

Measure 2

Energy Efficiency in Vehicles

- Vehicle labelling
- Cleaner Fuels
- Adopt mechanism to achieve 120g CO_2 per km travelled

Measure 3

Green Zones

- Design and Planning
- Governance and Delivery
- Carbon accounting and sustainability
- Tendering and Feasibility

Figure 14 Illustrates the mitigation interventions suggested within the measures

Chapter 4 – Draft Transport NAMA Measures

Measure 1 - Integrated Mobility

Aim

Integrating the Mobility of citizens and visitors in Lima and Callao will be central to the future quality of life of the city. The need is to move towards the organisation of the current dispersed system by optimising the different existing efforts already in place and enhancing better measures aimed at reducing carbon emissions. This integration will entail a variety of measures and programmes that will eventually lead to the achievement of an efficient transport system that will serve the integrated city in all modes (buses, taxis, Tren Eléctrico, Metropolitano, bicycles and pedestrian walkways) and provide a true sense of achievable mobility for all.

Objectives:

- Enable the mobility required for inhabitants' needs and the associated necessary goods and:
- Reduce CO_2 emissions and air pollution
- Make energy the prime objective in transport decisions
- Promote social inclusion and social equality
- Raise the level of social tolerance within the transport system
- Create awareness about sustainable modes of transport
- Increase and reinforce technology knowledge exchange

Justification of Proposed Objectives

Enable the mobility required for inhabitants to meet their needs

To enable the required mobility, it is necessary to establish what mobility is desired. There are several studies in Lima about the generation of an Origin-Destination matrix for the city. These are based on the use of conventional transport modelling, in which historic demand is used together with some form of growth factor to determine future demand. However, the major weakness in this approach is that it is not possible to include demand which does not currently exist – as there is no historical base, the future demand cannot be estimated – and it fails to take proper account of the reason why people travel. Developing a transport system that is going to be responsive to the energy-reduction and low carbon emission agenda means rethinking from scratch what mobility will be required and how this might be met. The Mobility Hierarchy in Figure 6 shows an example of a rethinking of the way in which such mobility should be considered. The RED strategy also leads to such reconsideration, with its emphasis on reducing the energy/carbon implications by reducing the need to travel as a first task before considering how journeys might be shifted towards low carbon impact modes and considering issues such as decarbonising the means of motorising the transport process. Therefore Mobility in a city needs to be reconsidered from the fundamental level upwards – a true Mobility Reform.

First, it is useful to consider some general points about mobility in a city. Most cities – and Lima/Callao is no exception – have grown over many years, starting from a city where the prime means of mobility was pedestrian. This accounts for the small size of the central area of such cities and (unless it has been heavily revised) the street network. Even cities which are now considered to be large have such characteristics, and Lima and London are both examples of a large city with a historic centre in which the street network is largely pedestrian-influenced and the size of the

central area is small. Because the city derives from those historical roots, there is a tendency for central activities to occur in the historic centre and the assumption in transport planning has therefore been to devise a transport system which will bring people into the centre in the morning and take them home again in the afternoon. Central London would be good example of this, where the difference between the population during the day and that during the night is some 2.5 million. The fact of the matter is that the structure and fabric of the historic centre of such cities simply cannot cope with such an influx without huge investment in the infrastructure to support it and the associated problems of congestion, pollution and wasted energy.

Rather than start with the assumption that the transport system needs to bring people into the centre, it would make more sense from the mobility point of view to encourage activities outside the centre. This would reduce the demand for space and transport inside the historic centre and increase the opportunities for economic activity in the areas around the city. By providing a transport system which can deliver people quickly and easily *around* rather than *to* or *within* the centre, we can reduce the pressure in the centre and increase the activity in the surrounding area. This can be achieved by conceptualising a polycentric model for the city, in which the suburbs play an important role in the economic life of the city as well as providing the dormitory for the activity which takes place in the centre. A key role for the transport system in providing this suburb-suburb mobility is the delivery of interconnectivity between suburbs. This suggests a network which is based around orbital routes which link the suburbs together without entering the city centre.

The city centre needs the provision of access because activities will still occur there, but by reducing the demand for the city centre, the access can be provided by modes which are at higher levels of the hierarchy – non-motorised modes such as walking and cycling – thus enabling the city to function well as it was designed to do. Access to the city centre can be provided by radial routes, which of course will intersect with the orbital routes at various points around the city. Each of these intersections will provide the nexus for the economic activity in that suburb. A city which was designed explicitly on this polycentric model is Curitiba – once a small historical city centre subject to annual flooding around the outskirts, but now a thriving economic powerhouse with high levels of income, high levels of public transport use, high levels of cycling and walking, high levels of recycling and green energy use, low levels of car use (but one of the highest car-ownership rates) in Brazil. Curitiba had the advantage of being able to develop on new land but, in this respect at least, Lima has an advantage compared with many other cities – it has a deficient and largely non-existent fixed transport infrastructure.

An illustration of the rationale for this approach can be seen in Figure 15.

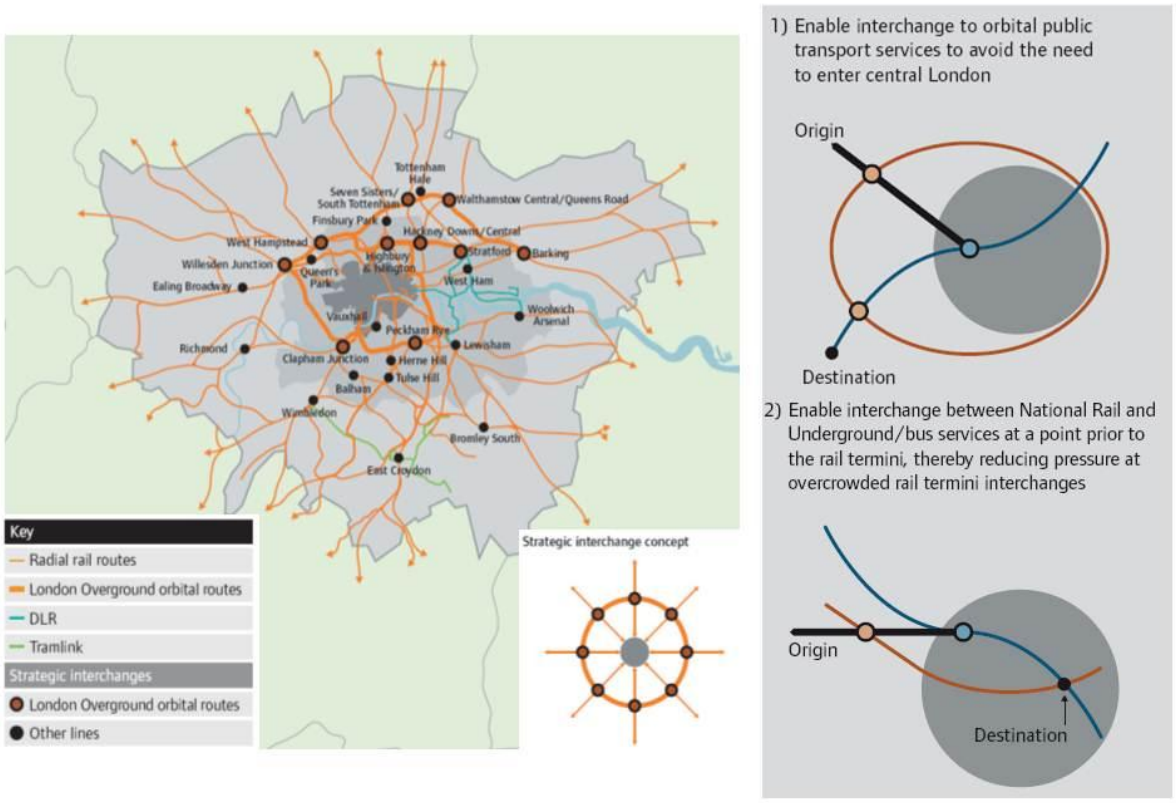


Figure 15 Orbital, radial and interconnectivity network principles in London. We would expect economic activity to increase around the strategic interchanges (evident in London, for example at West Hampstead, Stratford and Clapham Junction).

Taking the approach that we want to reduce the number of people in the city centre during the day and increase the number in the suburbs, we can redesign the transport network to provide the mobility necessary for this to take place – a combination of:

1. Orbital routes linking suburbs together,
2. Radial routes linking the outskirts to the city centre,
3. Easy accessible interchanges at the intersections of the orbital and radial routes and
4. Service frequencies which are sufficiently high to provide the capacity but which are – because of the nature of the network design – dispersed around the city rather than concentrated in the city centre.

The means by which this mobility is provided is a matter of deciding which mode of transport will be most successful in providing the mobility opportunities. This is in part a matter of capacity (see Box 1 Chapter 2) and in part a matter of accessibility. Easy accessibility suggests travel on the surface (to avoid lifts, escalators and stairs to change level), high frequency and regular, organised, well-designed and suitably located stations/stops. This accessibility is necessary to achieve the mobility – you cannot move in the system if you cannot reach it – but it is also a constraint on the capacity. Public transport systems have to be very carefully designed to obtain the best in respect of *both* capacity and accessibility. The modal debate is therefore not about buses competing against trains, but about the modes working together to provide an easy-to-use integrated means of mobility around the city. This requires a single view of the urban mobility needs for the city as a whole so that

a consistent approach can be made to ensure that the network works collectively to reach the desired outcome.

Enabling the required mobility in Lima and Callao therefore needs:

1. The establishment of a single technical body with the responsibility and authority to define, plan and manage the whole city of Lima and Callao,
2. Reconsideration of the public transport network, based on the need to spread activity around the city and its suburbs and delivering the mobility on the basis of the Mobility Hierarchy and
3. Consideration of the vehicles (from shoes to trains) required to deliver the city-wide mobility a modern yet historical city needs and
4. Consideration of the infrastructure required to enable the vehicles function smoothly and in an integrated way to deliver the required mobility.

Reduce CO_2 emissions

After the removal of unnecessary journeys, the easiest and most significant way to reduce CO_2 emissions in a transport system is to remove the motor from the journey – i.e. replace motorised modes of transport with non-motorised modes of transport. A journey which requires no energy input beyond the human provision will have no unique carbon emissions. Therefore the primary action must be to develop the capability of using non-motorised modes of transport as much as possible. In part this not only means developing cycle ways and associated facilities, but developing the proper design and maintenance of pedestrian facilities ('facility' in this context is mostly the footway which accompanies the vehicle-carrying roadway). In addition to ensuring that the ordinary footway is actually safe and usable by pedestrians, where the economic activity can be enhanced to benefit from the easy access by people on foot, it is often helpful to create pedestrian areas in which vehicle activity is either heavily restricted (e.g. to certain times of the day, or certain vehicles only) or removed completely. This has to be done with due consideration to the needs of the economic activity – it will almost certainly require delivery of goods of some form or other – but it needs to be recalled that the success of the economic activity depends on people, not vehicles (it is people who buy goods, not vehicles). Almost every such pedestrianisation scheme in the world has seen an increase in economic activity after the scheme has been implemented – the main factor in such success is to take due account of the supply of goods in the area and the appropriate delivery of people via public transport or appropriately situated parking. Often park-and-ride schemes (where cars are parked on the edge of the city and access towards the economic activity is provided by public transport) can help to achieve the latter. However, great care must be taken when installing such schemes as they can when poorly designed increase the number of car trips and, if subsidies are involved, can divert bus passengers from other bus routes[23].

A second strand to the CO_2 reduction is the smoothing of traffic flow. Congested traffic is terrible for carbon emissions; acceleration is where the energy is consumed at the greatest rate, so keeping traffic at as near to a constant speed as possible is important. The first issue to tackle is the reduction in the volume of traffic, as this causes capacity loss and thus creates congestion. Traffic volume can be reduced by incentivising the use of public transport (see Figure 8), thus removing the

[23] Changing Travel Behaviour. ESRC Transport Studies Unit. University College London 2006: [Accessed on 17/3/2012] Retrieved from: http://www2.cege.ucl.ac.uk/cts/tsu/conference/Changing_Travel_Behaviour.pdf

need for cars to be driven into the city. It is also important to incentivise the use of appropriate roads for circulating traffic and disincentivising the use of inappropriate roads. This can be achieved through strategic use of traffic signals (e.g. timing them to improve flow on arterial roads and to reduce speed on local roads) so that drivers tend to choose the smoother-flowing roads. However, maintaining the capacity for the public transport services to operate well is the main priority. This redistribution of journeys towards public transport or at least lower carbon impact modes is a part of the second element of the RED strategy.

Finally, if a motor is required to provide the movement, it is best to use a low carbon variety. Because of Peru's hydroelectric power production, moving to electricity is a good way of reducing carbon emissions. This suggests modes which are inherently powered by electricity – electric trains, buses and so on – and modes which use electricity for some part of their operation – hybrid modes, which will reduce carbon emissions, but by a smaller amount (~30% rather than the (could be) ~100% for full electricity powered vehicles, depending on the energy source). The use of electric vehicles has other benefits – less noise, less particulate pollution and so on – which makes them more suitable for lower density operation, for example in residential areas, where diesel buses would be less attractive, for example. Therefore the network design should take the energy source of the vehicles into account.

So, reduction of CO_2 emissions in Lima and Callao requires actions such as:

1. **Prioritise non-motorised modes**
2. **Reduce the volume of traffic**
3. **Smooth traffic flow**
4. **Decarbonise motive power**

Make energy the prime objective in transport decisions

Normally, transport network design is based around providing the capacity required to meet peak demand. This encourages large investments in high capacity infrastructure (but often these fail to succeed due to the misunderstanding of how capacity works in transport systems). However, the priority now is the reduction of energy use and carbon emissions and this means that – as stated in the RED Strategy – there is a need to shift our thinking about transport provision towards a mobility-needs approach in which the use of energy to provide transport is to be minimised. A major element of this is therefore to localise mobility – reduce the need to travel at all, or to enable activities to be reached via non-motorised modes – and then to prioritise the use of public transport, each of which is helpful towards meeting an energy reduction target.

Given that the objective has changed to 'energy minimisation' instead of 'capacity maximisation', it should be the case that all transport investments are set against an energy reduction objective. For example, consider a public transport line with several stops. In order to provide a given demand over a certain length of the route, we could do this by making all vehicles stop at every stop. This would give a high frequency service, but as every vehicle has to stop, there is a need for every vehicle to accelerate from each stop and thus consume energy, which is dissipated through heat and noise as the vehicle decelerates towards the next stop (the real benefits of regenerative braking, which tries to capture the energy dissipated whilst braking are yet to be fully achieved because of technological problems).

If some of the demand were carried by vehicles which do not stop at all the stops, the energy would be required at only the stops at which the vehicle stopped and in order to maintain momentum during the journey. There are cases where, for example, the demand from one end of the line to the other is quite high and an express service could provide this capacity with only (for example) a single acceleration from the first stop and a single deceleration towards the last stop and a minimal use of energy to maintain speed in between. Other vehicles could serve the intermediate stations.

Such a service can be operated on bus systems by designing overtaking lanes at bus stops to permit overtaking (this has been used extensively in Brazil and it is in place in the *Metropolitano* in Lima, but in neither case was this done as an energy-saving measure). It is also possible in rail systems, but the infrastructure needs to be constructed to permit the overtaking to take place. Interestingly, the appearance of such systems is that of high capacity – and many would argue that such capacity would not be required – but its energy-reduction performance provides the real reason and constraint on the design. In fact of course it is higher capacity than a non-overtaking system, and this is a case where the energy needs and the long term capacity needs meet.

So to meet the energy reduction target it is necessary to set energy minimisation as the primary objective for all transport schemes so that incentives are in place to design systems which seek to reduce energy use. As illustrated here, this does not necessarily mean that the energy-reduction objectives conflict with the capacity maximisation objectives. Energy reduction objectives in Lima and Callao would need to:

1. **Remember that energy minimisation includes the removal of the need to travel at all and that the best energy reduction modes are non-motorised**
2. **If motors are required, calculate the energy required to convey the required demand and seek the minimum requirement,**
3. **Include in the calculations the realisation that energy is consumed more in acceleration than for maintaining speed (and especially more than for coasting) and that a system could be designed to maintain or increase access while permitting longer-distance travel to occur with fewer stops/starts.**

Promote social inclusion and social equality

It is important to realise that a city which provides mobility only to a part of its population is neither equitable nor fair and, as such, is not sustainable. Therefore it is important to ensure that mobility is available on an equitable basis to everyone. This means that it is essential to favour public transport because it is the system which provides the means to mobility as a default without the need to own a private means of transport. Disadvantaging public transport in favour of private transport will increase social exclusion and increase the inequality of people within the city.

The need to maintain and increase inclusion is therefore a crucial element of human rights and, in terms of how a city provides those rights, starts with the attempt to make sure that mobility needs are, as far as possible, provided by means of non-motorised modes of transport. It should be possible to walk to obtain the basic needs – food, health care, education and so on – without the need to own a vehicle. If it is not possible to maintain the supply of activity at a sufficiently local level that NMT would be sufficient, the next step is to ensure that it is reachable by means of public transport. This in turn places requirements on the design of the public transport network so that the entire city is covered appropriately in both space and time. For example, London aims to have every

home within 400m of a bus stop and in the main minimum bus frequencies are greater than 6 buses per hour (one very ten minutes) and often considerably more so. Setting such equity standards provides the sense of social inclusion that will enable the city to be one in which people are able to live with a reasonable quality of life.

As the population changes – ageing populations are a characteristic of the 21st century throughout the world – it is necessary to consider the particular needs of older people and disabled people as core components of the specification of mobility provision. This affects the design of the network as well as the vehicles and infrastructure required to provide the transport systems – all should be accessible or it is necessary to provide a specialised accessible service. As the latter is extremely expensive it is usually better and cheaper to provide accessible vehicles, infrastructure and service in all the mainstream transport systems.

Basic requirements for a socially inclusive Lima and Callao include:

1. **Prioritisation of accessible non-motorised modes of transport to meet mobility needs**
2. **Coverage in both space and time of the entire city by an accessible public transport network and service**

Create awareness about sustainable modes of transport

Whatever provision is made in order to meet low carbon emissions targets or encourage the use of public transport, nothing will work unless the behaviour of the population is changed to incorporate consideration of these issues in their daily lives. Some measures which make perfect sense in a carbon-reduction strategy will simply be seen as an infringement of personal freedom – why should a person not drive their car in the city? – So it is essential that part of the strategy is to ensure that people are aware of the issues and understand what is being done and why.

There is therefore a crucial component in the carbon emissions reduction process in terms of the education of the population. A good place to start with this is through the school education system – many children are very aware of the environmental and planetary issues and can be instrumental in encouraging their parents and relatives to change behaviour.

Education campaigns should be targeted to address all ages and sections of the population and the use of all communications media in this project would be essential. The education should be based on solid science – not just opinions – but should be styled to be easily understood by all the population.

So, there is a need in Lima and Callao to:

1. **Educate the population as a whole in the issues around carbon emissions,**
2. **Ensure that aspects of personal behaviour and decisions which impact negatively on carbon emissions are laid out clearly and constructively and**
3. **Ensure that positive actions that will improve carbon emission reduction are encouraged and publicised.**

Raise the level of social tolerance within the transport system

An objective which is associated to social inclusion is that of the behaviour change required to achieve successful low carbon objectives. This includes the importance of ensuring that space is able to be used without fear of crime, violence and injury, whether from people or vehicles. This suggests

the use of 'shared space' schemes, which are designed to be calm places where movement is based around pedestrian use and other vehicles (including bicycles) are discouraged from operating at speeds greater than walking speed. These need carful design, but when implemented successfully can provide pleasant spaces around the city. Examples exist in small towns in Holland and the UK, the largest single systems of this sort can be found in London (e.g. Trafalgar Square, where traffic is forced to divert around it, leaving a large pedestrian space and Exhibition Road, which is a recently installed scheme some 1.2km in length).

Lima and Callao should therefore:

1. **Consider the development and proper design of shared space schemes and their infrastructure to allow convenient use of non-motorised transport modes and generate a calm and pleasant environment at suitable points in the city.**

Increase and reinforce technology knowledge exchange

The technology associated with carbon emissions reduction is changing rapidly and affecting everything from the basic science to the political and philosophical consideration of the issues involved. The developments are happening all over the world and there is a great need to ensure that these are widely communicated so that repetition of struggles to solve a problem is minimised. Good communication about technology advances means that successful ideas can be disseminated quickly and easily and taken up while less successful ideas can be crossed off the list.

It is also important to ensure that inappropriate technology is not transferred. It is very rare to have a system that can be simply installed without changes to make it suitable for the local context. Sometimes such considerations are quite subtle. For example, London is one of the cities in the world that has installed a congestion charge scheme. This has been largely successful in reducing the amount of traffic entering the centre of the city and improving public and non-motorised transport systems. However, the low level of car ownership in Lima suggests that the amount of money that could be raised would be insufficient to outweigh the political difficulties associated with implementation of such schemes. Although it should be kept in the toolbox for use if the situation changes, the best strategy at the moment is to make public and non-motorised transport so attractive that the population feels that the use of a private car for such journeys is unnecessary and inappropriate.

Another technology that might be of interest is that of for-hire bicycles and cars. These are parked in stations and can be used by people who have access by means of a smart card. These are particularly useful for single point-to-point journeys and, where implemented, are very popular. However, whether such a scheme would be appropriate for Lima and Callao would need to be investigated in relation to the local context before a decision is made to adopt the technology or not.

This is particularly important, for example, where investment is being considered. The purchase of new vehicles could be encouraged but these should be of the best performance in terms of energy reduction and carbon use. Those who are charged with procuring such vehicles are in great need of the best available information (and not just sales brochures) about what the technology can – and cannot – deliver. However this applies throughout – how a network is designed is changing rapidly from the way it was done just a few years ago and the results of this different thinking will be applicable in different ways and will meet different objectives compared to previous models.

In terms of encouraging technology knowledge exchange, Lima/Callao needs to:

1. **Ensure that it has the technical knowledge and leadership to understand and exploit the information**
2. **Ensure that the leadership is able to communicate to political decision-makers the implications of different technological choices**
3. **Ensure that the technical leadership can communicate the issues at appropriate levels to the whole population.**

Proposed Interventions

The achievement of some of these objectives can be done at a national level with some guidance and total commitment, however some other objectives require external support and funding; therefore, there are nine components suggested and highlighted in Table 5. The proposed components are based on a combination of existing initiatives, obtained from various stakeholders, through workshops, semi structured interviews and official meetings, and new initiatives obtained from the literature and climate change research. The components and the suggested objectives are to be implemented progressively at different time scales and with total commitment from local stakeholders as explained below.

Table 5 Proposed Interventions for Integrated Mobility

	Intervention	Goals
1	**Unified Technical Authority**	• Lima and Callao create UTA • Development of an integrated public transport system for Lima and Callao • Development of an integrated freight mobility system
2	**Mobility Reform for Lima and Callao**	• Integrated Mobility transport system
3	**Multi-institutional Transport NAMA committee**	• Consolidated and agreed decisions on the implementation of low carbon policies in Lima and Callao as well as Peru as a whole.
4	**Revision of draft Transport NAMA**	• A Transport NAMA for Peru is achieved
5	**Develop Travel Plans**	• Increase of employees' and businesses usage of NMT • Cycling parking facilities • Fall in private vehicle usage
6	**Development of an Energy-Efficient Mobility Plan**	• Obtain appropriate contractor to assist in the production of an integrated low carbon mobility plan for Lima and Callao
7	**Support for education and training**	• Train and obtain return from the training of relevant staff sent to courses. • High quality training is established in Peru
8	**New infrastructure for the capital and national infrastructure**	• Specifications of infrastructure required to implement the transport NAMA
9	**Seek international Finance for NAMA implementation**	• Finance is secured to enable the plan to be completed

As mentioned earlier, these interventions can be developed nationally and do not require external support.

Intervention 1: Creation of a single Unified Technical Authority (UTA) for transport in Lima and Callao

The implementation of transport NAMAs will pose great challenges for Peru and especially for Lima and Callao, thus the creation of a unified technical authority for mobility in the metropolitan capital will not only help confront these challenges but will play the central and crucial role in attaining the overall goal (GHG emissions reductions).

1.1. The Unified Technical Authority is of prime importance because without a unified approach to the transport system in the capital there can be no real progress on any of the other actions. The UTA therefore needs to be put in place in the shortest possible timeframe. However, it is also important that it is created with due attention paid to how it would work and the extent of its authority, yet with due flexibility in place so that it can adjust to a changing reality as and when necessary with a minimum of interruption.

Outcome: This is a facilitative action which is essential to enable other actions to happen. The outcome is therefore high level: Lima and Callao have the means to develop a concerted transport policy and implement it to achieve low carbon objectives.

1.2. With due care and attention, the authority could be set up quite quickly although some aspects of its implementation might take longer. Therefore it is necessary to establish a preferred order in which its activities would start.

Outcome: An agreed priority-ranked list of further actions.

1.3. The UTA should take responsibility for the street network – this is necessary so that other issues of mobility enhancement, including the pedestrian and cycling actions (which will yield benefits in the relatively short term) and the initiation of a freight network.

Outcome: This is a facilitative action. The outcome is therefore that it will enable use of the street network (by pedestrians, bicycles, public transport, taxis, freight vehicles) to be coordinated in line with low carbon objectives.

1.4. The UTA should take responsibility for the whole public transport network, including the bus, electric train and taxi systems. This is crucial so that a holistic view can be taken of the mobility system as a whole – with parts of the system being under the auspices of local or central government or the formal or informal private sector there can be no lasting coordination which is a cornerstone of any attempt to reduce carbon emissions from the public transport sector. This is an important early task, but cannot realistically work if the UTA does not have ownership of the street network; hence this action must be undertaken at the same time as, or immediately following, Action 1.3.

Outcome: This is a facilitative action. The Outcome is authority and responsibility to develop a unified integrated public transport system for Lima and Callao, consistent with low carbon objectives.

Intervention 2: Mobility Reform for Lima and Callao

Prioritisation of Non-Motorised Transport (NMT)

As mentioned in the Mobility Hierarchy earlier, the cheapest and cleanest ways of moving around a city are by foot or cycling, this is clearly influenced by the proximity of the activities and the way the city has been designed. In the Metropolitan area (Lima and Callao) 25% of the total daily trips are made by foot and 0.5% by bicycle (Blue area Figure 16). This is the second biggest mode of transport after public transport and therefore gives perfect evidence that if more attention is given to non-motorised transport these numbers might increase or at least remain the same. The enhancement should aim to increase the share of journeys made on foot or by bicycle, for example to 40% and 2% respectively.

2.1. Promote the benefits of walking and cycling through an educational campaign aimed at the entire population. This requires an educational campaign with material using many media

channels directed towards different sectors of the population, including children as well as adults.

Outcome: NMT modal share has increased by 100%

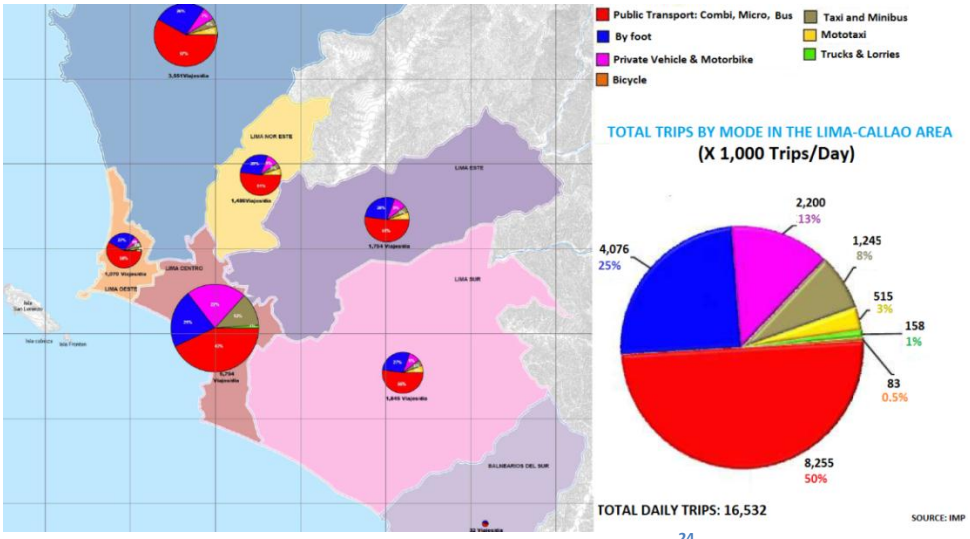


Figure 16 Trips by mode Lima and Callao[24]

2.2. Set up monitoring stations in pedestrian areas to evaluate the changes in CO_2 levels.

Outcome: Regular NMT reports in terms of usage, carbon emissions etc. and inputs to the generation of future schemes

2.3. Set up a process whereby NMT schemes can be developed and implemented as quickly as possible.

Outcome: an implementable plan for the installation of NMT schemes in Lima and Callao.

2.4. A very important and immediate action to be taken is capacity building of transport professionals. This not only facilitates identifying needs but addressing them adequately and with the right capacity. Therefore, the commissioning of bespoke training courses as well as more strategic education, at diploma, degree, masters and doctoral levels is required. Confirmation is required in the short term of how much appropriate education and training for the mitigation plan is available already or could be available within a short timeframe within Peru, what is currently available on the international market and what needs to be designed and specified. Some of this has been done (see the TNA report).

Outcome: This is a facilitative action. The Outcome is the start of a phased programme of education and training, initially involving international assistance, but leading to the establishment of a national capacity to supply appropriately trained mobility professionals who can work towards low carbon objectives.

2.5. The public transport network needs to be completely rethought from first principles. This is, in the first instance, a planning activity. The objective needs to be set to enhance mobility and spread the load around the city. Thus to determine where economic activity could be encouraged away from the historic centre, how peak demand could be reduced in the centre and the central role played by the transport network in achieving this. The planned

[24] La Vialidad y el Transporte Urbano Metropolitanos en la situación Actual. PowerPoint presentation by the Instituto de Planificación Metropolitana (IMP) and Lima Ciudad para todos.

network should make concerted use of orbital and radial routes to provide mobility throughout the city with a balanced load so that points of conflict and congestion are minimised. It should also embrace inter-modality and interchange in order to achieve a system of systems which is really easy to use. It should set objectives such as minimum/maximum walking distances to public transport stops/stations and service frequencies. It also needs to specify how it will facilitate mobility for people with lower capabilities of locomotion, such as older or disabled people.

Outcome: A consolidated plan for an integrated public transport system for Lima and Callao, aiming to meet low carbon objectives.

2.6. Control of the public transport systems at the level of procurement – of both services and vehicles – is required in order to ensure that the services designed in (2.5) are actually operated and that the vehicles used to provide the transport service are suitable for the purposes of mobility provision and carbon reduction. It might be the case that, to ensure consistent application of appropriate vehicles within a reasonable timeframe, support might be required to provide the first tranches of new vehicles. This could be necessary for two reasons: (1) there is no incipient culture within existing operators for purchasing new vehicles and (2) the new vehicles will be expensive. Accordingly there is a Supporting Action associated with this action.

Outcome: This is a facilitative action. The Outcome is to have the legal authority and financial capability to support the implementation of the integrated mobility plan.

2.7. Introduction of an integrated fare system.

Outcome: Lima and Callao have a unified fare system enabling the integration of modes for any journey, making it convenient and practical for its citizens.

2.8. Subcontracting of service operation to suitable companies will be required. Given the current nature of public transport provision, it will be necessary first to support the development of formal businesses which could take on the responsibility of operating services as a whole (rather than one or two buses on a service). A procurement process will be required – suitable ones could be modelled on the process used in London and this could be the subject of bespoke training as set out in (2.4) above.

Outcome: organised entrepreneurial business model for new companies to operate the public transport system in an integrated manner to achieve low carbon objectives.

2.9. Improvement of fuel quality to allow operation of better quality ICE and hybrid vehicles. This will not only reduce carbon emissions of existing vehicles but will enable new vehicles to work properly and not be damaged by the low quality of fuel.

Outcome: Peru supplies better refined fuels.

2.10. Procurement of new low carbon vehicles for all modes of the public transport system.

Outcome: A fleet of modern low carbon vehicles including taxis, buses of various sizes/types and trains is integrated in the Lima and Callao mobility system. It should also include the possibility for other vehicles such as for-hire bicycles and cars, trams etc.

2.11. Quality control of taxis needs to be implemented and maintained.

Outcome: a set of enforceable regulations relating to vehicle and driver quality. This needs to include a suitable enforcement body.

2.12. The provision of freight services to the city needs to be designed as a supply network, including preferred/mandatory routes for vehicles of certain dimensions, so that businesses around the city can receive their supplies by means of vehicles which are suitable to the

local circumstances. This might require the provision of transfer stations where cabotage and load transfer can be achieved so that suitable vehicles – especially those which are characterised by low carbon emissions – are used.

Outcome: a 'freight network' to complement the public transport network developed in Action 2.5 and directed to meet low carbon objectives.

2.13. The freight transport operating to and from the port of Callao needs to be allocated sufficient designated routes, with new infrastructure where appropriate. This might require the installation of one or more puertos secos so that queues for access to the port can be minimised.

Outcome: Also in conjunction with Actions 2.5 and 2.12, a directed network of routes for heavy freight vehicles; if necessary this could require investment in one or more puertos secos and access arrangements to and from the port of Callao and the rest of Peru.

2.14. Monitoring stations for carbon emissions need to be installed with suitable enforcement so that vehicles (all vehicles, including public, private and freight) that are insufficient in terms of emissions performance can be removed from the fleet.

Outcome: a set of monitored environmental quality measurement stations which are monitored and producing monthly (more frequently if required) reports on emissions.

Intervention 3: Institution of an Inter-Institutional Transport NAMA Committee (IITNC)

Creation of the IITN committee: The success of the development and implementation of the NAMAs will be driven by the effectiveness of the coordination efforts among all stakeholders; the involvement of political ownership and leadership and the clear definition and authority of a technical leadership for the successful management of the projects. An important component of achieving this is an Inter-Institutional Transport NAMA Committee formed by representatives from all relevant bodies including public and private sector entities, operators, users, universities and NGOs with clear responsibilities and specifics tasks.

3.1. A committee of all governmental parties involved in transport in Lima and Callao needs to be set up so that trans-institutional issues can be discussed and resolved in terms of authority, responsibility, duty and action. This should include not only the UTA and the municipalities of Lima and Callao but also the Ministries with responsibility for Transport, Environment, Energy, and Commerce, SUTRAN and PNP; other related Ministries such as the Ministry of Health and any other institutions that have a direct responsibility related to environmental issues. The importance of this is that all issues can be sorted out as far as possible in advance and issues which arise afterwards can be resolved as part of an established process without the need for sudden short term *ad hoc* meetings. Given the pre-eminence of Lima and Callao within the national economy, the IITNC should also include bodies with a remit in the rest of Peru.

Outcome: Consolidated and agreed decisions on the implementation of low carbon policies in Lima and Callao as well as Peru as a whole.

Intervention 4: The IITNC needs to review the draft Transport NAMA

4.1 Ensure that the estimates of emission reductions are updated to take account of new data, information and improved models, promote the confirmation of Actions and oversee the implementation of the Actions.

Outcome: The Transport NAMA is produced and submitted to the responsible authorities.

Intervention 5: Development of Travel Plans

5.1. Incentivise employers to develop low carbon travel plans for their business (in relation to both the company's own products, services and operations and the travel of its employees).

Outcome: Employers in Lima and Callao report an increase in the use of NMT, low carbon public and freight transport use by its employees and their business as a whole.

5.2. Facilitate the introduction of facilities for pedestrians and cyclists within the company premises (e.g. cycle parking, showers, changing rooms etc.).

Outcome: An increase in cycle parking near to and within company premises and provision of associated supportive facilities.

5.3. Incentivise people to use NMT and public transport for their travel to and from work.

Outcome: Increase in the use of NMT and public transport and a fall in private car use by people travelling to/from work.

Intervention 6: Development of an Energy-efficient Mobility Plan

6.1. Contract suitable assistance from international experts to support the specification of a project to develop a mobility plan for Lima and Callao which promotes energy reduction as a primary objective.

Outcome: Appropriate advice obtained and implemented on the specification of the integrated low carbon mobility plan for Lima and Callao.

6.2. Procure contractors to undertake the work specified in Action 6.1.

Outcome: Appropriate contractor(s) hired to assist in the production of an integrated low carbon mobility plan for Lima and Callao.

Intervention 7: Support for Education and Training

All the initiatives will fail unless there is technical capacity to plan, manage, monitor and evaluate the progress of all the actions, therefore constant capacity building is high on the agenda. This action will entail capacity building at the different levels of the Tyler's Capacity Training Pyramid (Figure 17). The suggested overall actions are:

1. **Enhancement of technical leadership:** This action aims at ensuring that technical leaders are trained adequately and empowered so as to close the gaps in technical expertise identified during the capacity needs assessment and facilitating constructive multidirectional communication between technical leaders and political decision-makers.
2. **Development of internships and secondments**: This action will entail developing partnerships with different transport authorities to facilitate practical learning from in-situ mobility projects. The programmes will involve technical leaders, managers and staff from Lima and Callao participating in real projects to facilitate knowledge exchange.

3. **Development of technical courses:** This action will entail the development of technical courses aimed at mobility technicians and operators to enhance their knowledge and facilitate the understanding and implementation of mobility strategies.

This capacity building action will require external support and therefore the projected vision of this training is represented in Figure 18; where the international support is highest at the beginning of the programme but tends to decrease over time reaching a point where the Peruvian technical capacity could contribute to such international support for other countries.

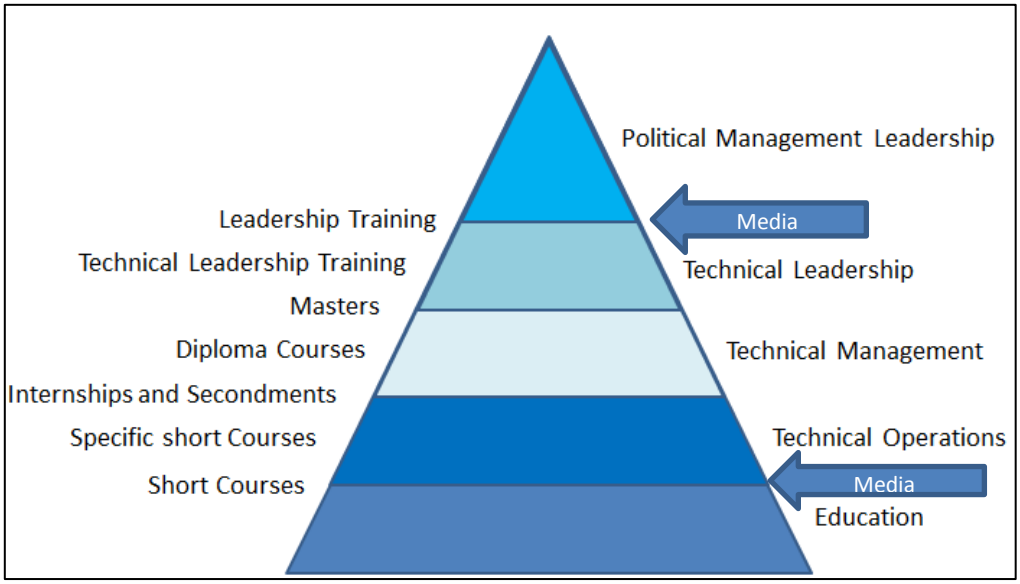


Figure 17 Capacity Training Pyramid

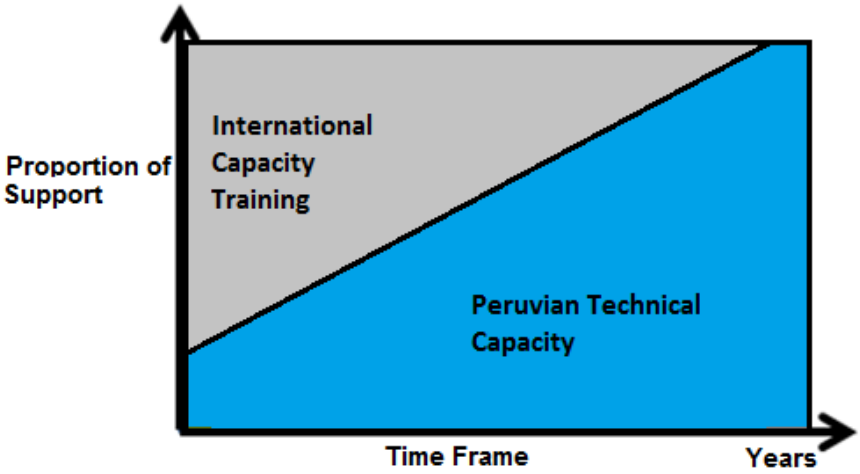


Figure 18 Proposed training time frame

7.1. Having undertaken the analyses in Action 2.4, it is necessary to specify the education and training needs that need to be undertaken and estimate the potential suppliers in both national and international markets. This should include both education in formal courses (e.g. degree, diploma, Masters and Doctoral) and other types of training such as secondments, short courses and so on.

Outcome: a detailed specification of training needs and opportunities aimed at all the requirements for implementing a low carbon transport strategy in Lima and Callao as well as Peru.

7.2. Procure the specified courses.

Outcome: Appropriate courses made available to relevant staff in Lima and Callao.

7.3. Select the personnel to attend the courses and start the education and training. Relevant staff identified, sent on the training courses and return to work in Lima and Callao to implement and share the products of their learning.

Outcome: High level of technical professionals work in the Mobility sector.

7.4. Develop appropriate collaborative arrangements for Peruvian universities to work with suitable international universities to assist with development of both research and teaching. A suitable set of collaborative arrangements is established which includes the best of modern low carbon mobility thinking and technological expertise

Outcome: Peru has a suitable set of collaborative arrangements for research and teaching.

7.5. Develop new capacity within Peruvian universities to provide a more sustainable and continuing source of well-qualified and appropriate mobility professionals at all levels within Peru.

Outcome: New high quality teaching/training programmes established in Peru for the future development and implementation of low carbon mobility policies.

Intervention 8: Devise new infrastructure plan for city and national infrastructure

8.1. Specify the infrastructure that is necessary for the low carbon mobility required in Lima and Callao.

Outcome: A detailed list of the costs of infrastructure required for the implementation of the low carbon mobility plan in Lima and Callao. This should include not only transport infrastructure, but also communications, energy, water, waste and information infrastructure.

8.2. Specify the infrastructure that is needed for the low carbon mobility required in Peru.

Outcome: A costed detailed list of infrastructure required for the implementation of the low carbon mobility plan in Peru, taking into account the provision in Lima and Callao as specified in Action 8.1. This should include not only transport infrastructure, but also communications, energy, water, waste and information infrastructure.

8.3. Seek financial support for this infrastructure development.

Outcome: Proposals agreed with international financial bodies to support the implementation of the low carbon mobility plan and Transport NAMA.

Intervention 9: Seek international finance for the NAMA implementation plan

9.1. Approach appropriate international bodies in public and private sectors to obtain required financial support for those parts of the plan that require this.

Outcome: Sufficient finance secured to enable the plan to be completed.

Time frame for implementation of the draft NAMA

The mitigation actions that result from the discussion above need to be seen in terms of:

1. When they need to be initiated
2. When implementation should be started

3. When implementation could be completed
4. When the outcomes start to become apparent

The emphasis on time is important and the explicit separation of initiation, implementation and the onset of the outcomes is crucial in both the practical issue of how they are put in place and the ways in which success can be observed and measured. The timings are important for political reasons – it is highly unlikely that the mitigation actions would be completed within a single political cycle (or even several cycles) so it is important that people are realistic about the expectations of success within convenient political timeframes.

We have captured these issues in simple tables (Table 6 to Table 19). In these tables, we have determined the time issue in terms of short (1-2 years), medium (3-5 years) and long term (5+ years). We have also indicated when each of the actions should be started, when planning and implementation would be carried out and when the outcomes might become apparent. Actions shown in the following tables which are facilitative are shaded.

Table 6 Actions within intervention 1: Creation of (UTA for transport in Lima and Callao

Key:	Start	Plan	Implement	Facilitative Action

	Action	**Time for Action**			**Time for Outcome**			**Indicators of Successful Outcomes**
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
1.1	Lima and Callao create a technical body responsible for the mobility of the metropolitan capital.							Lima and Callao have the means to develop a concerted transport policy to achieve low carbon objectives.
1.2	UTA plans and develops action plan for Integrated mobility.							An agreed priority-ranked list of further actions
1.3	UTA takes responsibility of the street network.							The street network (by pedestrians, bicycles, public transport, taxis, and freight vehicles) is coordinated in line with low carbon objectives.
1.4	UTA takes responsibility of the whole public transport network.							UTA has the authority and responsibility to develop a unified integrated public transport system for Lima and Callao consistent with low carbon objectives.

Table 7 Actions within intervention 2 - Mobility Reform for Lima and Callao

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
2.1	Set up process to prioritise Non-Motorised Transport							Implementable plan for the installation of NMT schemes in Lima and Callao
2.2	Promote walking and cycling							NMT modal share has increased by 100%
2.3	Establishment of NMT monitoring stations							Regular NMT reports in terms of usage, carbon emissions, etc.
2.4	Capacity building of transport professionals							Phase programme of education and training for Mobility professionals starts.
2.5	Transport network rethought from first principles							Consolidated plan for an integrated public transport system for Lima and Callao aiming to meet low carbon objectives.
2.6	Control of public transport procurement							Legal authority and financial capability is available to support the implementation of the integrated mobility plan.
2.7	Introduction of an integrated fare system							Lima and Callao have a unified fare system enabling the integration of modes for any journey, making it convenient and practical for its citizens.
2.8	Subcontracting of service operation to suitable companies							Organised entrepreneurial business model for new companies to operate the public transport system.
2.9	Improvement of fuel (See action 11.1)							Peru supplies better refined fuels.
2.10	Procurement of new low carbon vehicles							A fleet of modern low carbon vehicles is integrated in the Lima and Callao mobility system.

Table 8 Actions within intervention 2 - Mobility Reform for Lima and Callao (Continue)

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
2.11	Quality control of taxis							Set of enforceable regulations relating to vehicle and driver quality is developed.
2.12	Provision of 'freight network' to meet the city needs							Lima and Callao have an intelligent Mobility System (In conjunction with 2.5).
2.13	Suitable allocation of freight transport from Callao within Network							Directed network of routes for heavy freight vehicles (in conjunction with 2.5 and 2.12).
2.14	Monitoring stations for carbon emissions with suitable enforcement							A set of monitored environmental quality measurement stations produce monthly reports on emissions.

Table 9 Actions within intervention 3 - Institution of an Inter-Institutional Transport NAMA Committee (IITNC)

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
3.1	Establishment of an Inter-Institutional Transport NAMA Committee (IITNC)							Consolidated and agreed decisions on the implementation of low carbon policies in Lima and Callao as well as Peru as a whole.

Table 10 Actions within intervention 4 - Development of a Transport NAMA

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
4.1	The IITNC reviews the draft transport NAMA							A transport NAMA for Peru is produced

Table 11 Actions within intervention 5: Development of Travel Plans

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
5.1	Create incentives to develop Travel Plans							Employers in Lima and Callao report an increase in the use of NMT, low carbon public and freight transport.
5.2	Introduction of facilities for pedestrians							An increase in cycle parking near to and within company premises and provision of associated supportive facilities.
5.3	Create incentives for people to use NMT and public transport							An increase in the use of NMT and public transport and fall on private vehicle usage.

Table 12 Actions within intervention 6: Development of an Energy-efficient Mobility Plan

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
6.1	Contract suitable assistance on the development of a mobility plan for Lima							Appropriate advice obtained and implemented in the integrated low carbon mobility plan for Lima and Callao.
6.2	Procure contractors to undertake work							Appropriate contractor(s) hired to assist in the production of an integrated low carbon mobility plan for Lima and Callao.

Table 13 Actions within intervention 7 - Support for Education and Training

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
7.1	Specification of training needs (After 2.4)							A detailed specification of training needs and opportunities for low carbon transport strategy.
7.2	Procure specified courses							Appropriate courses made available to relevant staff in Lima and Callao
7.3	Select participants and trainers							High level of technical professionals work in the Mobility sector.
7.4	Develop appropriate collaborative programme							Peru has a suitable set of collaborative arrangements for research and teaching.
7.5	Develop capacity within Peruvian universities							New high quality teaching/training Mobility programmes are established in Peru.

Table 14 Actions within intervention 8 - Devise new infrastructure plan for city and national infrastructure

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
8.1	Specify the infrastructure necessary for low carbon mobility							Detailed costing of infrastructure needed for low carbon mobility in **Lima and Callao**
8.2	Specify the infrastructure necessary for low carbon mobility							Detailed costing of infrastructure needed for low carbon mobility in **Peru**
8.3	Seek International financial support for infrastructure development							Peru achieves financial support for Mobility plan

Table 15 Actions within intervention 9 - Seek Financial support for the Implementation of the NAMA

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
9.1	Seek International financial support for the NAMA implementation							Peru achieves financial support to implement transport NAMA

Risks or limitations

The barriers that might intervene to obstruct the development and implementation of the actions mentioned above to attain the NAMA can be classified in the following:

Funding: Some of the reasons that might delay action for both unilateral and supported actions could be that credit might not be readily available at the local or national level, difficulty in the attainment of funds due to long term returns and lack of awareness of existing financial possibilities that have been made available to reduce carbon emissions. NAMAs offer the advantage of being able to target three different types of funding; funding available from different government levels; international financial flows and specific climate change funds. Low carbon transport projects tend to be measurable through GHG emission reductions, improved air quality and vehicle efficiency to name some indicators and this facilitates the likelihood of attaining sources of funding, so the important factor here is to provide clear information of why is the funding needed and develop a good MRV system to support the proposal. Additionally, the nature of the targets (contribute to national goals) is such that funding from national and local government is very conceivable.

Technology: Research and best practice suggest technology as crucial for success, however it is important to note that 'appropriate' technology is the fundamental concept for success. This is due to the relevance of the needs in the countries; latest technologies might work in some areas of the world however simple technologies such walkways or cycle lanes might generate stronger impacts in other areas. Barriers related to technology could be the lack of understanding of local needs, lack of knowledge of technology available to address specific targets and lack of easy access to these technologies to be able to test them. Therefore, exploratory methods and partner research might enable an appropriate solution to be found that would work well for Lima and Callao. In addition organisations such as the *Climate Technology Centre and Network* could provide advice to help obtain better results.

Capacity: Having the technology and the funds to develop appropriate strategies will not be enough if the metropolitan city does not have the capacity to lead the development and implementation of any strategy. As mentioned several times above, technical capacity is essential in the achievement of ambitious goals and the empowerment of local leaders, essential actors and the team working alongside them are key to the success of any project. Therefore to guarantee capacity is not a barrier, we need to invest in continuous capacity building; *optimise to capitalise,* this will ensure that projects are robust and their long term sustainability and resilience.

Institutional: Another risk that the NAMA might face is the lack of support, engagement and commitment among all relevant institutions to develop and implement the actions. This may be due to a wide range of reasons; misinformation on the subject, lack of coordination (fragmentation of responsibilities), actions that are too difficult to execute (lengthy processes) or do not align within the national/local priorities, lack of understanding of the relevance or relationship between the actions and the institution's tasks as well as resistance to alteration or modification of certain practices. Thus the NAMA should be developed alongside institutional participation, with total political ownership and guidance, constant coordination and communication among all organisations and complete understanding of alignments to institutional priorities, roles and responsibilities.

Information: The setting and most importantly the identification of NAMAs require vast amounts of data to enable the analysis and selection of the most appropriate measures and their continuous monitoring. Obtaining this data goes in hand with the capacity to collect it, therefore, planning plays an important part on the process; data collection should not intervene in the development of other initiatives that might not need extensive data. Prioritising and coordinating activities should enable decision makers to mitigate this barrier.

Innovation: Another barrier that the NAMA might face is related to misconceptions and resistance to the adoption new ideas. It is very common to fall into assumptions and myths regarding innovative measures as being too costly and complex and only applicable to certain well-structured cities or areas or people. Similarly, there is resistance to the modification of procedures and habits because of the high reliance in historical models which give no credit to latest innovations and lessons learnt. If innovation is accepted, there is also the danger of delegating the task to third parties that might not have the same sustainable intentions and social responsibility to suggest and implement adequate measures. Therefore as mentioned before, all actors should be involved in the development of the NAMA, important support should be given to the planning process (funding and flexibility for in-depth research) and the information should be disseminated in a clear and concise way, so that if third parties are involved they can understand it.

Measure 2 – Energy Efficiency[25]

Aim

The aim of the Energy Efficiency measure is to help Peru achieve its targets of reducing GHG emissions by creating an energy efficiency certification scheme for light vehicles. This way, the consumers will have reliable information regarding indicators of energy performance set by the relevant sectors and will allow buyers to choose alternatives that no only meet the guidelines of the vehicle's operations and performance, but also emits permissible ranges of greenhouse gases (in the case of carbon dioxide) under the national regulations.

The proposal focuses on the establishment of a mean limit of CO_2 emissions applicable to vehicles manufactured and imported in order to reach by the year 2022, 120 g CO_2 per km travelled for all new vehicles registered in the country.

[25] Extracted from Appendix II

Objectives

- Promote fuel efficiency in vehicles
- Produce better information to customers

Background

Energy and Fuel Consumption

The energy consumption in the transport sector increased by 12.5% from 2009 to 2010 and this is due to the rise in vehicle fleet resulted from the economic growth seen in recent years (MINEM, Balance Nacional de Energia 2010, 2011). The total energy consumption published on the National Energy Balance 2010 was 654,115TJ from which 60.1% corresponded to hydrocarbons; the transport sector is the highest consumer of hydrocarbons derivatives as seen in Figure 19.

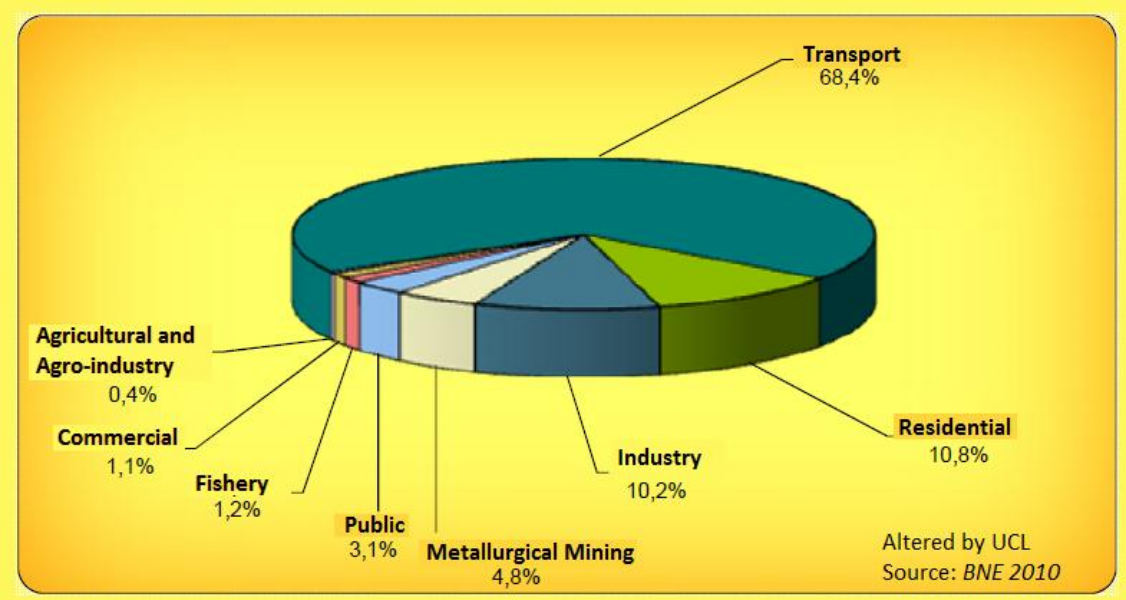


Figure 19 Final consumption structure of hydrocarbons and biofuels by sectors

Air Quality and GHG Emissions

The Ministry of Health through the Directory of General Environmental Health (DIGESA – Spanish acronym), the Ministry of the Environment through the National Service of Meteorology and Hydrology (SEHAMHI) and the Metropolitan Institute PROTRANSPORTE do not develop their monitoring in a coordinated manner. Furthermore, the main national monitoring body DIGESA, to this date, does not have available data to support this report; the report available is incomplete and outdated.

The transport sector has seen an annual increase in vehicle fleet of 4% since the year 2000 and this has shown a direct relation to air pollution due to the presence of total suspended particles and sulphur dioxide ($SO2_2$). These contaminants are generated by fuels that contain sulphur as well as nitrogen dioxide (NO_2) generated by petrol. The biggest barrier in Lima/Callao is due to the fact that diesel motors cannot be converted and therefore the only way to reach a shift to gas is by replacing the motor. Please see Appendix V for full report produced by Swisscontact.

Proposed Interventions

Table 16 Proposed Intervention for Energy Efficiency

	Intervention	Goals
10	**Vehicle Labelling**	• All new lightweight vehicles provide environmental performance labels • Peru has its own national energy efficiency accreditation body
11	**Cleaner fuels**	• Peru provides clean fuels
12	**Adopt a mechanism for light vehicles to achieve emissions target**	• Peru reaches target of 120g CO_2 per km travelled

Intervention 10 - Vehicle Labelling

10.1 To inform customers and begin to raise awareness of carbon emissions, it is necessary to develop a labelling mechanism that indicates the vehicles' environmental and fuel efficiency performance. The label should incorporate aspects such as model, emissions rate; fuel usage for 18,000km travelled and fuel consumption, etc. The Ministry of Transport needs to regulate this measure. This is a facilitative action.

Outcome: All new light weight vehicles provide environmental performance labels

10.2 Initially the labels from action 10.1 will be accepted from accredited bodies whose recognition will have been granted by a certification of the countries where the vehicle are originated from or other country with laboratories that meet international standards set for certification bodies. However, in a second stage, the certification should be made at national level, promoting a national accreditation that can validate and perform compliance testing for certification in energy efficiency for new light vehicles.

Outcome: Peru has a national energy assessor and accreditation body for energy efficiency in light vehicles.

Intervention 11 - Cleaner Fuels

11.2 In order to attract more environmentally friendly vehicles and enable the import of new fuel efficient vehicles it is necessary to introduce cleaner fuels, especially in terms of sulphur in Diesel. These actions should be addressed by the Ministry of Mines and Energy. This is a facilitative action.

Outcome: Peru supplies cleaner fuels

Intervention 12 – Adopt a mechanism for light vehicles to achieve emissions target

12.2 Finally, in order to contribute to energy reduction in the transport sector, it is crucial to set a mechanism that sets a gradual goal of achieving average GHG emissions of 120g CO_2 per km travelled. This will be applicable to vehicle fleet manufacturers and importers. To mitigate the magnitude and implications of this measure; it is suggested to start with a target of 130g CO_2 per km travelled by 2018 and develop additional measures that allow achieving 10g of CO_2 per km travelled by 2022.

Outcome: Peru reaches target of 120g CO_2 per km travelled.

Time Frame

As specified before, to be able to implement the mitigation actions, it is necessary to identify:

1. When they need to be initiated
2. When implementation should be started
3. When implementation could be completed
4. When the outcomes start to become apparent

Tables 17, 18 and 19 represent these timeframes.

Intervention 9 - Labelling of vehicles

Table 17 Actions within intervention 10 – Vehicle Labelling

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
10.1	Ministry of Transport demands emissions labelling from vehicle manufacturers							All vehicles have labels to identify their energy efficiency and emissions
10.2	Creation of a Peruvian energy assessor and accreditation body for energy efficiency in light vehicles.							Peru has a national energy assessor and accreditation body for energy efficiency in light vehicles.

Intervention 10 – Cleaner Fuels

Table 18 Actions within intervention 11 - Cleaner Fuels

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
11.1	Ministry of Mines and Energy introduces cleaner fuels for cleaner vehicles							Peru supplies cleaner fuels

Intervention 12 – Mechanism to achieve 120g CO_2 per km travelled

Table 19 Actions within intervention 12– Mechanism to achieve 120g CO_2 per km travelled

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
12.1	Develop a method to achieve 120g CO_2 per km starting with 130g CO_2 per km by 2018 and implement complementary measures to decrease by 10g of CO_2 km travelled.							Peru reaches target of 120g CO_2 per km travelled for light vehicles

Field of Application

This CO_2 emissions limit will apply to all new vehicles that belong to category M1; vehicles with eight seats or less, excluding the driver's seat, as specified by the National Regulation of Vehicles from the Ministry of Transport and Communications.

The CO_2 emission level will be measured in accordance with the regulations set by the European Community (EC) No. 715/2007 on approval of vehicles with regard to emissions. The emission limit value does not apply to each vehicle individually, but is applied based on the mean value of all new vehicles reported by a registered manufacturer and importer in Peru.

Risks or limitations

The risks and limitations that might arise fall under the same umbrella as the ones identified for the integrated mobility measure, however there are two specific barriers that will require mitigating priority:

1. The Ministry of Transport does not have the capacity to develop or enforce the vehicle labelling.
2. The Ministry of Mines and Energy do not have the capacity, political or funding to introduce new fuels.

Expected Benefits

Even though studies have shown that environmental aspects do not influence the decision making process of buying a car; fuel efficiency does play an important part and thus relates directly to energy efficiency and CO_2 emissions.

Many countries have carried out these types of initiatives (the United States, UK, France and Denmark among many), and so far the results for a 5 year period (1998 to 2002) showed CO_2 emissions reductions, improved efficiency of new vehicles and a change in fleet composition vehicle. Denmark for example, showed that the performance of diesel vehicles increased by 26.1% and gasoline by 4.5%, also the proportion of more efficient vehicles increased. In France the average performance of vehicles increased by 12% and the proportion of more efficient cars increased by 10% for diesel cars and gasoline vehicles 0.89%.

An example of the annual savings that a light-vehicle owner could obtain per 15,000km travelled is estimated in Table 2020.

Table 20 Cost and benefit estimation for light vehicles (15,000km)

CO_2 emissions regulation (gr CO2/Km)	Km / year	Litres / 100 Km	Fuel price (new soles)	Annual cost (new soles)	Benefit (new soles)	Comments
190	15000	8.17	11	3479	511	Trucks 2011
160	15000	6.97	11	2968	0	Average 2011
130	15000	5.58	11	2376	-592	Vehicles 2011
120	15000	5.15	11	2193	-775	
95	15000	4.08	11	1737	-1231	

Measure 3 - Green Zones

Aim

Lima-Callao, as other metropolitan agglomerations in Latin America, has major environmental problems related to the lack of coordinated approaches to urban systems such as mobility, infrastructure, public transport, land uses and energy sources.

In this context, the Green Zones initiative proposes to introduce a substantial change in the development of Peruvian cities by creating zones of exemplar sustainable development. These will demonstrate the benefits of an integrated approach to planning in which national and city governments, the private sector, and the local communities join their efforts in the creation of more sustainable environments able to reduce their impact in the ecosystem.

Objectives

Green zones will provide a holistic approach of what sustainable urban cities should be about:

- Improved quality of life
- Promote community's sense of pride and ownership of their city
- Optimisation of the community's mobility and accessibility
- Coordination and integration among services
- Implementation of resource-efficient growth

Green zones will be **vibrant medium to high density city quarters** characterised by innovation in the design of places where people can live, work and play. Their vibrancy will attract dynamic businesses and diverse communities that will incorporate sustainable principles in their day-to-day choices. It is envisioned a network of **active public spaces** that are full of life. These will incorporate sustainable infrastructures that will benefit the environmental performance and resilience of the community. It is propose to implement **flexible buildings** that can integrate mixed uses from the early stages.

These will prioritise the integration of strategies to reduce consumption of energy and water, as well as minimising the generation of waste.

Efficient and **sustainable transport choices** will be available for the travel of citizens within, into and out of the green zones. These will integrate innovative strategies such as new fuel options (for example, electric cars, hydrogen BRT buses, etc); reduction in the need for travel due to availability of housing, jobs and leisure options; and the prioritisation of the use of efficient modes of transport (such as public transport) and non-motorised modes such as walking and cycling.

People living, working and playing in the green zones will be aware of the impact that their choices have on the environment. Through an active process of accounting and engagement, the Green Zones will **influence people's behaviour** towards a more sustainable lifestyle.

An initial step on the green zones has already been accomplished during the development of this transport NAMA. Initially the British Embassy together with the IMP (Instituto Metropolitano de Planificacion) identified seven zones that potentially could be developed into green zones. The scope for the areas was:

- A reference area of 500 hectares.
- The current use of the site should consider low and medium density occupation inside or outside the urban boundaries of the city.
- Areas should have a potential for rapid mass transportation servicing, associated to either the BRT (Metropolitano de Lima) or metro (tren electrico).
- Located in areas of low to medium income population.
- Potential for private real estate investment.

Initial stakeholder meetings have taken place with the IMP, the UCL team and other stakeholders from the municipality of Lima to discuss these zones. Key main areas of focus have been identified: sustainable use of transport, urban infrastructure, waste management, sewage and energy.

Furthermore, Arup was appointed the study of the vision for sustainable urban planning for these areas and between the 11-14th of March 2012 they visited the zones and met with various authorities and private sector stakeholders. Following Arup's analysis on the sites (full analysis available in Appendix VI) the sites with high development potential, requiring focus on understanding of existing ownership conditions are:

- Aeropuerto Las Palmas
- Pampas de Lurin y San Bartolo
- Villa El Salvador
- Chacracerro Comas

Consistently with discussions from the main report (See Appendix VI) about the project, it is suggested that the delivery of the project is likely to be most efficient by using a public private partnership (PPP). Further research indicated that this PPP should be implemented under the Exclusive Development Rights modality, as this model gives the most flexibility, is well-understood in the marketplace, and would likely not involve significant legislative changes to be implemented.

In order to provide a consistent approach to the reduction of carbon emissions in the Green Zones initiative, Arup proposes to follow the principles set by internationally recognised GHG accounting methods. In this context, it is suggested to utilise CPDP Framework as this has been designed specifically for new developments, and a carbon accounting tool is currently being developed.

Figure 20 represents graphically the zones under study and Table 21 summarises Arup's analysis on the four specific sites chosen for further work.

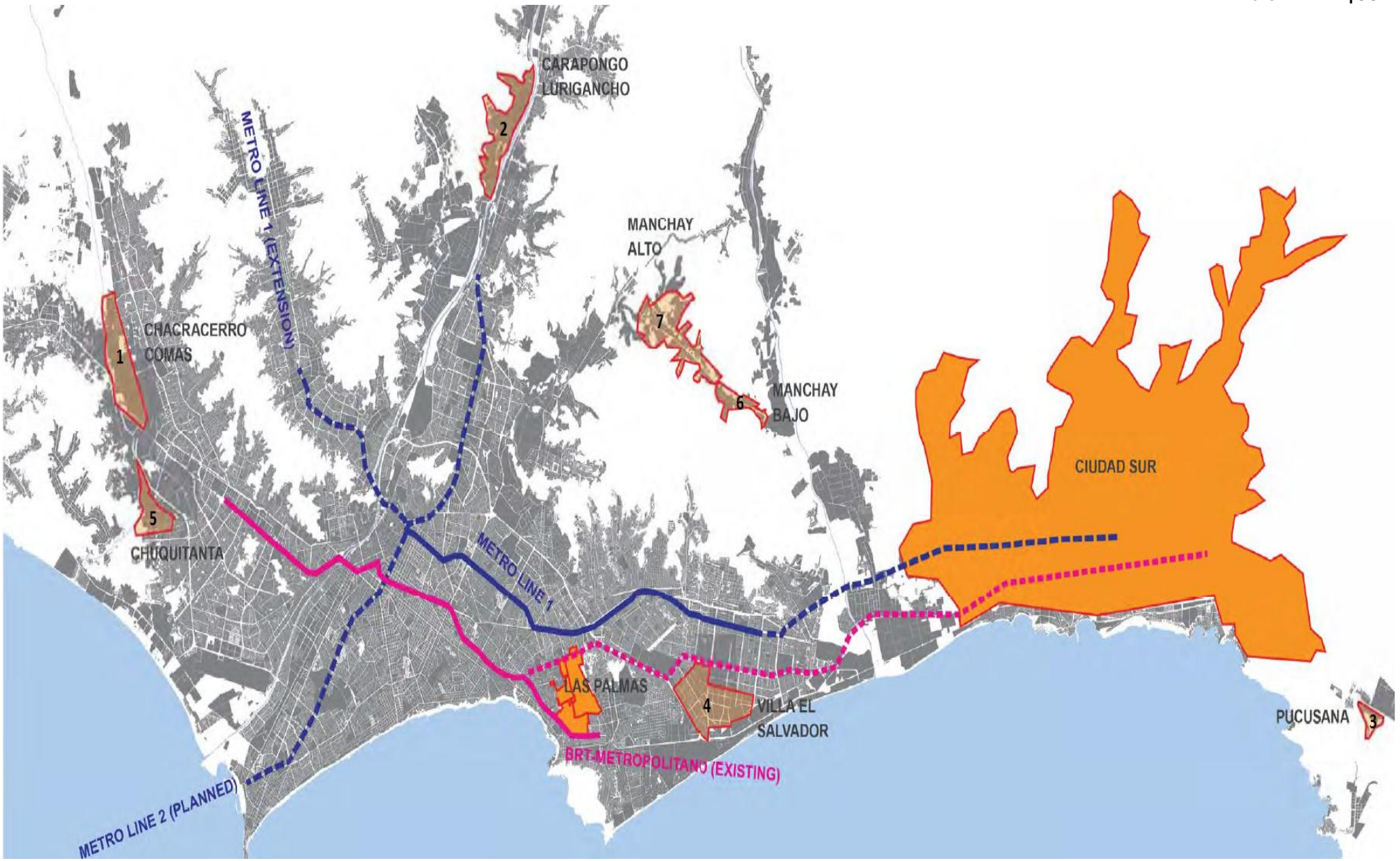


Figure 20 Potential areas for the development of Green Zones in Lima

Table 21 Potential zones for the development of Green Zones

Name	Area	Existing population	Opportunities	Constraints
Aeropuerto Las Palmas	300 ha (approx)	0	• A single land owner (Peruvian Air force) • Surrounded by substantial population that could be benefited from the new accessibility and social infrastructure delivered by the project • Potential connection to extension of Paseo de la Republica • Likely connection to BRT system • High potential for real estate investment	• The implementation will require the identification of an alternative location for the Air Force facilities currently located on the site
Pampas de Lurin y San Bartolo	23,500 ha	115,000	• Accessible from Panamericana Sur and potentially from a future extension of Pachacutec road. • Strong interest from national government • High interest from private sector • Potential to create a new image for the city • Its environmental conditions require high levels of innovation in the provision of urban infrastructure	• Distance from city centre increases cost of mass transit public transport systems • The development of this major site requires a coordinated effort of the city and national governments • There are perceived levels of speculation in the real estate market • Its development will require substantial investment in urban infrastructure • Water provision for the area is difficult • In order to ensure the development of medium density districts, this large size of the site requires a phasing plan that integrates development in the short, medium and long term. This will discourage land speculation and saturation of property market • Requires substantial work with existing communities
Villa El Salvador	581 ha	5,340	• Direct access from Panamericana Sur increases opportunities to utilise existing road infrastructure to gain access to the site • Potentially create a positive impact for a large number of inhabitants in the surrounding area	• Land is subdivided • Unorganised mix of agricultural and industrial land uses is present in the same area
Chacracerro-Comas	530 ha	11,017	• Direct access from Panamericana Norte increases opportunities to utilise existing road infrastructure	• Distance from city centre increases cost of mass transit public transport systems • Risk of flooding

Name	Area	Existing population	Opportunities	Constraints
			to gain access to the site • Likely to be connected to mass transit systems • Existing agricultural use	• Irregular settlements • High number of land owners requires substantial work with existing communities

Proposed Interventions

Developing green zones requires extensive studies of the areas, planning, consultation, policy frameworks, etc., therefore, adding to the initial actions specified for integrated mobility and energy efficiency; the following are initial suggestions to be included within the visioning, planning and design process:

Table 22 Proposed Interventions for Green Zones in Lima

	Intervention	Goals
13	**Design and Planning**	• A steering group is set up • Stakeholder engagement, investment interest, governance and community support is verified.
14	**Governance and Delivery**	• A delivery model is adopted • Preliminary market test is achieved
15	**Carbon accounting and sustainability**	• Clear measurable targets are in place
16	**Tendering and Feasibility**	• The feasibility of the project regarding land use, legal and financial aspects is successfully completed

Intervention 13 - Design and Planning

13.1 Identify a steering committee, which formally or informally will act as a decision maker in the initial stages of the project, i.e. first year. Establish a formal process of communication between the planning, environmental and economic authorities at the national and local levels. While there is an acknowledgement that the green zones project can contribute to develop a future vision for Lima, further discussions are required to address issues at the strategic and practical level.

Outcome: (This is a facilitative action) A Green Zone steering group is set up and a communication process has been established

13.2 Undertake an informal round of consultations with national and metropolitan authorities so that there is initial support on the prioritisation of sites and the preferred delivery model. This could take the shape of an initial workshop in which the relevant stakeholders (e.g. Lima municipality, IMP, Ministry of Housing, British Embassy) will discuss their views on the project.

Outcome: First high level stakeholder engagement Green Zone workshop is executed.

13.3 Identify private investors with interest in the development of the sites identified and validated by the relevant stakeholders. Further round of discussions with real estate investors and an understanding of their views on the development potential for the sites, is necessary to

complement Arup's initial analysis. This information can be compiled by an independent planning consultant.

Outcome: Investment interest analysis is completed.

Intervention 14 - **Governance and Delivery**

14.1 Based on the recommendation for a delivery model of the Green Zones project, an Exclusive Development Rights PPP, it is recommended to understand how this model could apply in practice to Lima, and how the governance structure should be developed to lead this effort. It is recommended to conduct a workshop with key stakeholders to discuss options and agree on the best approach.

Outcome: A delivery model approach has been adopted

14.2 Undertake a preliminary soft market testing with real estate developers to understand their preferences and concerns about how the PPP would be structured.

Outcome: A preliminary soft market testing has been completed

14.3 Analyse the ownership condition for each of the sites prioritised by the relevant stakeholders. This legal/planning study should rely in local knowledge and should identify the number of owners associated with each of the proposed sites. This should also take into account the legality of existing settlements in the sites.

Outcome: Ownership condition of the sites has been fully analysed.

Intervention 15 - **Carbon accounting and sustainability**

15.1 Identify preliminary carbon accounting and sustainability objectives. We suggest this task takes the shape of an initial literature review study (2 weeks) together with an initial sustainability workshop. The objective of this workshop should be limited to the identification of possible funding for the carbon accounting aspects of the project and the objectives associated with it. The definition of the objectives should not be limited to carbon accounting; hence it should include other social, economic and environmental variables.

Outcome: Green zones sustainability and carbon accounting objectives have been defined

15.2 Identify possible sources of funding for the project as well as a summary of possible incentives already available in the national and international contexts.

Outcome: A financial assessment has been formulated along with incentives.

15.3 Identify the preliminary targets associated with a carbon accounting and sustainability framework. This should capture the diversity of aspirations proposed by the various stakeholders, such as developers, politicians, and existing

Outcome: A set of measurable targets is defined for the development of Green Zones

Intervention 16 – Tendering and feasibility studies

16.1 Tendering and undertaking of feasibility studies for: land uses, accessibility, enabling works, and utility infrastructure

Outcome: Feasibility studies are finalised

16.2 Identification of high level costs, which should only include a rough order of magnitude, based on the feasibility studies in progress

Outcome: A financial assessment of the Green Zones is completed.

16.3 Set up a governance structure, this should define the duties and rights for each of the major stakeholders, as well as for representatives of local communities.

Outcome: A governance structure is put in place

16.4 The next step will be to proceed with legal studies to support the land acquisition process. At the end of the first year, these studies should identify a feasible process of transferring/selling the land from its current situation to the agreements associated with an Exclusive Development Rights PPP.

Outcome: A feasible legal process for land use has been identified for the Green Zones

Time Frame

The tables below highlight the detailed time frame for each action and their indicator of success.

Intervention 13 – Design and Planning

Table 23 Actions within intervention 13 - Design and Planning

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
13.1	Set up a steering group for Green zones project.							A Green Zone steering group is set up and a communication process has been established.
13.2	Develop high level of stakeholder consultation.							First high level stakeholder engagement Green Zone workshop is executed.
13.3	Consultation on investment interest.							Investment interest analysis is completed.

Intervention 14 - Governance and Delivery

Table 24 Actions within intervention 14 - Governance and Delivery

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
14.1	Stakeholder engagement to select the best-suited approach to deliver the Green Zone project.							A delivery model approach has been adopted.
14.2	Undertake soft market testing with real estate developers.							A preliminary soft market testing has been completed.
14.3	Undertake site's ownership analysis.							Ownership condition of the sites has been fully analysed.

Intervention 15 - Carbon accounting and sustainability

Table 25 Actions within intervention 15 - Carbon accounting and sustainability

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
15.1	Identification of preliminary carbon accounting and sustainability objectives.							Green zones sustainability and carbon accounting objectives have been defined.
15.2	Identification of primary sources of funding.							A financial assessment has been completed.
15.3	Identify targets for carbon accounting and sustainability.							A set of measurable targets is defined for the development of Green Zones.

Intervention 16 – Tendering and feasibility studies

Table 26 Actions within intervention 16 - Tendering and feasibility studies

Key:	Start	Plan	Implement	Facilitative Action

	Action	Time for Action			Time for Outcome			Indicators of Successful Outcomes
		Year 1	1-3 years	3-5 years	1-2 years Short	3-5 years Med	5+ years Long	
16.1	Development of feasibility studies on land uses, accessibility, enabling works, and utility infrastructure.							Feasibility studies on land uses, accessibility, enabling works, and utility infrastructure are finalised.
16.2	Identification of high level costs for Green Zones.							A financial assessment of the Green Zones is completed.
16.3	Set up a governance structure.							A governance structure is put in place.
16.4	Perform legal studies to support the land acquisition process.							A set of measurable targets is defined for the development of Green Zones.

The suggested overall time frames for the development of Green Zones are explained in Figure 21 (next page) and for further details please refer to appendix VI.

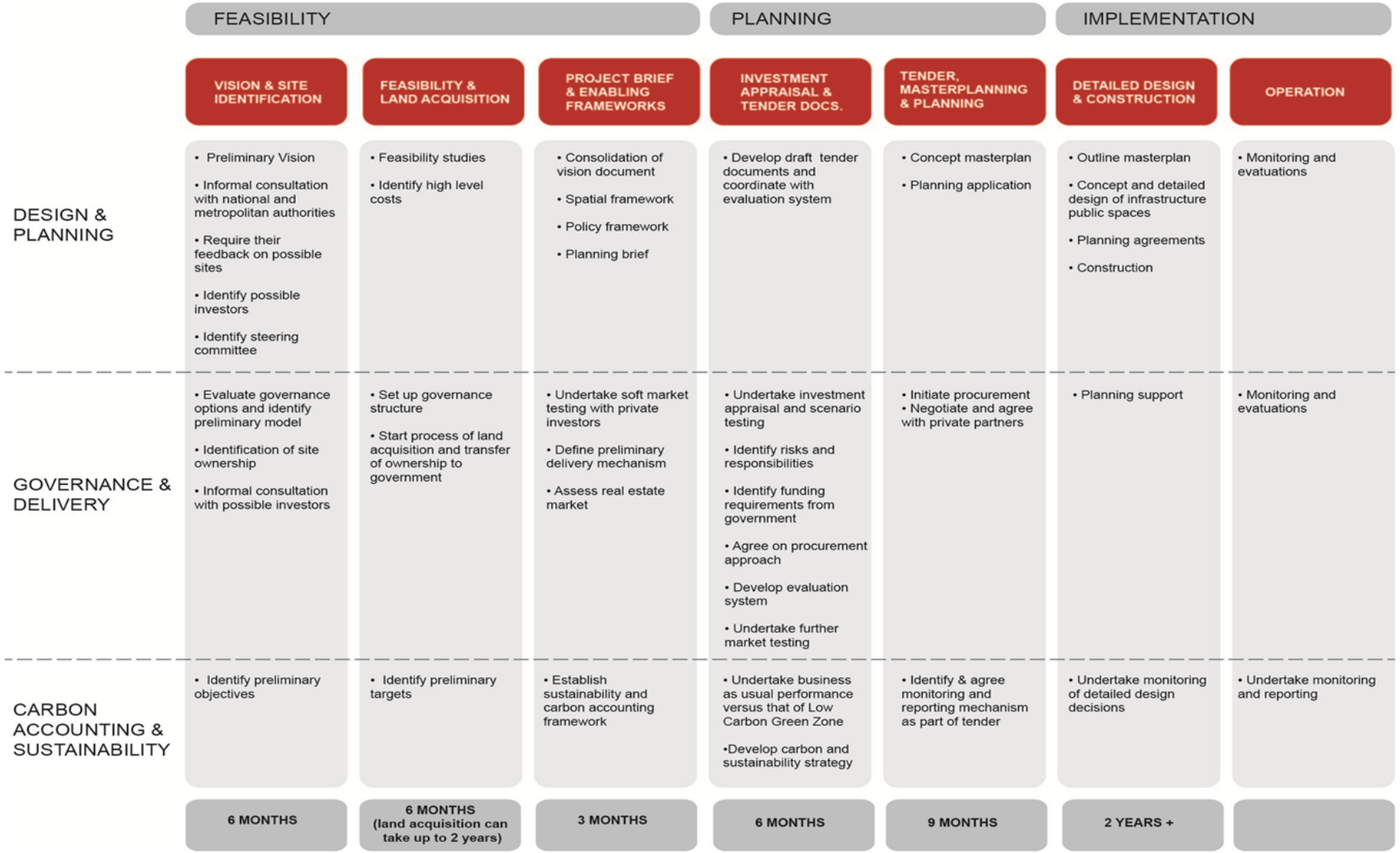


Figure 21 Proposed time frame for Green Zones

Co-benefits

Environmental

Among the many environmental advantages that the creation of green zones in Lima will produce, the following are envisage:

- Green Zones can enable the implementation of carbon neutrality principles in the planning and design process of city districts.
- Co-location of both commercial and residential space in dense areas has the potential to eliminate or shorten motorised journeys to work, thus maximising time for residents, and lessening fuel use
- Designing buildings according to a consistent sustainable approach focused in resource efficiency.
- By providing a multiplicity of choices for more efficient and sustainable modes of transport, commuting choices can be influenced.

Economic

Economic sustainability is generally defined as economic growth that positively impacts both quality of life and the environment. Value creation is the financial attractor that has the potential to persuade developers and governmental agencies to reprioritise the drivers within the development business. Economic advantages could be:

- The creation of a local green economy can boost the demand for the location of inhabitants and business in a certain area.
- The implementation of innovative approaches to urban development allows the creation of a strong urban identity able to attract new investment and jobs.
- The creation of green zones and active role of private investors in urban development offers an opportunity to rethink the pricing and investments models on infrastructure
- The definition of a delimited Green Zone will concentrate development into a smaller quarter thereby reducing the areas requiring utility services in a business as usual context.

Social

The benefits that will directly affect society, the developers or long-term land owner include :

- Creation of employment and retail areas can act as an attractor for residential sales
- Diversity in commercial, retail and industrial space offers diversification opportunities and different revenue streams
- Leasing of space offers an opportunity to gain through increasing capital values over time and extend the revenue generation period beyond the typical sales period of strictly residential development;
- Proximity to quality social infrastructure (namely schools and high quality public facilities) and well maintained green spaces can increase land values
- Potential to attract enough employers and residents to make public transport economically viable.

Chapter 5 - Conclusions and Recommendations

In this report, we have set out the rationale for developing a Transport NAMA for Peru. Much of this NAMA applies to Lima and Callao. The reason for this is that Lima and Callao represent such a large proportion of activity within Peru – the conurbation is more than ten times larger than the next largest city and the economic activity it represents is huge. Therefore any national plan for low carbon will affect Lima and Callao and actions which work against successful operation in Lima and Callao will fail.

The draft NAMA includes a series of interventions and actions within these interventions. We have defined two types of Action: Substantive Actions, which lead directly to the reduction of carbon and other emissions, and Facilitative Actions, which need to be in place in order to enable the Substantive Actions to happen. Many of these are not, in a superficial sense, directly related to low carbon transport, but they do relate to the governance and organisational arrangements that need to be in place to oversee the considerable changes that are required for Peru to meet its low carbon objectives. Actions without the contextual changes in governance will fail to be implemented, or, possibly worse, will be implemented in a way that cannot and will not be enforced and thus will fail. Therefore our analysis showed that some 'facilitative actions' will be required, which need to be put in place in order to obtain the low carbon benefits from the more substantive actions. The Facilitative Actions are identified as such in the text and the tables. The draft NAMA consists of three Measures prioritised as follows: **Integrated Mobility, Energy Efficiency and Land Use Planning**, There are 16 Interventions and 51 actions within the three measures. The actions for planning, implementation and outcome timescales are summarised in Table 6-Table 155, Table 17-Table 19 and Table 23-Table 26. A single table with all Measures, Interventions, Actions and Outcomes is provided as Table 28 in Appendix IV.

Another important point to be made in conclusion is that there is a timescale issue. Many actions need to be started in the (very) short term in order to have any meaningful effect, but the planning and implementation might take several years in some cases, although in others they could be in place within a few months or a couple of years. Therefore, even though the process needs to start in the short term, some of the outcomes might not be revealed for some time and this should be made very clear to all the stakeholders. Reporting of progress is essential to maintain support of actions which have a long lead time before the outcomes are detectable.

A **mobility reform** is vital to improve the quality of life of the Lima-Callao citizens and therefore it is critical that measures to address this issue are put in place. Although initial steps have been achieved; the UCL team recommends that a strategic unified technical authority be set up to facilitate the improvement of the mobility in Lima and Callao. Without such an authority it will be nearly impossible to implement the processes and actions required to bring low carbon emissions into force. This is a primary Facilitative Action because it is a prerequisite for devising how mobility is to be achieved in the capital. Having initiated such an authority, and having provided it with sufficient technical expertise, it will then be well placed to manage the implementation of the rest of the strategy and thus to deliver the NAMA for this region of the country, to help other areas of the country to implement their own actions and thus to assist the Peruvian Government in controlling rural migration.

Another Facilitative Action involves the capacity-building of the technical profession in transport in Peru. This is required so that the Substantive Actions can be put in place with an appropriate competence and quality. Some capacity-building support is available in the form of courses, degrees and diplomas within Peru and the UK. However, the innovative nature of the low carbon issue and the need to approach such a complex problem from first principles suggests that much of the capacity-building support will need to be developed specifically for this purpose (although such material would then be usable to support other initiatives in Peru and elsewhere).

The importance of improving the quality of the fuel available in Peru cannot be underestimated: if poor quality fuel is fed into a motor, poor quality emissions will emerge. The legislative norms and standards are in place, but enforcement is currently weak. This is an urgent Facilitative Action – without it all the other measures will be unable to deliver a reduction in emissions.

There will be a need to renew the public transport, taxi and freight vehicle fleets. This will require investment at a level that is not typically undertaken in Peru. There is therefore a need to consider how such investment might be made, incentivised and supported.

An important element of the reduction in travel required in order to meet the strategy is the change that is required in human behaviour. A powerful way of encouraging such a change is to demonstrate that behaviour change does not necessarily result in a lower quality of life. We have therefore recommended that one or more Green Zones are set up. These will demonstrate a low carbon lifestyle to the population so that they can see and understand the benefits of making such a change and thence be more likely to make the necessary changes themselves.

We have suggested that there is a need for a number of detailed reappraisals of the current and proposed transport systems for Lima and Callao. It is important to take this opportunity to rethink the needs and solutions because much of the associated investment will be in place for many years to come and will influence not only the present and short term performance of the system but the long term constraints under which future generations will have to operate. For example, a metro line has a life of more than a century: making the right decisions now about where it should be and where it should go is therefore crucial and there is an opportunity to consider the social, mobility and economic opportunities that can be resolved as well as the energy and emissions which form the main basis of a transport NAMA.

We have hesitated to stipulate deterministic figures for achievable outcomes. This is because such figures are likely to be highly speculative and based on poor knowledge of the current situation on-street and also the true status of the predictive models for carbon emission. Instead we encourage the authorities to establish suitable targets in light of the best available evidence at the time and to keep these under review. Proper measurement, calculation, reporting and verification depend on proper technical competence in the collection and analysis of the data and this is a further reason for the establishment of a technical leadership in Peru, ably educated and trained to provide a continuity of technical advice in the matter of urban mobility in a low carbon context.

For the next steps, the UCL team recommends especial attention to be drawn to the facilitative actions mentioned above to stimulate the Mobility Reform process seen recently. A potential second phase for this project will enable the UCL team to assist in the capacity building process as well as in

the further development of the draft Transport NAMA into a full NAMA proposal. All of this is aimed to be achieved in collaboration with the technical leadership network already established.

Appendix I – NAMAs Context

There are three types of NAMAS:

- *Unilateral NAMAs or domestically supported*: These NAMAS are designed and implemented nationally by developing countries without any external support.
- *Internationally supported NAMAs**: These NAMAs are supported technically, financially and more importantly enabled by capacity building from developed country parties.
- *Credited NAMAs**: These are actions that are credited for sale in the global carbon market to offset the country buyers' GHG.

  **International support on technology/knowledge transfer, capacity building and financing.*

A NAMA can include projects, programmes, policies or strategies designed for any sector. The current global development of the NAMAs, has outlined two stages in the process of a NAMA:

NAMA concept: is an overview of the NAMA idea, and includes objectives, activities, suggestions on implementations and monitoring and estimation of finance requirements.

NAMA proposal: is a detailed description of the NAMA concept with added information such as expected outputs, emission reductions, benefits, target groups, MRV plan, etc.

Further climate negotiations have occurred since the establishment of the NAMAs and recently (Durban 2011) some conditions for the NAMA were updated under the COP 17 (Communication on Progress) such as[26]:

- Launching of the ***Green Climate Fund***: 'as a financial mechanism for the Convention to support projects, programmes, policies, and other activities in developing country Parties'. This body will provide direct and indirect public and private sector financing to strategies approved by the Board.
- Setting up an ***Ad Hoc Working Group on the Durban Platform for Enhanced Action***: This body will work on raising the level of ambition and will ensure the highest possible mitigation efforts by all Parties for the next three years.
- Establishment of the ***Technology Executive Committee and a Climate Technology Centre and Network (CTCN)***: This technology mechanism was established with the aim of intensifying action in technology development supporting NAMA efforts.

PLANNA - Air pollution

Figure 22represents the strategy number 3 set by MINAM (Ministry of Environment) under the PLANAA (Environmental National Action Plan). This strategy is the closest applicable to the transport sector in the PLANAA and relates to air pollution. Like this strategy, there are a variety of existing initiatives that could easily be enhanced and included in the development of the NAMA.

[26] Durban Climate Change Conference November/December 2011. United Nations Framework Convention on Climate Change. [Accessed on 6/3/2012] Retrieved from: http://unfccc.int/meetings/durban_nov_2011/meeting/6245/php/view/decisions.php

ACCIÓN ESTRATÉGICA	META AL 2012	META AL 2017	META AL 2021
3.1 Prevenir y controlar la contaminación atmosférica.	-Trece (13) ciudades priorizadas implementan sus Planes de Acción para mejorar la calidad del aire y cumplen los ECA para Aire aplicables[116]. -Línea base actualizada sobre la calidad de aire en las trece (13) ciudades priorizadas.	-Trece (13) ciudades priorizadas mantienen la calidad de aire. -El 60 % de nuevas ciudades priorizadas implementan sus Planes de Acción para mejorar la calidad del aire y cumplen los ECA para Aire aplicables.	-Trece (13) ciudades priorizadas mantienen la calidad de aire. -El 100 % de nuevas ciudades priorizadas implementan sus Planes de Acción para mejorar la calidad del aire y cumplen los ECA para Aire aplicables. -Disminución del 10% de la morbilidad en zonas priorizadas por contaminación de la calidad del aire por exposición (material particulado y dióxido de azufre), con relación a la línea base.
	Indicador: -Número de ciudades con Planes de Acción implementados y que cumplen los ECA para Aire.		
	Responsables: MINSA, MINAM, GL. **Co-Responsables:** MINEM, MTC, MVCS, MINAG, PRODUCE, SENAMHI, OEFA, GR, Empresas, Sociedad Civil.		
3.2 Mejorar los mecanismos de prevención y control del ruido urbano.	-Reglamento de los Estándares de Calidad Ambiental (ECA) para Ruido actualizado.	-El 50% de capitales de provincia implementan Planes para la prevención y control del ruido urbano y cumplen con el ECA para Ruido.	-El 100% de capitales de provincia implementan Planes para la prevención y control del ruido urbano y cumplen con el ECA para Ruido.
	Indicador: -Norma elaborada y/o aprobada	**Indicador:** -Planes formulados y/o implementados. -Porcentaje de capitales de provincia que cumplen con ECA para Ruido.	
	Responsables: GL provinciales y distritales. **Co-Responsables:** MINSA, PRODUCE, MINAG, MTC, MINEM, MVCS MINAM, OEFA INDECOPI.		
3.3 Ampliación de la cobertura de áreas verdes en ambientes urbanos.	-El 100% de las Municipalidades Provinciales incorporan en sus instrumentos de planificación el incremento de áreas verdes en ambientes urbanos.	-El 50% de las capitales de departamento alcanzan la superficie de áreas verdes establecida por la Organización Mundial de la Salud- OMS. -Incremento de áreas verdes en el Parque Ecológico Nacional Antonio Raimondi – (Piloto).	-El 100% de las capitales de departamento alcanzan la superficie de áreas verdes establecida por la Organización Mundial de la Salud- OMS. -Incremento de áreas verdes en el Parque Ecológico Nacional Antonio Raimondi – (Piloto).
	Indicador: -Porcentaje de municipalidades provinciales que establecen sus requerimientos de áreas verdes.	**Indicador:** -Porcentaje de capitales departamentales que cumplen los estándares establecidos por la OMS. -Porcentaje de incremento de áreas verdes.	
	Responsables: GL provinciales y distritales. **Co-Responsables:** GR, MINAM, MVCS, Sociedad Civil.		

Figure 22 Strategic Actions suggested by MINAM under the PLANAA[27]

International Voluntary communication by Peru

Peru submitted the following communication signed by the Peruvian Embassy in Germany on the 21st of June 2010:

(a) Reduction to zero of the net deforestation of primary or natural forests by year 2021;
(b) The modification of the current energy grid, so that renewable energy (nonconventional energy, hydropower and biofuels) represents at least 33 per cent of the total energy use by 2020;
(c) The design and implementation of measures which allow the reduction of emissions caused by the inappropriate management of solid waste.

In this document, Peru expressed the firm willingness of its government to strengthen the collective action to mitigate climate change through the development of a sustainable and low-carbon

[27] Plan Nacional de Acción Ambiental PLANAA Perú 2011-2021. CEPLAN. [Accessed on 23/03/2012] Retrieved from:http://www.ceplan.gob.pe/documents/10157/8e102de1-2cb3-423e-a58d-da674bc7322f

economy. It also stated that its mitigation actions listed above are voluntary in nature and are guided by the principles and provisions of the Convention. FCCC/AWGLCA/2011/INF.1

Peru also stated that its mitigation measures do not exclude the use of the CDM or other market-based mechanisms which could be created under the Convention. It added that for the development and implementation of its mitigation actions it requires support from the international community through the range of financial and cooperative mechanisms available.

Second National Communication

The Government of Peru, through the Ministry of Environment in coordination with the Ministries of Foreign Affairs and Economy and Finance presented on the 28th September 2010[28] the Second National Communication which highlights their active mitigation efforts including the priorities for various NAMAs; including NAMAs for the energy (including proposed actions in the transport sector), industry, management of solid wastes, forestry and agriculture sectors. This communication expresses Peru's willingness to explore the feasibility of ensuring their development through a sustainable low carbon economy.

It also specifies mitigation actions that have been implemented in these sectors and describes in detail proposed measures for further emissions reductions. Finally it highlights the limitations and training needs for the implementation of these measures.

Peru's reiteration of the National Commitment[29]

On the 25th of July 2011 the Peruvian government sent a letter reaffirming their national commitment to the goals specified in the first voluntary compromise communication of the emission reduction actions to be done by 2021, clarifying them as follows (Maria Paz Cigaran, 2011):

a) Zero net emissions in the USCUS sector: Aim to conserve 54 Million ha which is estimated to reduce 45% of emissions compared to the year 2000, and a potential 50 MT O_2 equivalent of emissions avoided.
b) At least 40% of the energy mix to involve renewable energies including hydro, biomass, wind and solar and increase of energy efficiency to reduce the use of fossil fuels. Approximately 28% reduction compared to 2000 with the potential reduction of 7 MT of CO_2 equivalent.
c) Reduction of emissions from municipal solid waste: development of a national programme that prioritises landfills for large and medium cities. Potential reduction of 7 MT CO_2 equivalent.

As seen in this last communication, Peru has committed to reduce at least 28% of its energy-based (including transport) emissions by 2021 equivalent to 7 million tonnes of CO_2 and the transport sector has a very important role to play in achieving this goal.

[28] Non-Annex I National Communications. United Nations Framework Convention on Climate Change (UNFCCC). [Accessed on 3/3/2012). Retrieved From: http://unfccc.int/national_reports/non-annex_i_natcom/items/2979.php

[29] Letter 055 – 2011 DVMDERN/MINAM. Signed by Rosario Gomez Gamarra, Vice Minister of Strategic Development of the Natural Resources. [Accessed on: 6/3/2012] Obtained from: Libelula [Accessed on: 6/3/2012]

Appendix II - Tools to support the development of a NAMA

Mobility Hierarchy

The following is the description of the Mobility hierarchy which, as specified in Chapter 2, requires essential understanding to be able to facilitate the prioritisation of actions and interventions aimed at carbon reduction and improvement of quality of life.

Pedestrians

The cheapest vehicle that a human can acquire is a pair of shoes. All journeys require a pedestrian stage, irrespective of the mode used for the main displacement. Walking is thus one of the most essential and common modes of transport used in the world and the major source of accessibility to any activity by any person regardless of age, sex or social status. Insufficiency of the pedestrian network precludes the possibility of making journeys for much of the population and if public transport is to be the mode of choice in order to make better use of energy, a satisfactory pedestrian network is essential. With this in mind, the top priority is to design for pedestrians[30] to ensure proximity to their activities and improve their safety and satisfaction to motivate them to walk more.

Bicycles

The second priority in the hierarchy is the bicycle because it alleviates congestion, lowers air pollution, increases fitness and reduces the risks of obesity. It is also within the economic range of the majority of the population who cannot afford to buy a car in any city in the world. Bicycles are excellent replacements for vehicles for short trips because they do not occupy much space, provide easy access to areas where cars will not be able to reach and avoid extensive and expensive searches for costly parking spaces.

Public Transport

The next best mode of transport in the hierarchy is the public transport system because of its capacity to transfer high numbers of people from one point to another as quickly and efficiently as possible. Figure 23 highlights that it takes two buses to transport the same amount of people that 175 vehicles can transport, with the difference that the road seems bigger and more pedestrian-friendly using the buses. Public transport also includes the provision of trains – in particular in the urban environment, metro trains, whether these are located on the surface or underground. The provision of a metro train is complementary to the bus system and the two systems must be integrated so that together they form a coherent public transport network.

Figure 23 Vehicles vs Bus – Taken from Non-Motorised Transport (Municipality of Lima presentation)

Freight Transport

It is important to remember that one of the prime needs for mobility is that of obtaining goods – food from a shop for example. This

[30] The term 'Pedestrian' is taken to include a person using a mobility aid such as a wheelchair, for whom all transport systems, including pedestrian infrastructure and public transport vehicles should be designed to be accessible.

presents an important issue for mobility because some goods might be delivered to the home rather than to the shop, thus reducing the need for a personal journey. It is also the case that some proportion at least of passenger journeys are really freight journeys because their sole purpose is to carry goods. At a larger scale, however, freight journeys are those associated with trade and industry and, in the case of Lima and Callao, with the access to and egress from the port of Callao. Therefore, proceeding down the inverted pyramid, the priority is given to freight to ensure goods are collected and delivered.

As urban areas become more dense, the city centres have become areas of high consumption, which has resulted in increased demand for urban freight transport. It is therefore important to develop a freight strategy that caters explicitly for (1) the large vehicles carrying freight to and from the port and which have little need to enter the city of Lima itself, (2) the medium-sized vehicles which might need to enter the city in order to deliver or collect goods from businesses in the city, (3) the smaller freight vehicles making local deliveries and (4) the freight journeys which are undertaken by people either making unique journeys for freight purposes or combining a freight journey with a passenger journey. Such a strategy needs to show how the freight system can be devised and designed to allow all of these in combination to function properly with a low-energy/carbon objective in order to sustain economic growth and facilitate the access of people to the goods they require.

Low Occupancy Vehicles (LOVs)

The lowest priority transport modes are therefore the ones that provide a smaller occupancy-to-space ratio and that tend to prioritise the small proportion of high-income population within a city. There are two main forms of low occupancy vehicle: taxis and private cars.

The utilisation of a private car is very low indeed – the average occupancy of a private car in Lima is around 1.1 person/vehicle and the actual use *in travel* is around 4% (i.e. a car spends 96% of its life parked). It therefore requires both space for the person to be able to travel during the travel time (approx. $15m^2$ per second when in motion at 18km/hr) and approx. $7.5m^2$ per person when stationary (approx. $20m^2$ per person if it is parked in a car park), for the rest of the time when it is parked. The travel time includes, of course, the time spent stationary due to congestion (which is often caused by the reduction in road capacity caused by parked cars).

Taxis work on a different basis. These are occupied by people when they are travelling and can carry more than one person in a day. Often they are conveying more than one passenger at a time. As a result, a taxi is a higher occupancy vehicle than a private car and should be prioritised over the private car when considering energy reduction measures. Lima/Callao is unusual because, relative to other cities, it has a very low proportion of private cars and a high proportion of taxis. These two facts are strongly related: the easy availability of taxis is a reason why people are less tempted to purchase or use a private car. One of the disadvantages of taxis is that they search for passengers and thus are often circulating in the traffic stream with no passengers. This needs to be managed so that empty taxis are given lower priority than occupied taxis and appropriate provision is made for them to have organised taxi ranks. There is also an issue in Lima/Callao over the quality of both vehicles and drivers: registration of taxis and drivers should include issues of quality for both, including the fuel and safety of the vehicle.

Outcomes-Based Strategy theory

The following is a brief description of the key factors that involve the development of the Outcome based strategy:

Desired Outcome

The desired outcome aims at identifying the end result, the long-term vision of a desired future and seeks to answer the question of '*what do you want to achieve*?'. The definition of this end-result marks the situation that decision makers would like to see/experience after their decision has been successfully implemented. It is therefore essential to define the scope of the desired outcome sufficiently clearly to allow a focused decision to be made and defined in a way that it is clearly measurable.

Success Factors

The Success Factors are the required actions, steps and/or activities that would contribute to achieving the desired outcome, its definition answers the question: '*What does the desired outcome require in order to achieve it?*'. There are two critical aspects for this step; (1) to ensure that the success factors contribute to achieving the desired outcome and (2) to identify clearly and transparently the indicators of success and failure to facilitate monitoring and process development.

Constraints

The Constraints are the actions that could limit the attainment of the desired outcome, defined as all the reasons that could stop or severely reduce the likelihood of the desired outcome from being achieved. It is crucial to be realistic in highlighting all the possible barriers that might arise from the drivers, and it is also very important that each constraint is defined in sufficient detail to permit clear identification of its characteristics to determine possible routes for mitigation.

Strategic Actions

The main analysis of the decision making model is performed in this step. This analysis determines the actions necessary to ensure that the success factors will be achieved and that the constraints are eliminated, reduced or mitigated. Creative and strategic thinking are the key tools to attain this final step in order to achieve the desired outcomes. These Actions should therefore consider all the Success Factors and Constraints, should define clearly how the set of actions will achieve the desired outcomes, how each action will eliminate, reduce or mitigate all the Constraints and how the whole performance will be monitored, reported and verified. Each Action should therefore have a clear strategy to monitor and assess its effectiveness by defining the indicators for both Success Factors and Constraints and by selecting appropriate time frames and performance thresholds.

The RED Strategy

The RED Strategy highlights a significant shift in emphasis towards a holistic approach to the problem. The system of interest is a mobility system, not the transport system. It has objectives about enabling people to live better lives, not just to facilitate moving around. The RED Strategy starts with the consideration of reducing the amount of travel required in order for people to achieve their personal goals. The land use and person-oriented approach to reducing the need to travel at all and to reduce the amount of travel needed to carry out the chosen activities is a key starting point that changes the perspective of what land use analysis is about. It shows that decisions about what happens where can have a major influence on the design and operation of the transport system which could yield significant reductions in energy use. The 'Reduce' element also requires a

participatory approach to the definition of what is required – people, not transport experts, choose the activities they wish to follow – and it is therefore highly important that the methods used to establish the location of activities (and thence the land use implications) incorporate clear processes by which the population as a whole can make their views heard.

The second element of the RED Strategy emphasises the shift from low capacity modes of transport to high capacity modes and, although the second stage of the Strategy, it is a crucial aspect of the design of the mobility system. There is a pressing need for a much clearer understanding of 'capacity' – the difference between Static Capacity and Dynamic Capacity is a fundamental distinction which applies to transport and clarifies important issues around the provision of transport supply. This is badly needed so that higher capacity really is provided where it is needed – and will actually be delivered in operation – whilst energy reductions are delivered through more focused delivery of transport supply where and when it is needed.

The third element of the RED strategy allows for attention to be paid to the source of the energy used in delivering mobility. Using electricity as the energy source has the advantage of reducing the emissions at the point of use – this will help to clear the air in congested areas. However, in terms of the delivery of reduction in carbon emissions, this is not sufficient, as the energy source might well be producing significant emissions at the point of production. The opportunities afforded by hydro power, renewable energy and other non-carbon-based sources of energy to produce electricity can be encouraged so that the electricity used in the city is actually reducing carbon emissions in its own right. Shifting energy production away from carbon-based inputs is not without its challenges of course. Carbon-based energy is common because of the high energy density of fossil fuels and this enables energy systems to manage sharp changes in demand – the peak load – by creating sufficient peak load capacity which can be brought on line quickly and turned off when no longer required. Renewable sources of energy are much less able to deliver peak load in this way, so the Reduction and Exchange elements of the RED Strategy are crucial in reducing that peak demand for energy so that the mobility system becomes much more suited to the energy production afforded by renewable sources. It is for this reason that the Decarbonisation element of the strategy requires the concurrent as well as an earlier implementation of the Reduction and Exchange elements.

Even with a radical decarbonisation process in place, there will still be a need in the foreseeable future for fossil fuels. The poor quality of fuel in Peru is a major impediment to improving the whole transport system – if you put poor quality fuel into the motor poor quality emissions and possibly damage to the motor will result. The laws and standards are in place but are simply not enforced.

The RED Strategy places the transport sector within the mobility context because it sees the significance of reducing the need for a person to make a journey in order to reach their desired activity. If a journey is still required, then the effort must go to reducing its impact on carbon emissions by better route and service planning and improving the (carbon-based) energy efficiency of the transport system. The RED Strategy allows us to define different actions which would lead to potential reductions in carbon emissions, with an increasing effect as they are combined. Figure 7 shows how these might be envisaged.

Using Multi-Criteria Analysis

An example of how the multi-criteria analysis would be carried out by the decision makers is as follows:

First, the Desired Outcome is commonly agreed and defined by all stakeholders. This is followed by the consideration of Success Factors and Constraints, ending with the possible Strategic Actions to attain the desired outcome. Once that list is ready, the multi-criteria analysis will help the decision-maker decide what the best/more appropriate Actions should be. To illustrate this process, we can take a simple example. For this example, it has been decided that the Desired Outcome is to reduce 10% of CO_2 emissions by 2018 in the transport sector.

We hold a meeting with all stakeholders to define possible actions and select some for further analysis. The actions selected by all stakeholders in this example are:

Action A – Renew 15% of the bus fleet
Action B – Build 300km of cycle lanes and develop an information programme to incentivise walking
Action C – Provide cleaner fuel

Following the selection of actions, the criteria that might be affected in one way or another by these actions – and thus constitute the means for evaluating success – are defined. This is done by a group of all stakeholders. In this example we have defined seven criteria: health, the environment, the economy, social issues, capacity, time and transport (there could of course be other criteria if agreed by the stakeholders). Then, each action is analysed against each criterion, for instance, health.

For the health criterion, the factors that might improve as a result of these actions could be related, for example, to the change in the number of people dying from pollution-related causes, the number of people with respiratory illnesses, and/or the change in life expectancy to name a few. In the case of the social criterion, the actions might reduce the number of accidents, improve accessibility, and reduce stress levels. The equivalent process is undertaken for all seven areas. Then all the stakeholders will agree on how much each action will improve/affect each indicator and will give it a score. We can use any sensible scoring system, but for this example, a simple scale from 0-5 will serve as an illustration. We could allow 0 to refer to a negative impact and 5 to a positive impact.

Continuing with the health example, if Action A were implemented, we could expect it to reduce the number of people dying from pollution-related causes but the question would remain: by how much? Assuming that data is available and reliable, we could predict the impact of the renewal of 15% of the vehicle fleet and therefore decide whether it would score, say, a 5 (highly positive) if a large reduction is expected or less if the change were smaller. The same is done for illnesses and life expectancy. All the scores should be worked out with all the stakeholders using supportive evidence (research or factual) for their decisions. All the scores should be worked out with all the stakeholders using supportive evidence (research or factual) for their decisions. Table 27 shows the results of the analysis made of all the actions in the health criterion:

Table 27 Impacts on Health from actions

	% of People dying from pollution	Change in the number of respiratory illnesses	Change in life expectancy
Action A	3	2	2
Action B	2	1	4
Action C	5	5	4

The change in the proportion of people dying from pollution due to action A is significant however it depends on the age of the vehicles targeted to achieve better results (Filipe Fraga, 2011), therefore it will be necessary to know the quality of the new vehicles, the type of emissions that might reduce, etc. It has been assumed that the vehicles will eliminate NO_x considerably and therefore it has been assigned 3. Action B relates to building cycle lanes. Increasing NMT might have a direct effect on improving health as there might be a modal shift. However, if the vehicles remain polluting in the same way, the positive impact might not be very high. Assuming data is available to support this assumption the allocated score is 2. Finally action C (changing the fuel to a cleaner variety) will have a high impact on the number of people dying. The overall analysis is shown graphically in Figure 24.

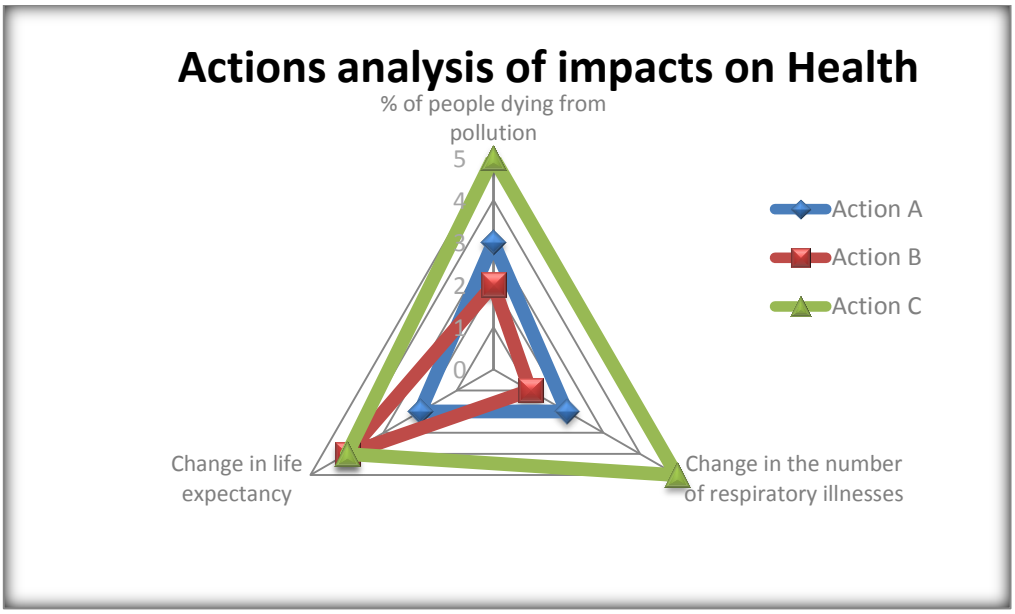


Figure 24 Impact on Health

Figure 24 shows the impact analysis of the three Actions within the health criterion for our simple example. The action that covers the largest area is the one that suits best all factors considered and in this case Action C is the most positive in terms of Health. The stakeholders then allocate a value to this outcome according to their evaluation of its impact. The equivalent analysis should be done for the rest of the criteria.

Once the seven areas have been analysed individually, they are analysed together to show the overall action that should be implemented. This results in a set of scores for each action and its impact on each criterion. Figure 25 shows the three action scores for all criteria. In this case it can be seen that the action with the greatest area, and therefore the one that should be chosen, is Action B.

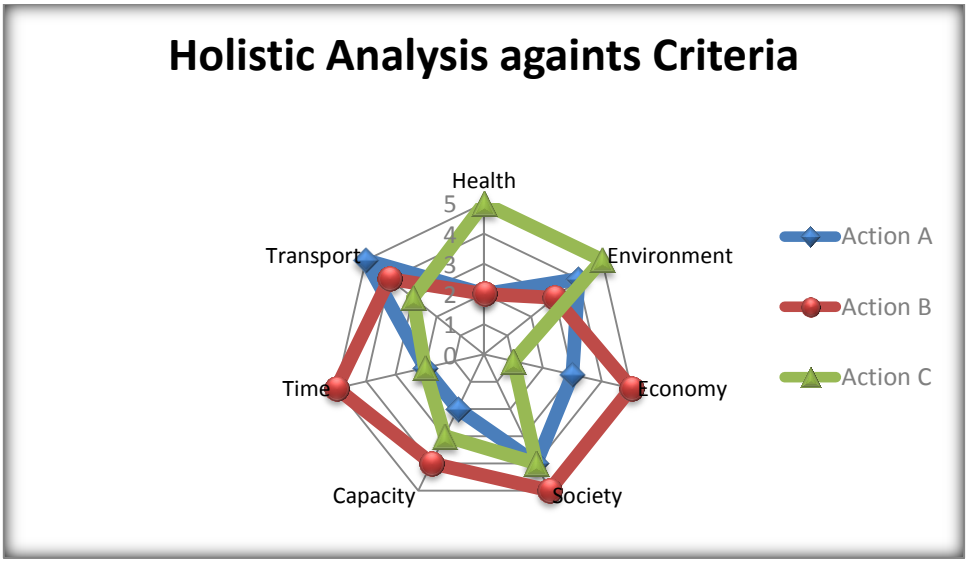


Figure 25 Scores for the three actions considered against all seven criteria

However, in this analysis it is likely that we would want to differentiate between, for example, the number of people dying as a result of respiratory diseases brought on by pollution and the travel time savings brought about by the actions under consideration: one is a major health impact and the other is a matter of convenience. Therefore we have to consider their relative values in relation to the different criteria by means of weighting the scores for each criterion. The stakeholders can consider how they wish to weight the impact scores for each criterion in order to produce an overall multi-criteria outcome.

Figure 26 shows such a holistic analysis, in which the action scores have been adjusted by weights agreed by the stakeholders. For example, it can be seen that the score for Action B in relation to Time is reduced to 2 in Figure 25 from its high value of 5 in Figure 24. This, together with other changes, means that the Action with the largest area has changed and is now Action C.

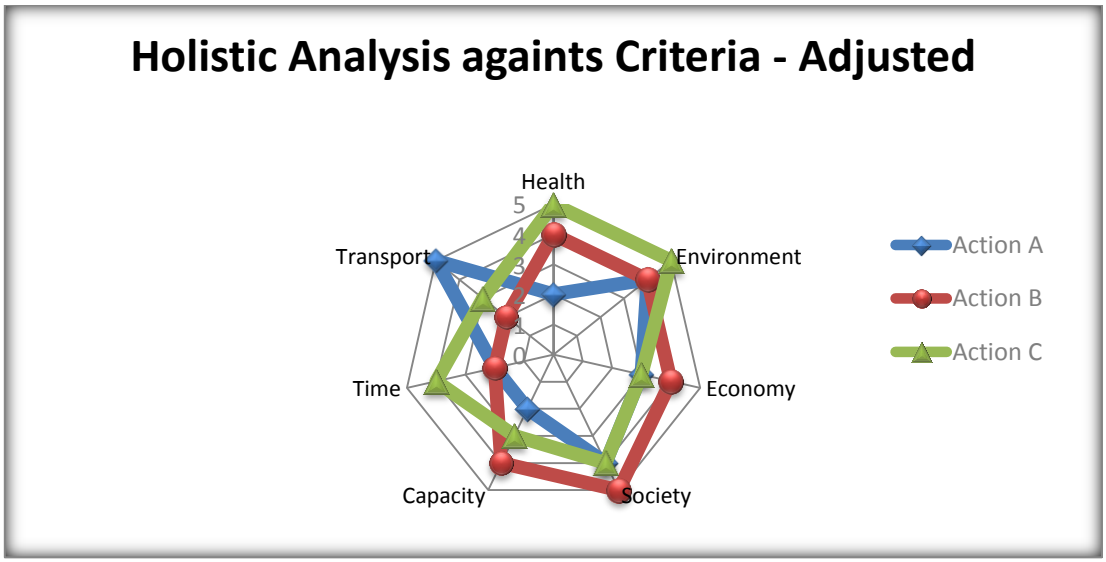


Figure 26 Holistic Multicriteria Analysis

The essence of multi-criteria analysis is the scientific evaluation of the assessments within each criterion and the agreement of the weights – these processes need to be the result of stakeholder

inputs and there are several techniques for ensuring that these weights are both credible and supported by scientific evidence.

Establishing a base line - Calculation of Greenhouse Gas Emissions savings

To be brief, we will explain the issue using the equations of Hidalgo *et al.*

For the base year scenario, greenhouse gas (GHG) emissions, *E*, in the base year, *0*, are given by:

Equation 1

$$E_0 = \sum_{m=1}^{M} (V_{m0} * F_{m0})$$

Where

M is the mode of transport;
F_{m0} is the emission factor per kilometre for mode *m* in year *0*;
V_{m0} is the number of vehicle-kilometres for mode *m* in year *0*.

And

Equation 2

$$F_{m0} = \sum_{t=1}^{T} \left[I_{tm} * (C + M + N + D + H + K + P) * \left(\frac{U_{tm}}{U_m} \right) * F_{ut} \right]$$

Where

T is the fuel type
I_{tm} is the vehicle fuel efficiency for each fuel type (litres/km)
C is the emission factor for CO_2 (grammes/litre)
M is the emission factor for CH_4 (grammes/litre)
N is the emission factor for N_2O (grammes/litre)
D is the emission factor for CO (grammes/litre)
H is the emission factor for hydrocarbons (grammes/litre)
K is the emission factor for NO_x (grammes/litre)
P is the emission factor for particulate matters (grammes/litre)
U_{tm} is the number of vehicles of fuel type *t* in mode *m*
U_m is the number of vehicles in mode *m*
F_{ut} is the upstream emissions factor for fuel type *t*

The simplest way to include the effects of a change in operating style would be to amend the vehicle fuel efficiency I_{tm}. This would enable us to consider the difference in energy use obtained as a result of, for example, reducing the amount or rate of acceleration events, increasing the amount of coasting events (either of which would result in an increase in vehicle fuel efficiency), or increasing the number of stops/stations, or amount of time spent stationary by vehicles with the engine running (either of which would reduce the vehicle fuel efficiency). It would be almost impossible to obtain a suitable figure for such changes in efficiency so our suggestion for the present is to replace I_{tm} with a function:

Equation 3

$$(I^*_{tm})_S = (I_l * I_{tm} + I_n * I_{tm} + I_h * I_{tm})_S$$

Where

I^*_{tm} is the adjusted vehicle fuel efficiency (consumption) for each fuel type I_{tm}
I_l is a dummy variable, equal to 1 if the mode operation is very efficient and 0 otherwise
I_n is a dummy variable, equal to 1 if the mode operation is normal and 0 otherwise
I_h is a dummy variable, equal to 1 if the mode operation is very inefficient and 0 otherwise
S is the sector of the network under consideration

This change would enable approximations of the effect of different operation styles for each mode in each sector of the network. This value should be applied to the calculation of F_{m0} by dealing with each sector in the network according to the operation style and then factoring for the entire network.

Conventionally the estimation of GHG emissions is made according to a number of different investment and/or climate scenarios. This is usually taken to allow for different levels of investment (e.g. less or more kilometres of BRT system, investment in metro train lines etc.) and it might be argued that this would be covered by our consideration of operating styles in different sectors within the network. However, we believe it is better to be explicit about the operating styles independently of the investment scenarios so that the differences in outputs can be assessed, reported and verified according to actual operation in future years. In addition, it is sensible to allow for changes in climatic and other exogenous conditions (e.g. economy, population change etc.) which could have a bearing in future years. Thus our interpretation of 'scenario' is in terms of the exogenous conditions in which the transport system is operating.

Therefore, to calculate the emissions for the future years and scenarios *z*:

Equation 4

$$E_{yz} = \sum_{m=1}^{M} (V_{myz} * F_{myz})$$

Where

M is the mode of transport;
F_{myz} is the emission factor per kilometre for mode *m* in year *y* under scenario *z*;
V_{myz} is the number of vehicle-kilometres for mode *m* in year *y* under scenario *z*.

And

Equation 5

$$F_{m0} = \sum_{t=1}^{T} \left[\sum_{s=1}^{S} (I^*_{tm})_s * (C + M + N + D + H + K + P) * \left(\frac{U_{tm}}{U_m} \right) * F_{ut} \right]$$

Where
T is the fuel type
I^*_{tmyz} is the adjusted vehicle fuel efficiency (consumption) for each fuel type in mode *m*, in year *y* under scenario *z*;

C is the emission factor for CO_2
M is the emission factor for CH_4
N is the emission factor for N_2O
D is the emission factor for CO (grammes/litre)
H is the emission factor for hydrocarbons (grammes/litre)
K is the emission factor for NO_x (grammes/litre)
P is the emission factor for particulate matters (grammes/litre)
U_{tmyz} is the number of vehicles of fuel type *t* in mode *m* in year *y* under scenario *z*;
U_{myz} is the number of vehicles in mode *m* in year *y* under scenario *z;*

s is the index for the sector within the network under consideration

F_{ut} is the upstream emissions factor for fuel type *t*

Then, total Greenhouse gas emissions can be calculated by adding each year's emissions for each relevant scenario:

Equation 6

$$E_{ztotal} = \sum_{y=1}^{Y} E_{yz}$$

Where

E_{ztotal} is the total greenhouse gas emissions for scenario *z*

GHG savings, E_{zsave}, can then be estimated by comparing E_{btotal} with the dynamic baseline total (i.e. what would have been expected without the actions):

Equation 7

$$E_{zsave} = E_{btotal} - E_{ztotal}$$

Where
E_{zsave} is the total Greenhouse gas emissions savings in scenario *z*
E_{btotal} is the total GHG emissions for dynamic baseline conditions
E_{ztotal} is the total GHG emissions for scenario *z.*

Appendix III Developing a NAMA

Stakeholders consulted in the draft NAMA project

Private Sector Stakeholder	Public Sector Stakeholder	Civil society Stakeholder
• ARAPER • Asociación Automotriz del Perú • Banco Interamericano de Desarrollo (BID) • Confederación General del Transporte • Ecológico Vial • Grupo Empresarial G-9 • Grupo MIBUS Transvial Lima SAC • LimaBus • Taxi Amarillo • DP World	• Autoridad Portuaria Nacional • Consejo Nacional de Competitividad • Comisión de Transportes del Congreso de la República • Confederación General de Transporte CGT • Instituto Metropolitano de Planificación • Ministerio del Ambiente (MINAM) • Ministerio de Economía y Finanzas (MEF) • Ministerio de Energía y Minas • Ministerio de Transportes y Comunicaciones (MTC) • Ministerio de Vivienda, Construcción y Saneamiento • Municipalidad del Callao • Municipalidad de Lima • Secretaría del Consejo de Transporte de Lima y Callao • Policía Nacional del Perú (PNP) • Protransporte • Sutran	• Cruzada Vial • El Comercio • Fundación Transitemos • Libélula, Proyecto MAPS • Lima Como Vamos • Luz Ambar • Plataforma de Transporte y Logística (PTL) –Universidad Nacional de Ingeniería (UNI) • Pontificia Universidad Católica del Perú (PUCP) • Proyecto Especial de Transporte no Motorizado MML • RPP • SENATI-CTA • Stakeholders Magazine • SwissContact

Appendix IV Table Summary of Proposed Actions

Table 28 Summary of all actions within interventions

Measure	Intervention	Action	Outcome
17. Integrated Mobility	1. Creation of a Unified Technical Authority (UTA)	1.1 Lima and Callao create a technical body responsible for the mobility of the metropolitan capital	Lima and Callao have the means to develop a concerted transport policy to achieve low carbon objectives.
		1.2 UTA plans and develops action plan for Integrated mobility	An agreed priority-ranked list of further action
		1.3 UTA takes responsibility of the street network	The street network (by pedestrians, bicycles, public transport, taxis, and freight vehicles) is coordinated in line with low carbon objectives.
		1.4 UTA takes responsibility of the whole public transport network	UTA has the authority and responsibility to develop a unified integrated public transport system for Lima and Callao consistent with low carbon objectives.
	2. Mobility Reform for Lima and Callao	2.1 Set up process to prioritise Non-Motorised Transport	Implementable plan for the installation of NMT schemes in Lima and Callao
		2.2 Promote walking and cycling	NMT modal share has increased by 100%
		2.3 Establishment of NMT monitoring stations	Regular NMT reports in terms of usage, carbon emissions, etc.
		2.4 Capacity building of transport professionals	The phase programme of education and training for Mobility professionals starts.
		2.5 Transport network rethought from first principles	Consolidated plan for an integrated public transport system for Lima and Callao aiming to meet low carbon objectives
		2.6 Control of public transport procurement	Legal authority and financial capability is available to support the implementation of the integrated mobility plan
		2.7 Introduction of an integrated fare system	Lima and Callao have a unified fare system enabling

Measure	Intervention	Action	Outcome
			integration of modes for any journey, making it convenient and practical for its citizens.
		2.8 Subcontracting of service operation to suitable companies	Organised entrepreneurial business model for new companies to operate the public transport system
		2.9 Improvement of fuel (See Action 11.1)	Peru supplies better refined fuels
		2.10 Procurement of new low carbon vehicles	A fleet of modern low carbon vehicles is integrated in the Lima and Callao mobility system
		2.11 Quality control of taxis	Set of enforceable regulations relating to vehicle and driver quality is developed.
		2.12 Provision of 'freight network' to meet the city needs	Lima and Callao have an intelligent Mobility System (In conjunction with 2.5)
		2.13 Suitable allocation of freight transport from Callao within Network system	Directed network of routes for heavy freight vehicles (in conjunction with 2.5 and 2.12)
		2.14 Monitoring stations for carbon emissions with suitable enforcement	A set of monitored environmental quality measurement stations produce monthly reports on emissions.
	3. Institution of an Inter-Institutional Transport NAMA Committee (IITNC)	3.1 Establishment of an Inter-Institutional Transport NAMA Committee (IITNC)	Consolidated and agreed decisions on the implementation of low carbon policies in Lima and Callao as well as Peru as a whole.
	4. The IITNC needs to review the draft Transport NAMA	4.1 The IITNC reviews the draft transport NAMA	A transport NAMA for Peru is produced
	5. Development of Travel plans	5.1 Encourage incentives for the private sector to develop Travel Plans	Employers in Lima and Callao report an increase in the use of NMT, low carbon public and freight transport.
		5.2 Introduction of facilities for pedestrians	An increase in cycle parking near to and within company

Measure	Intervention	Action	Outcome
			premises and provision of associated supportive facilities.
		5.3 Create incentives for people to use NMT and public transport	An increase in the use of NMT and public transport and fall on private vehicle usage.
	6. Development of an Energy-efficient Mobility Plan	6.1 Contract suitable assistance on the development of a mobility plan for Lima and Callao	Appropriate advice obtained and implemented in the integrated low carbon mobility plan for Lima and Callao.
		6.2 Procure contractors to undertake work	Appropriate contractor(s) hired to assist in the production of an integrated low carbon mobility plan for Lima and Callao.
	7. Support for Education and Training	7.1 Specification of training needs (After 2.4)	A detailed specification of training needs and opportunities for low carbon transport strategy
		7.2 Procure specified courses	Appropriate courses made available to relevant staff in Lima and Callao
		7.3 Select participants and trainers	High level of technical professionals work in the Mobility sector
		7.4 Develop appropriate collaborative programme	Peru has a suitable set of collaborative arrangements for research and teaching.
		7.5 Develop capacity within Peruvian universities	New high quality teaching/training Mobility programmes are established in Peru
	8. Devise new infrastructure plan for city and national infrastructure	8.1 Specify the infrastructure necessary for low carbon mobility	Detailed costing of infrastructure needed for low carbon mobility in **Lima and Callao**
		8.2 Specify the infrastructure necessary for low carbon mobility	Detailed costing of infrastructure needed for low carbon mobility in **Peru**
		8.3 Seek International financial support for	Peru achieves financial support for Mobility plan

Measure	Intervention	Action	Outcome
		infrastructure development	
	9. Seek international finance for the NAMA implementation plan	9.1 Seek International financial support for the NAMA implementation	Peru achieves financial support to implement transport NAMA
2. Energy Efficiency for light vehicles	10. Vehicle Labelling	10.1 Ministry of Transport demands emissions labelling from vehicle manufacturers	All vehicles have labels to identify their energy efficiency and emissions
		10.2 Creation of a Peruvian energy assessor and accreditation body for energy efficiency in light vehicles.	Peru has a national energy assessor and accreditation body for energy efficiency in light vehicles.
	11. Cleaner Fuels	11.1 Ministry of Mines and Energy introduces cleaner fuels for cleaner vehicles	Peru supplies cleaner fuels
	12. Adopt a mechanism for light vehicles to achieve emissions target	12.1 Develop a method to achieve 120g CO2 per km starting with 130g CO2 per km by 2018 and implement complementary measures to decrease by 10g of CO2 km travelled.	Peru reaches target of 120g CO_2 per km travelled for light vehicles
3. Green Zones	13. Design and Planning	13.1 Set up a steering group for Green zones project	A Green Zone steering group is set up and a communication process has been established
		13.2 Develop high level of stakeholder consultation	First high level stakeholder engagement Green Zone workshop is executed.
		13.3 Consultation on investment interest	Investment interest analysis is completed.
	14. Governance and Delivery	14.1 Stakeholder engagement to select the best-suited approach to deliver the Green Zone project	A delivery model approach has been adopted
		14.2 Undertake soft market testing with real estate developers	A preliminary soft market testing has been completed.

Measure	Intervention	Action	Outcome
		14.3 Undertake site's ownership analysis.	Ownership condition of the sites has been fully analysed.
	15. Delivery Carbon accounting and sustainability	15.1 Identification of preliminary carbon accounting and sustainability objectives	Green zones sustainability and carbon accounting objectives have been defined
		15.2 Identification of primary sources of funding	A financial assessment has been completed.
		15.3 Identify targets for carbon accounting and sustainability	A set of measurable targets is defined for the development of Green Zones
	16. Tendering and feasibility studies	16.1 Development of feasibility studies on land uses, accessibility, enabling works, and utility infrastructure.	Feasibility studies on land uses, accessibility, enabling works, and utility infrastructure are finalised
		16.2 Identification of high level costs for Green Zones	A financial assessment of the Green Zones is completed.
		16.3 Set up a governance structure	A governance structure is put in place
		16.4 Perform legal studies to support the land acquisition process	A set of measurable targets is defined for the development of Green Zones

Appendix V Eficiencia energética para vehículos ligeros en el Perú

INFORME FINAL

Elaborado por SWISSCONTACT

Lima, 22 de Marzo del 2012

Contacto: Jon Bickel

SWISSCONTACT PERU

Swiss Foundation for Technical Cooperation

Juan Dellepiani 585 – Lima 27

Teléfono: 01-2641707

Fax: 01-2643212

Correo electrónico: jonb@swisscontact.org.pe

CONTENIDO

Página

RESUMEN EJECUTIVO

1. INTRODUCCIÓN 109

2. ANTECEDENTES
- 2.1 Eficiencia energética en el Perú 111
- 2.2 Flujo energético 111
- 2.3 Uso de combustibles para vehículos 112
- 2.4 Calidad de aire y emisiones de gases de efecto invernadero 116
  - 2.4.1 Calidad del aire ambiental 116
  - 2.4.2 Emisiones al ambiente generadas por el consumo final de energía 133
- 2.5 Medidas de mitigación en el sector transporte 137
  - 2.5.1 Importaciones de vehículos 138
  - 2.5.2 Sistema Nacional de Inspecciones Técnicas Vehiculares 139
  - 2.5.3 Renovación del parque automotor y el chatarreo 145
  - 2.5.4 Régimen tributario aplicable a combustibles y su impacto en la 147
  - 2.5.5 Medidas Nacionales Apropiadas de Mitigación (NAMAs) en el Sector Transporte 147

3. EFICIENCIA ENERGÉTICA EN VEHÍCULOS PARA PASAJEROS 153
- 3.1 Definición 153
- 3.2 Terminología 153
- 3.3 Comparación de diferentes enfoques a nivel mundial 155
  - 3.3.1 Comunidad Europea 156
  - 3.3.2 Estados Unidos 159
  - 3.3.3 Japón 162
  - 3.3.4 Chile 163
  - 3.3.5 Suiza 167
  - 3.3.6 China 168

4. PROPUESTA PARA LA CERTIFICACIÓN DE LA EFICIENCIA ENERGÉTICA EN VEHÍCULOS LIGEROS EN PERÚ 172
- 4.1 Estructuración del programa de certificación de eficiencia energética 172
  - 4.1.1 Objetivo general 172
  - 4.1.2 Campo de aplicación 172
  - 4.1.3 Características del parque automotor 173
  - 4.1.4 Normativa 177
  - 4.1.5 Indicador de eficiencia energética 178
  - 4.1.6 Mecanismo de aplicación 178

4.1.7 Muestreo para la certificación 179

4.1.8 Capacidad de certificación 179

4.1.9 Implementación del sello de certificación 180

4.1.10 Mecanismo de difusión del programa 181

4.2 Análisis costo - beneficio 182

5. COMENTARIOS FINALES 188

6. REFERENCIAS 190

RESUMEN EJECUTIVO

El transporte a nivel de los países tiene una participación significativa en la emisión de gases de efecto invernadero (GEI)[31], estas emisiones vienen incrementándose debido al crecimiento cada vez mayor del parque automotor[32]; en este contexto, los países viene implementando diferentes medidas para mitigar los efectos del sector transporte al cambio climático, en cumplimiento de sus compromisos y obligaciones como parte de la Convención Marco de las Naciones Unidas sobre Cambio Climático.

En el Perú, se han identificado diferentes medidas para controlar las emisiones del sector transporte[33], especialmente el terrestre, sin embargo aun no se considerado un marco normativo que regule las emisiones de dióxido de carbono en vehículos ligeros nuevos, como parte de una estrategia de mejora de la eficiencia energética a nivel de este sector. El Ministerio de Energía y Minas de Perú (MINEM), a través de la Dirección General de Eficiencia Energética (DGEE), viene impulsando prácticas para el ahorro de energía a nivel nacional. El D.S. N° 064-2010-EM *establece como* uno de los objetivos de la política energética el desarrollo de un sector energético con mínimo impacto ambiental y bajas emisiones de carbono en un marco de desarrollo sostenible, de la mano con una normativa ambiental cuyos requerimientos sean compatibles con la política nacional del ambiente y los estándares internacionales.

En este documento se propone la promoción de una norma que permita fijar las emisiones medias de GEI para el caso de vehículos ligeros nuevos[34], para lo cual se requiere planificar una estrategia gradual para reducir las emisiones promedio de GEI producidas por los vehículos. La propuesta para la evaluación de la eficiencia energética en vehículos ligeros en el Perú toma como referencia los lineamientos de la normativa de la Comunidad Europea, así como la propuesta para la implementación del sistema de certificación de eficiencia energética para vehículos motorizados del gobierno chileno.

En este contexto, se propone que para el caso de los vehículos nuevos que ingresen al país se aplique un mecanismo que permita fijar progresivamente la meta de cumplimiento de emisiones promedio de GEI a 120 g de CO_2/Km recorrido (para las flotas de vehículos de fabricantes e importadores). Considerando la magnitud y las implicancias que un mecanismo de este tipo ameritaría, se propone una primera reducción de emisiones promedio de GEI a 130 g de CO_2/Km recorrido al año 2018 como promedio de la flota, para luego implementar medidas complementarias que permitan alcanzar como meta la reducción adicional de 10 g de CO_2/Km recorrido al año 2020 para llegar a 120 g de CO_2/Km.

Para que los consumidores puedan elegir automóviles de bajo consumo de combustible, el Ministerio de Transporte y Comunicaciones deberá exigir a los vendedores de autos nuevos que faciliten a los compradores la información referente al consumo de combustible y las emisiones de

[31] *En el Cuarto Informe de Evaluación del Panel Intergubernamental sobre Cambio Climático (PICC) se afirma que en el año 2004, el sector transporte global fue responsable de 6 GtCO2-eq, es decir, un 13% del total de emisiones de GEI (Kahn Ribeiro et al., 2007)*

[32] *Datos de la Asociación Automotriz del Perú : en el año 2011 se vendieron 93055 vehículos ligeros, 26% más en comparación del año 2010*

[33] *Segunda Comunicación Nacional el Perú a la Convención Marco de las Naciones Unidas sobre Cambio Climático, 2010*

[34] *Categoría M1 de acuerdo a lo establecido en el DS 058-2003-MTC*

CO_2 de dichos vehículos. Esta información deberá figurar en el folleto del vehículo, en los carteles y otro material de promoción, así como en guías específicas. La publicación de información acerca de la eficiencia energética de los vehículos disponibles en el mercado es una práctica cada vez más común en el mundo, ya que constituye una herramienta para ayudar al consumidor a la adquisición de vehículos más eficientes y, por ende, que emiten menos emisiones de GEI.

De acuerdo a los cálculos de costo-beneficio desarrollados, el cambio de una norma de eficiencia energética promedio de 160 g/Km[35] a 130 g/Km para 100,000 vehículos representa un ahorro en combustible de 20´850,000 litros/año, si se considera el galón de combustible a un precio de once nuevos soles, esto representa un ahorro de 60´674,603 nuevos soles o su equivalente US$ 22´472,075[36] por año. En caso se implementara un laboratorio nacional de homologación vehicular en eficiencia energética, un precio de homologación de aproximadamente US$ 1860 por vehículo permitiría cubrir los costos de operación y depreciación de la infraestructura del laboratorio d certificación. Como puede observarse, la medida no sólo tiene un impacto a nivel ambiental y social, sino también a nivel económico.

En conclusión, el programa de certificación de eficiencia energética aplicado a vehículos ligeros incorporará un indicador de cumplimiento relacionado con las emisiones de dióxido de carbono por kilómetro recorrido para cada modelo comercializado y brindará información al usuario de modo que el indicador de eficiencia energética sea una de las variables que le permita tomar la decisión al momento de la compra del vehículo nuevo.

De otro lado, para poder importar vehículos que cumplan con las normas de emisiones será necesaria la introducción de combustibles más limpios, especialmente en lo referente al contenido de azufre en el diesel y gasolinas, pues combustible con alto contenido de azufre no son compatibles con las normas de emisiones propuestas que deben ser introducidas paralelamente con el límite de emisión de CO_2. Este es un tema de competencia del Ministerio de Energía y Minas (MINEM), que involucra de manera directa al sector transportes.

[35] *En la que se estima se encuentra actualmente el nivel para vehículos ligeros nuevos en el Perú*

[36] *A u tipo de cambio de 1US$ = 2.7 nuevos soles*

1. INTRODUCCIÓN

El sector transporte es uno de los contribuyentes más importantes de gases de efecto invernadero (GEI) a escala mundial ya que tiene una tendencia a aumentar sus emisiones dramáticamente. Se estima que actualmente éste contribuye con aproximadamente el 23% de las emisiones globales de dióxido de carbono (CO_2), aumentando a un ritmo de 2.1% a nivel mundial y a 3.5% en los países en desarrollo por año.

Diferentes países viene regulando la economía de los combustibles de los nuevos vehículos ligeros, en tanto otros regulan el nivel de CO_2 por kilómetro, lo que es casi equivalente. La implementación de estas normas tiene dos razones principales:

- El requerimiento de que los fabricantes de automóviles diseñen vehículos más eficientes en combustible o que se direccionen las ventas hacia modelos más eficientes, de modo que se puedan reducir las emisiones de CO_2, se reduzca la dependencia del petróleo en los mercados sujetos a la incertidumbre económica y política, además de mitigar otras externalidades asociadas con el consumo de petróleo. Cabe señalar que estas regulaciones se limitan a mejorar la economía de los combustibles en los automóviles nuevos, no fomentan otras formas de conservación o la afectación a otros sectores; por el contrario, pues los impuestos directos al petróleo o el carbón elevan los precios de combustible para todo el que lo consume. Por lo tanto, se busca promover el ahorro de combustible en los automóviles nuevos, reducir las emisiones contaminantes y de gases de efecto invernadero, así como el uso de petróleo en el sector automotriz[37].

- Aplicación en vehículos pesados, es decir los vehículos de uso comercial, son fabricados de tal forma que optimizan el consumo de combustible. Los dueños de flotas comerciales establecen como uno de los criterios de compra la eficiencia energética, pues es uno de los aspectos más importantes que está relacionado con el transporte comercial.

El estudio chileno de análisis e implementación de un sistema de certificación de eficiencia energética para vehículos motorizados, elaborado por la empresa DEUMAN en el año 2007, hace referencia a diferentes prácticas relacionadas con la eficiencia energética para el sector transporte: el estudio establece que se pueden asociar reducciones de consumo de combustible en el rango de 2% a 10% aplicando buenas prácticas de mantenimiento; se estima que la reducción del peso en los vehículos a través del uso de nuevos materiales puede contribuir a la reducción de la intensidad energética en el orden del 15% al 30%; asimismo, el diseño de nuevos motores permitiría mejoras de este indicador en el rango de 10% a 20% y de 15% a 30% para el caso de nuevos motores diesel y a gasolina respectivamente; adicionalmente, se estima que a través del fomento de buenas prácticas de operación y mantenimiento, así como la incorporación de tecnologías vehiculares energéticamente más eficientes, se obtendría un potencial de ahorro energético del 35% en automóviles y del 20% en buses y camiones considerando para ello un plazo de 15 años.

[37] *Los programas de difusión de la información referente a las medidas de eficiencia energética para el sector transporte pueden enfrentar errores de percepción de los consumidores entre la medida de eficiencia y una normatividad económica para combustibles. Por ello, es importante enfocar el programa de difusión para que los consumidores perciban las oportunidades costo-beneficio por la eficiencia energética mejorada*

En el marco de la medidas de mitigación al cambio climático, el Perú tiene como objetivo la reducción de las emisiones de gases de efecto invernadero (GEI)[388]. La propuesta para la promoción de una norma que permita fijar las emisiones medias de GEI para el caso de vehículos nuevos conlleva a la planificación de una estrategia gradual para lograr el objetivo dereducir las emisiones de CO_2 producidas por los vehiculos. Esta estrategia se basa en dos elementos principales:

- La promoción, mediante medidas fiscales, de vehiculos que consumen menos combustible, considerando una relación directa con el tamaño/peso del vehiculo.
- Una mejor información a los consumidores

En este contexto se propone que para el caso de los vehiculos nuevos que ingresen al pais se aplique un mecanismo que permita fijar progresivamente la meta de cumplimiento de emisiones promedio de GEI a 120 g de CO_2/Km recorrido (para las flotas de vehiculos de fabricantes e importadores). Considerando la magnitud y las implicancias que un mecanismo de este tipo ameritaria, se propone una primera reducción de emisiones promedio de GEI a 130 g de CO_2/Km recorrido al año 2018 como promedio de la flota, para luego implementar medidas complementarias que permitan alcanzar como meta la reducción adicional de 10 g de CO_2/Km recorrido al año 2020 para llegar asi a los 120 g de CO_2/Km.

Para que los consumidores puedan elegir automóviles de bajo consumo de combustible, el Ministerio de Transporte y Comunicaciones deberá exigir a los vendedores de autos nuevos que faciliten a los compradores la información referente al consumo de combustible y las emisiones de CO_2 de dichos vehiculos. Esta información deberá figurar en el folleto del vehiculo, en los carteles y otro material de promoción, asi como en guias especificas.

De otro lado, para poder importar vehiculos que cumplan con las normas de emisiones será necesaria la introducción de combustibles más limpios, especialmente en lo referente al contenido de azufre en el diesel y gasolinas, pues combustible con alto contenido de azufre no son compatibles con las normas de emisiones propuestas que deben ser introducidas paralelamente con el limite de emisión de CO_2. Este es un tema de competencia del Ministerio de Energia y Minas (MINEM), que involucra de manera directa al sector transportes.

La experiencia internacional ha sido el material referente para el desarrollo de la presente propuesta, la que ha considerado los diversos aspectos de carácter politico y económico que se presentan a nivel del pais, siendo el producto generado una base técnica y de gestión que conlleve a una propuesta normativa que regule emisiones de GEI en vehiculos nuevos livianos.

[38] Segunda Comunicación Nacional el Perú a la Convención Marco de las Naciones Unidas sobre Cambio Climático, 2010

2. ANTECEDENTES

2.1 Eficiencia energética en el Perú

En los últimos años se percibe que existe el interés por parte del gobierno central en temas relacionados a la eficiencia energética en el sector transporte, los que aun cuando ya han sido considerados a nivel normativo y de planificación, requieren ser desarrollados e implementados con un horizonte que permita alcanzar la meta de reducción de consumo de energía establecida por el sector.

El Ministerio de Energía y Minas de Perú (MINEM), a través de la Dirección General de Eficiencia Energética (DGEE), viene impulsando prácticas para el ahorro de energía a nivel nacional. De acuerdo a lo establecido en el *D.S. N° 064-2010-EM Aprueban la Política Energética Nacional del Perú 2010-2040*, uno de los objetivos de la política energética es el desarrollo de un sector energético con mínimo impacto ambiental y bajas emisiones de carbono en un marco de desarrollo sostenible, en este mismo contexto, los lineamiento de política están direccionados a impulsar el desarrollo y uso de energías limpias y de tecnologías con bajas emisiones contaminantes que eviten la biodegradación de los recursos, así como el establecimiento de medidas para la mitigación de emisiones provenientes de las actividades energéticas y alcanzar una normativa ambiental con requerimientos compatibles con la política nacional del ambiente y los estándares internacionales.

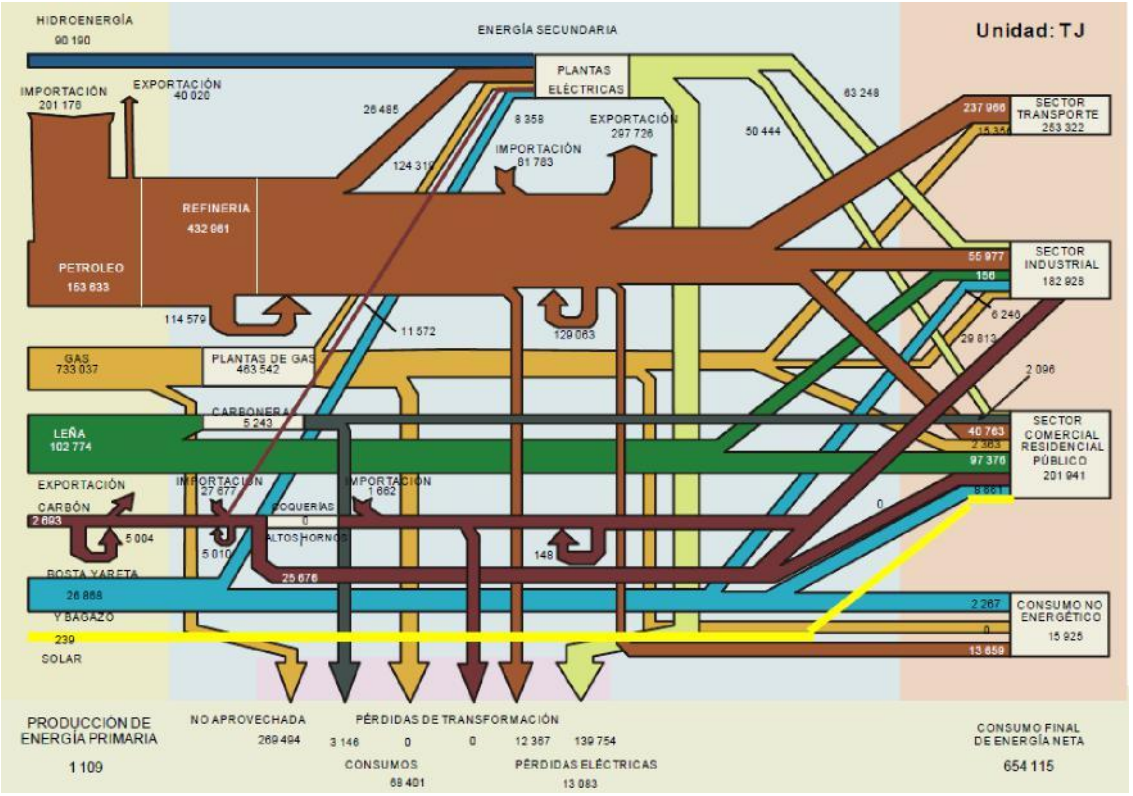
Adicionalmente, y en el marco de un óptimo uso de los recursos energéticos del país, el MINEM ha elaborado el *Plan referencial del uso eficiente de la energía 2009 - 2018*, desarrollado para los cuatro sectores establecidos en el reglamento: residencial, productivo y de servicios, público y transportes; en este último sector la meta es reducir el consumo de combustible por unidad de recorrido en el transporte urbano, a través de campañas de información y otras medidas regulatorias para lograr la conducción y gestión eficiente del tráfico vehicular, que en otros países ha dado como resultado un ahorro de aproximadamente 10%. El plan referencial contempla entre las acciones a implementar una estrategia de orientación al consumidor a través del etiquetado de vehículos y la publicación del rendimiento por galón de los vehículos del mercado (a través de medios virtuales e impresos), es así que, desde un enfoque de sustitución tecnológica, se considera la determinación y publicación permanente de los consumos por kilómetro recorrido de los vehículos que se ofertan en el mercado nacional, haciendo uso del etiquetado de eficiencia de vehículos desde el punto de la normalización, además de la reglamentación que permita evitar el ingreso de vehículos de baja eficiencia.

2.2 Flujo energético

En el año 2010, el consumo de energía eléctrica en el país creció 6,4% respecto al año anterior. En la generación, se destaca el incremento del consumo de petróleo industrial y de gas natural en 37,6% y 27,5%, respectivamente. Asimismo, al igual que el 2008 y con aún mayor margen en el 2010, el gas natural superó a la hidroenergía en 26% como fuente de energía para la generación eléctrica (ver Gráfico 1).

Por el lado de la demanda se destaca el incremento del sector industrial, reportándose un aumento del 10,7% respecto al año anterior. Adicionalmente, en el año 2010 el Perú exportó 112 GWh de energía eléctrica a Ecuador.

Gráfico 1 - Flujo energético 2010



Fuente: MINEM Balance Nacional de Energía 2010

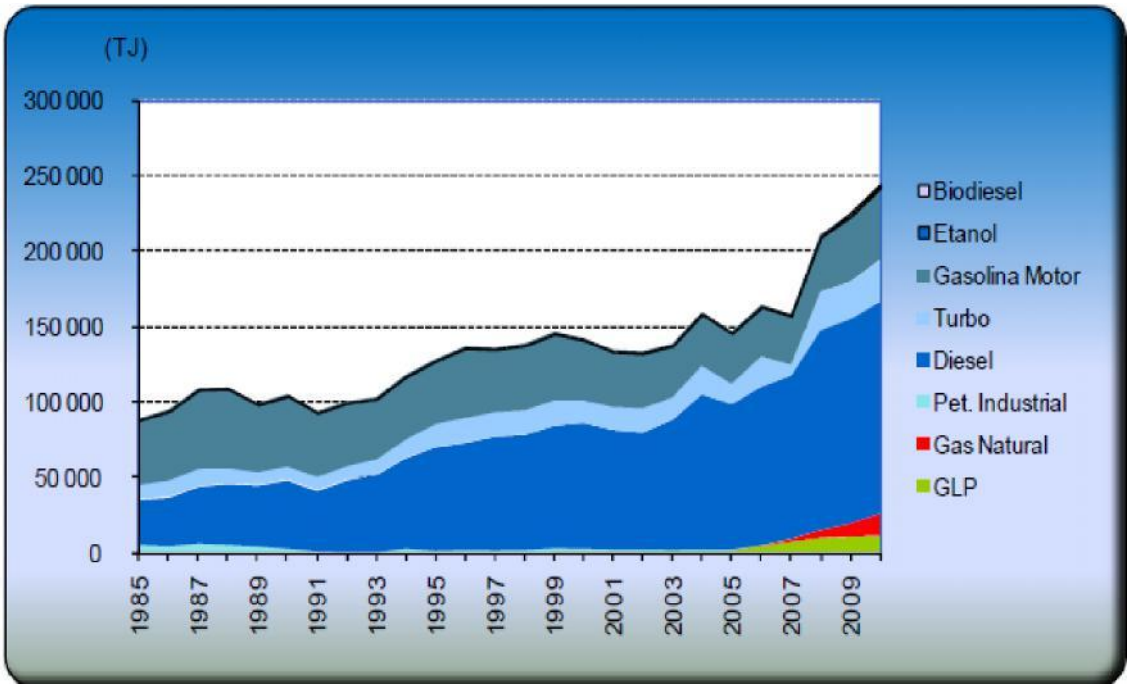
2.3 Uso de combustibles para vehículos

De acuerdo a lo reportado en el *Balance Nacional de Energía (BNE) 2010 del MINEM*, el consumo total de energía fue de 654,115 TJ, superior en 5,8% con respecto al año anterior, esto se debió al incremento del consumo de hidrocarburos líquidos y gas natural en los sectores transporte, industria y minería.

La estructura del consumo final de energía, estuvo conformada de la siguiente manera: 60,1% hidrocarburos; 17,6% electricidad; 16,4% leña, bosta y yareta; 4,3% carbón mineral y sus derivados; 2,0% bagazo y carbón vegetal y 0,04% energía solar (ver Gráfico 2).

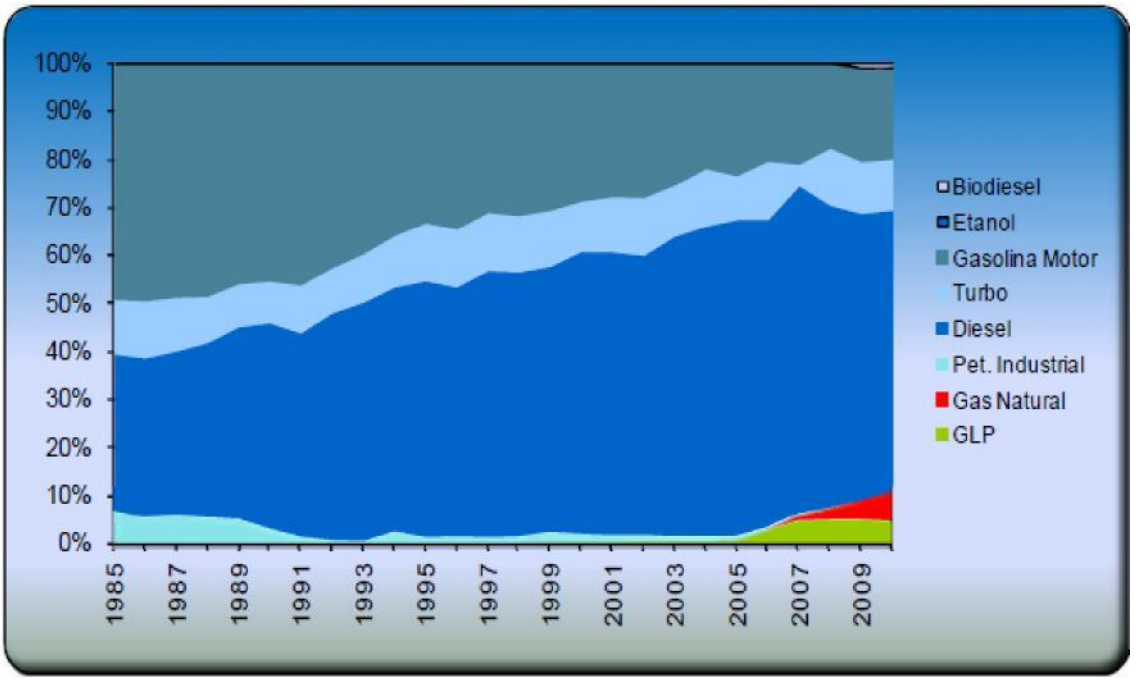
El consumo de energía del sector residencial, comercial y público (30,9%) fue de 201,941 TJ, por encima del sector industrial y minero (25,5%) y debajo del sector transporte (38,7%). El consumo de energía del sector transporte respecto al año anterior se incrementó en 12,5% debido a un mayor crecimiento del parque automotor, reflejo del crecimiento económico de los últimos años en el país. Se observó, por un lado, la penetración del diesel B2 en el transporte carretero, el consumo de gasolina se mantuvo en crecimiento estable y de otro lado se redujo el consumo de petróleo industrial para flotas navieras dentro de la estructura de consumo de este sector; la fuente de gas licuado de petróleo (GLP) mantuvo un crecimiento constante, mientras que el gas natural (GN) incrementó su consumo en 42,7% con respecto al año 2009 (ver Gráfico 3).

Gráfico 2 - Consumo de energía en el sector transporte



Fuente: MINEM Balance Nacional de Energía 2010

Gráfico 3 - Estructura de participación por fuentes



Fuente: MINEM Balance Nacional de Energía 2010

Para el año 2010, la producción de derivados de petróleo crudo fue de 11,805 x 10^3 m^3, lo que representa un crecimiento de 7,6% respecto al año 2009. Del total de derivados producidos, el diesel B2 representó el 41,0% seguido del petróleo industrial con 21,4% y la gasolina con 20,5%. Los datos para el año en mención se reportan en la Tabla 1.

Tabla 1 - Producción de derivados del petróleo crudo (10^3 m^3)

Cargas	2009	2010	Variación (%)
Diesel B2	4022	4842	20.4
Petróleo industrial	2427	2524	4.0
Gasolina	2353	2409	2.4
Turbo	748	842	12.6
GLP	346	385	11.3
Diesel	595	232	-61.0
Gas de refinería	111	174	56.3
Kerosene	54	13	-76.4
Gasohol	0	8	100.
No energético	319	376	18.0
Total	**10973**	**11805**	**7.6**

Fuente: MINEM Balance Nacional de Energía 2010

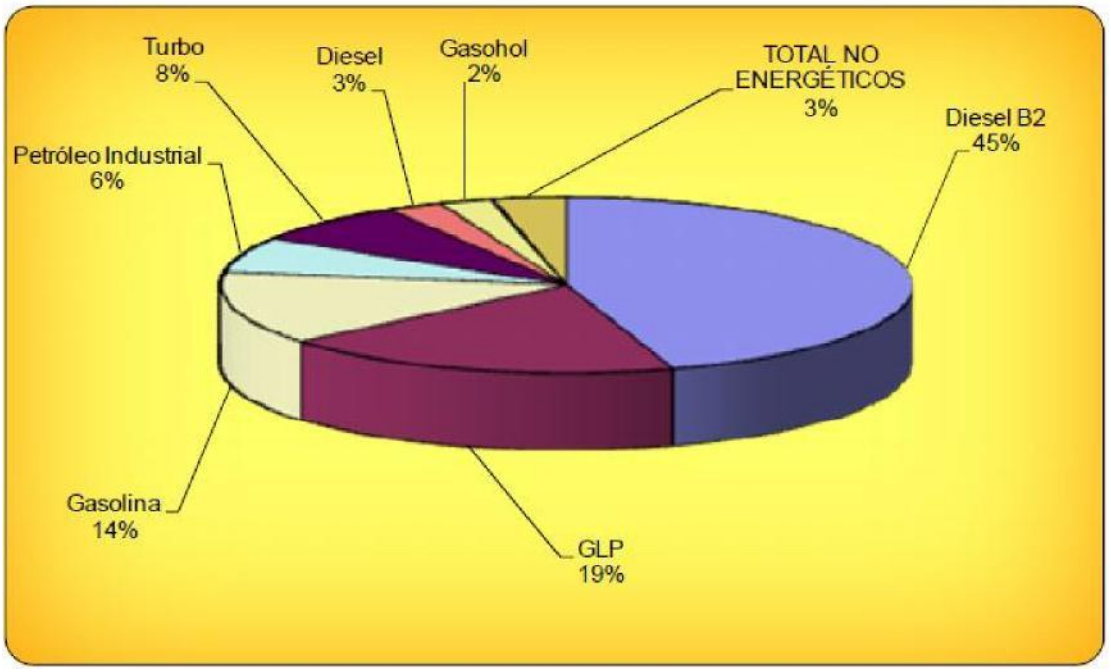
Con relación a la demanda de los derivados de petróleo crudo, ésta aumento en 8,9% respecto al 2009; observándose además que el Ministerio de Economía y Finanzas (MEF) reguló el Impuesto Selectivo al Consumo (ISC) de los combustibles:

- Mediante D.S. Nº 211-2007 EF se establecieron montos fijos para el ISC basado en la proporcionalidad por el grado de nocividad del combustible
- Mediante D.S. Nº 322-2009-EF, fueron reducidos los valores del ISC para gasolinas y gasolinas con mezclas de alcohol carburante
- Por D.S. Nº 270-2010-EF se redujeron los valores del ISC para gasoils y mezclas de diesel con biodiesel: considerando que a menor contenido de azufre (50 ppm o menos) existe una mayor reducción; adicionalmente se exoneró del ISC al GLP

La gasolina y gasohol, cuyo uso principalmente se registra en el sector transporte, se incrementó en 9,8% con respecto al año anterior, esto debido principalmente al incremento del parque automotor. La estructura de la venta de derivados de hidrocarburos y biocombustibles se presenta en el Gráfico 4.

A nivel nacional se consumieron 5691,6 x 10_6 m^3 de gas distribuido: 54,0% en generación eléctrica; 13,7% en refinerías; 11,6% en operaciones petroleras; 11,3% en el sector industrial y el resto en los sectores doméstico, comercial, transportes y minero metalúrgico (9,4%). Los datos se reportan en la Tabla 2.

Gráfico 4 - Estructura de la venta de derivados de hidrocarburos y biocombustibles



Fuente: MINEM Balance Nacional de Energía 2010

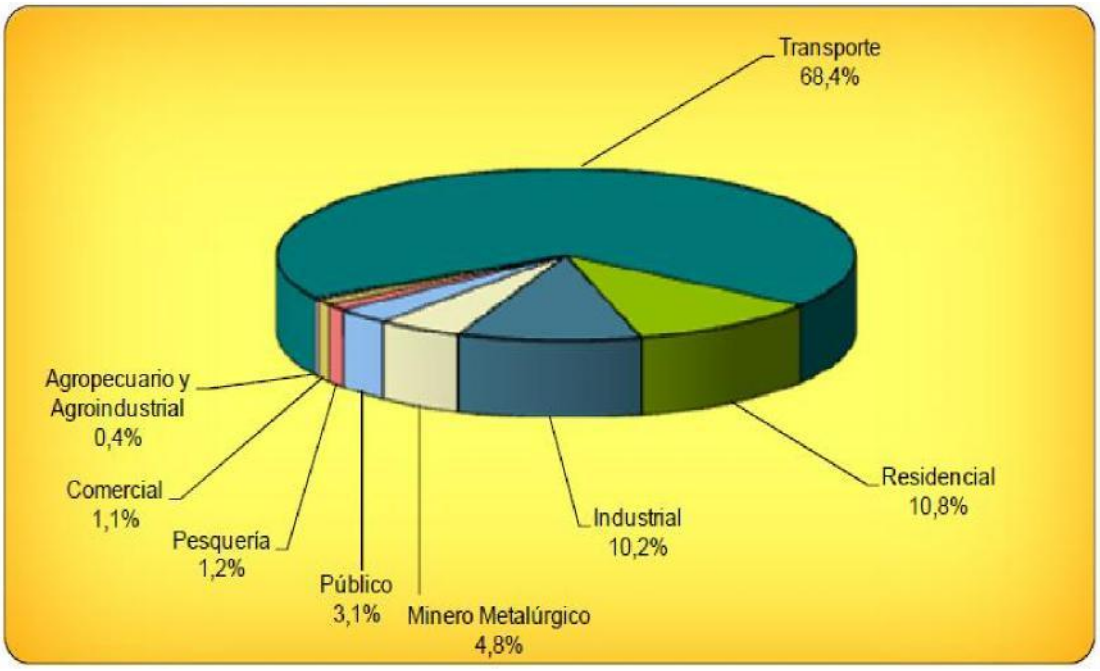
Tabla 2 - Uso del gas natural distribuido el 2010 (10^6 m^3)

Actividad	**Cantidad**
Generación de electricidad	3075
Refinerías	782
Operaciones petroleras	659
Sector industrial	643
Sector transportes	380
Sector minero metalúrgico	87
Sector comercial	52
Sector pesquero	8
Sector doméstico	6
Total	5692

Fuente: MINEM Balance Nacional de Energía 2010

Dentro de los diferentes sectores económicos, el principal demandante de los derivados de hidrocarburos fue el sector transporte, con el 68,4%, seguido del sector residencial con el 10,8% y del sector industrial con el 10,2% del total, otros sectores consumidores se presentan a continuación en el Gráfico 5.

Gráfico 5 - Estructura del consumo final de los derivados de hidrocarburos y biocombustibles por sectores económicos



Fuente: MINEM Balance Nacional de Energía 2010

2.4 Calidad de aire y emisiones de gases de efecto invernadero

2.4.1 Calidad del aire ambiental

De acuerdo a lo establecido en el D.S. 074-2011-PCM, el Ministerio de Salud a través de la Dirección General de Salud Ambiental (DIGESA) es la autoridad responsable del monitoreo de la calidad del aire a nivel nacional, el que se desarrolla en el interior del país a través de sus Direcciones Ejecutivas de Salud Ambiental en diferentes regiones (las ciudades de las regiones que cuentan con redes de monitoreo de la calidad del aire son Arequipa, Cusco, Huancayo, La Libertad y Chiclayo), a la fecha de elaboración de este documento la información del monitoreo de la calidad del aire no se encontraba disponible.

La red de monitoreo de la calidad del aire ambiental, operada por la Dirección General de Salud Ambiental (DIGESA), además de otras redes de monitoreo operadas por el Ministerio del Ambiente a través del Servicio Nacional de Meteorología e Hidrología (SENAMHI) y el Instituto Metropolitano PROTRANSPORTE de Lima, no desarrollan las actividades de monitoreo de contaminantes atmosféricos de manera coordinada.

A nivel de Lima se reportan otras iniciativas de medición de la calidad del aire, como es el caso de las mediciones realizadas por las Municipalidades de San Isidro y Miraflores en el marco de sus programas de gestión ambiental.

A continuación se presenta la información de la calidad del aire generada en los últimos años y publicada por la DIGESA, se han resaltado en rojo aquellos valores que superan los estándares de la calidad del aire para el país, en aquellos casos en los que no se reporta

el promedio anual, esto responde a que la cantidad de datos no es el mínimo requerido para obtener promedios anuales (ver Tabla 3 a la Tabla 7).

Tabla 3 . Concentración de contaminantes Estación Bellavista Callao

Mes	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	$PM_{2.5}$	PM_{10}
Estándar de Calidad Ambiental	80	100	15	50
2011				
Enero	8.2	0.7	9	31
Febrero	7.8	1.2	34	57
2010				
Febrero	7.0	3.0	33	38
Marzo	8.0	1.5	10	27
Abril	8.0	2.0	19	51
Mayo	8.0	1.0	49	87
Junio	9.0	2.0	17	32
Julio	8.0	2.0	11	34
Agosto	8.0	2.0	9	12
Setiembre	8.0	2.0	23	56
Octubre	8.0	2.0	10	19
Noviembre	8.0	2.4	20	26
Diciembre	8.0	1.0	15	22
Promedio anual	8.0	1.9	20	37
2009				
Febrero	-	1.0	9	25
Marzo	8.0	11.0	18	25
Abril	8.0	1.0	18	29
Mayo	8.0	1.0	26	47
Junio	8.0	1.0	39	55
Julio	9.0	0.1	23	41
Agosto	9.0	1.0	-	-
Setiembre	8.0	1.0	30	53
Octubre	7.7	0.9	70	24
Noviembre	0.5	7.8	8	19
Diciembre	8.1	0.1	10	26
Promedio anual	7.4	2.4	25	34
2008				
Enero	9.4	6.7	10	23
Febrero	8.6	0.5	11	21
Marzo	9.1	10.6	14	28
Abril	8.0	10.5	13	28
Mayo	12.8	8.0	25	43
Junio	14.4	11.6	16	44
Julio	9.7	9.0	31	62
Agosto	7.8	12.9	25	39
Setiembre	8.8	6.7	21	27
Octubre	12.4	3.1	12	40
Noviembre	8.0	5.0	16	47
Diciembre	10.9	2.7	16	26
Promedio anual	10.0	7.3	18	36

Mes	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	$PM_{2.5}$	PM_{10}
2007				
Febrero	9.2	14.0	28	-
Marzo	9.3	7.3	27	-
Abril	15.1	29.7	47	-
Mayo	10.2	7.4	36	-
Junio	9.9	9.4	-	-
Julio	8.3	11.2	56	-
Agosto	10.1	9.0	64	64
Setiembre	38.3	7.3	28	49
Octubre	9.5	4.4	-	41
Noviembre	8.4	4.7	10	24
Diciembre	8.2	7.4	-	29
Promedio anual	12.4	10.2	37	41

Fuente: http://www.digesa.minsa.gob.pe/DEPA/airelc/limacallao.asp

Tabla 4 . Concentración de contaminantes Estación Hipólito Unanue El Agustino

Mes	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	$PM_{2.5}$	PM_{10}
Estándares de calidad ambiental	80	100	50	15
2011				
Enero	8.2	1.7	40	65
Febrero	7.8	1.6	32	44
2010				
Febrero	23.0	33.0	14	45
Marzo	8.0	28.0	40	52
Abril	11.0	41.0	37	81
Mayo	-	23.0	59	104
Junio	9.0	41.0	98	140
Julio	13.0	33.0	21	56
Agosto	10.0	34.0	28	56
Setiembre	9.0	31.0	24	99
Octubre	10.0	32.0	17	45
Noviembre	9.0	20.0	25	65
Diciembre	9.0	17.0	24	68
Promedio anual	11.1	30.3	35	74

Mes	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	$PM_{2.5}$	PM_{10}
2009				
Febrero	-	29.0	35	67
Marzo	10.0	30.0	42	81
Abril	9.0	31.0	-	-
Mayo	9.0	93.0	146	162
Junio	9.0	27.0	56	92
Julio	9.0	22.0	65	78
Agosto	12.0	29.0	-	-
Setiembre	13.0	35.0	52	79
Octubre	9.6	42.0	40	73
Noviembre	9.3	32.0	66	35
Diciembre	8.8	37.1	34	39
Promedio anual	9.9	37	60	78
2008				
Enero	14.0	19.4	39	66
Febrero	18.1	31.0	46	85
Marzo	24.4	42.0	52	117
Abril	19.5	20.4	57	124
Mayo	14.9	41.0	136	181
Junio	18.3	35.9	-	257
Julio	-	-	-	-
Agosto	-	-	-	-
Setiembre	11.9	30.3	41	46
Octubre	10.0	31.0	47	53
Noviembre	11.0	25.0	42	59
Diciembre	10.0	34.1	40	93
Promedio anual	15.2	31.0	56	108
2007				
Febrero	11.8	11.6	-	-
Marzo	8.7	20.5	46	-
Abril	35.3	33.6	61	-
Mayo	29.7	34.3	77	-
Junio	24.6	21.8	92	-
Julio	12.1	20.2	56	-
Agosto	15.5	17.3	46	104
Setiembre	12.4	14.6	62	101
Octubre	11.2	15.1	58	87
Noviembre	13.7	14.8	50	87
Diciembre	11.0	22.5	49	76
Promedio anual	16.9	20.6	60	-

Fuente: http://www.digesa.minsa.gob.pe/DEPA/airelc/limacallao.asp

Tabla 5 - Concentración de contaminantes Estación San Juan de Miraflores

Mes	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	$PM_{2.5}$	PM_{10}
Estándares de calidad ambiental	80	100	50	15
2011				
Enero	14.3	4.5	30	65
2010				
Febrero	10.0	23.0	38	95
Marzo	-	-	23	88
Abril	24.0	18.0	62	123
Mayo	19.0	13.0	67	95
Junio	11.0	13.0	28	76
Julio	9.0	26.0	28	64
Agosto	9.0	30.0	10	37
Setiembre	12.0	35.0	43	99
Octubre	8.0	-	32	84
Noviembre	13.0	16.0	17	65
Diciembre	9.0	3.0	14	40
Promedio anual	12.4	19.7	33	79
2009				
Febrero	9.0	-	38	75
Marzo	9.0	20	40	86
Abril	50.0	26	44	91
Mayo	25.0	23	69	122
Junio	22.0	14	62	88
Julio	-	5	38	72
Agosto	60.0	38	37	78
Setiembre	91.0	-	48	79
Octubre	11.8	29.1	15	67
Noviembre	38.6	39.1	29	53
Diciembre	23.8	28.6	12	53
Promedio anual	34.0	24.8	39	79
2008				
Enero	93.8	10.6	81	82
Febrero	106.1	16.4	81	84
Marzo	75.8	18.3	76	115
Abril	70.8	21.5	73	114
Mayo	56.1	30.4	60	150
Junio	48.2	18.3	38	156
Julio	58.0	9.8	46	87
Agosto	11.2	-	48	84
Setiembre	18.7	-	76	63
Octubre	53.8	17.4	42	109
Noviembre	68.0	13.0	54	100
Diciembre	50.9	-	36	89
Promedio anual	59.3	17.3	59	103

Mes	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	$PM_{2.5}$	PM_{10}
2007				
Febrero	17.8	26.2	81	-
Marzo	10.0	22.0	75	-
Abril	11.8	-	75	-
Mayo	18.4	-	56	-
Junio	22.8	22.9	64	-
Julio	8.8	25.6	58	-
Agosto	-	-	-	-
Setiembre	-	-	-	-
Octubre	61.3	21.0	60	75
Noviembre	42.4	3.6	38	83
Diciembre	41.2	20.6	56	77
Promedio anual	26.1	-	63	-

Fuente: http://www.digesa.minsa.gob.pe/DEPA/airelc/limacallao.asp

Tabla 6 . Concentración de contaminantes Estación Santa Luzmila Comas

Mes	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	$PM_{2.5}$	PM_{10}
Estándares de calidad ambiental	80	100	50	15
2011				
Enero	18.4	3.4	63	91
Febrero	10.6	3.2	99	130
2010				
Febrero	10.0	31.0	34	80
Marzo	10.0	37.0	37	75
Abril	11.0	40.0	30	110
Mayo	39.0	33.0	45	77
Junio	10.	31.0	33	55
Julio	7.0	30.0	24	54
Agosto	7.0	13.0	11	52
Setiembre	7.0	15.0	23	110
Octubre	7.0	15.0	36	96
Noviembre	8.0	15.0	59	100
Diciembre	11.0	12.0	48	100
Promedio anual	11.5	24.7	35	83

Mes	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	$PM_{2.5}$	PM_{10}
2009				
Febrero	-	5.0	45	110
Marzo	14.0	20.0	44	111
Abril	34.0	38.0	73	185
Mayo	9.0	33.9	76	125
Junio	8.0	19.0	40	180
Julio	8.0	14.0	50	135
Agosto	18.0	37.0	80	149
Setiembre	8.0	34.0	38	105
Octubre	96.3	26.8	12	60
Noviembre	12.0	28.7	30	80
Diciembre	9.5	26.8	13	111
Promedio anual	21.7	25.7	46	123
2008				
Enero	9.7	13.9	28	-
Febrero	8.6	17.1	-	-
Marzo	16.1	19.6	42	105
Abril	76.3	41.7	69	137
Mayo	16.2	26.1	68	126
Junio	12.9	28.8	49	121
Julio	13.9	29.9	62	94
Agosto	8.8	37.0	56	96
Setiembre	9.1	43.0	51	88
Octubre	8.8	56.6	43	95
Noviembre	15.0	60.0	43	92
Diciembre	13.4	53.2	49	81
Promedio anual	17.4	35.6	51	104
2007				
Febrero	24.0	30.1	46	-
Marzo	11.6	31.2	53	-
Abril	23.7	30.7	59	-
Mayo	25.4	46.2	73	-
Junio	44.3	28.3	67	-
Julio	12.4	20.4	58	-
Agosto	13.5	23.9	67	98
Setiembre	12.4	17.8	56	105
Octubre	52.8	13.0	39	100
Noviembre	72.2	14.7	42	85
Diciembre	58.9	28.1	42	81
Promedio anual	31.9	25.9	55	94

Fuente: http://www.digesa.minsa.gob.pe/DEPA/airelc/limacallao.asp

Tabla 7 - Concentración de contaminantes Estación Congreso Lima Centro

Mes	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	$PM_{2.5}$	PM_{10}
Estándares de calidad ambiental	80	100	50	15
2010				
Febrero	-	-	-	87
Marzo	-	-	-	66
Abril	-	-	-	68
Mayo	-	-	-	64
Junio	-	-	-	61
2009				
Febrero	34.0	23.0	37	100
Marzo	9.0	41.0	85	102
Abril	27.0	36.0	59	125
Mayo	24.0	67.0	121	144
Junio	11.0	42.0	72	134
Julio	20.0	18.0	74	100
Agosto	16.0	32.0	70	102
Setiembre	-	40.0	41	100
2008				
Enero	52.5	72.1	65	98
Febrero	52.4	81.7	54	100
Marzo	57.9	85.8	-	130
Abril	47.9	90.1	106	141
Mayo	47.1	73.5	95	170
Junio	37.2	77.8	65	127
Julio	29.4	67.2	96	134
Agosto	20.5	86.6	62	134
Setiembre	29.3	70.7	69	130
Octubre	31.5	86.3	64	136
Noviembre	40.0	69.0	82	107
Diciembre	24.0	15.3	81	100
Promedio anual	39.1	73.0	76	126
2007				
Febrero	50.4	54.5	90	-
Marzo	45.4	61.2	90	-
Abril	63.7	69.5	84	-
Mayo	64.0	74.9	82	-
Junio	72.6	84.3	136	-
Julio	70.6	100.8	101	-
Agosto	105.8	82.8	102	178
Setiembre	117.4	80.2	89	139
Octubre	93.2	65.3	100	122
Noviembre	91.4	57.5	-	107
Diciembre	62.7	68.8	72	94
Promedio anual	76.1	72.7	95	

Fuente: http://www.digesa.minsa.gob.pe/DEPA/airelc/limacallao.asp

Para el año 2006 la DIGESA no reportó resultados de la calidad del aire; en el caso de los años 2000 al 2005 se reportaron los resultados anuales por tipo de contaminante, las gráficas elaboradas incluyen el valor del estándar de calidad ambiental a fin de identificar aquellas zonas de Lima en las que se excede el valor de referencia nacional (ver Tabla 8 a la Tabla 12, así como la Gráfica 6 a la Gráfica 10).

Tabla 8 - *Concentración anual de dióxido de azufre (2000 - 2005)*

Zona	Ubicación	2000	2001	2002	2003	2004	2005
Callao	C.S. Perú Corea	19.8	13.2	-	25.3	7.2	13.1
Lima Sur	H. María Auxiliadora	227	15.6	10.5	18.7	15.9	14.6
Lima Norte	C.S. Laura Rodríguez	24.9	27.4	21.0	18.2	-	29.4
Lima Este	H. Honorio Delgado	32.2	25.8	22.8	36.1	30.4	30.4
Lima Ciudad	CONACO	126.8	75.8	-	108.4	87.6	53.8

Gráfico 6 - Concentración anual de dióxido de azufre (2001 - 2005)

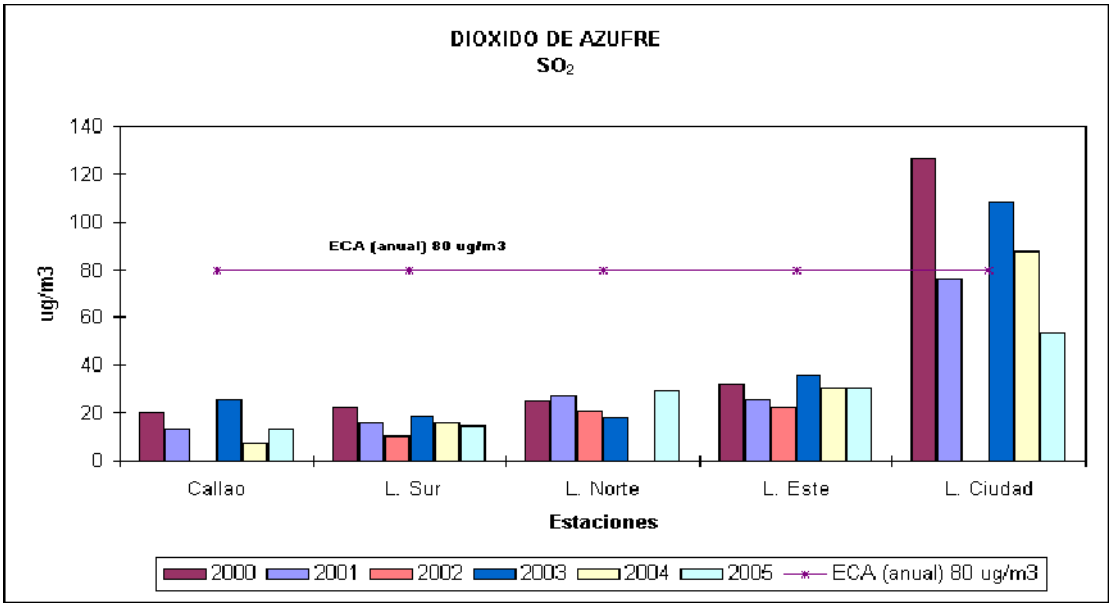


Tabla 9 - *Concentración anual de dióxido de nitrógeno (2000 - 2005)*

Zona	Ubicación	2000	2001	2002	2003	2004	2005
Callao	C.S. Perú Corea	42.8	21.9	-	13.7	22.7	15.25
Lima Sur	H. María Auxiliadora	60.8	34.3	17.8	21.2	28.6	24.3
Lima Norte	C.S. Laura Rodríguez	107.9	30.0	24.6	22.1	-	44.9
Lima Este	H. Honorio Delgado	95.0	41.1	34.4	44.5	34.1	37.1
Lima Ciudad	CONACO	254.9	76.0	-	69.6	81.4	81.5

Gráfico 7 - Concentración anual de dióxido de nitrógeno (2001 - 2005)

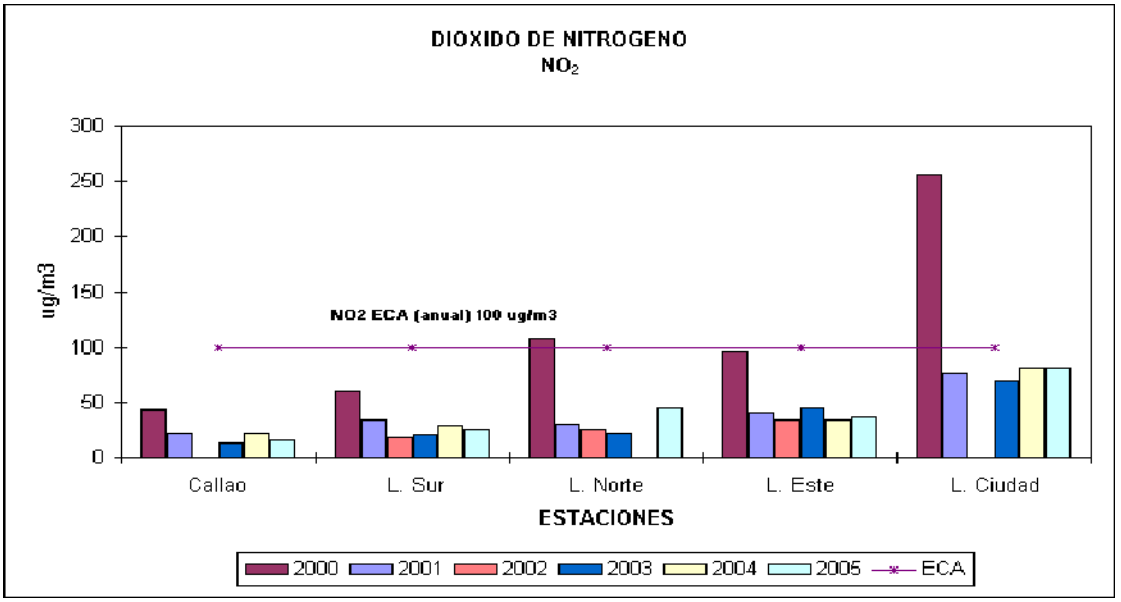


Tabla 10. *Concentración anual de material particulado $_{PM2.5}$ (2001 - 2005)*

Zona	Ubicación	2001	2002	2003	2004	2005
Callao	C.S. Perú Corea	25	-	40	28	36
Lima Sur	H. María Auxiliadora	37	41	41	37	54
Lima Norte	C.S. Laura Rodríguez	61	49	53	65	75
Lima Este	H. Honorio Delgado	44	36	48	55	47
Lima Ciudad	CONACO	80	-	89	84	87

Gráfico 8 - Concentración anual de material particulado $_{PM2.5}$ (2001 - 2005)

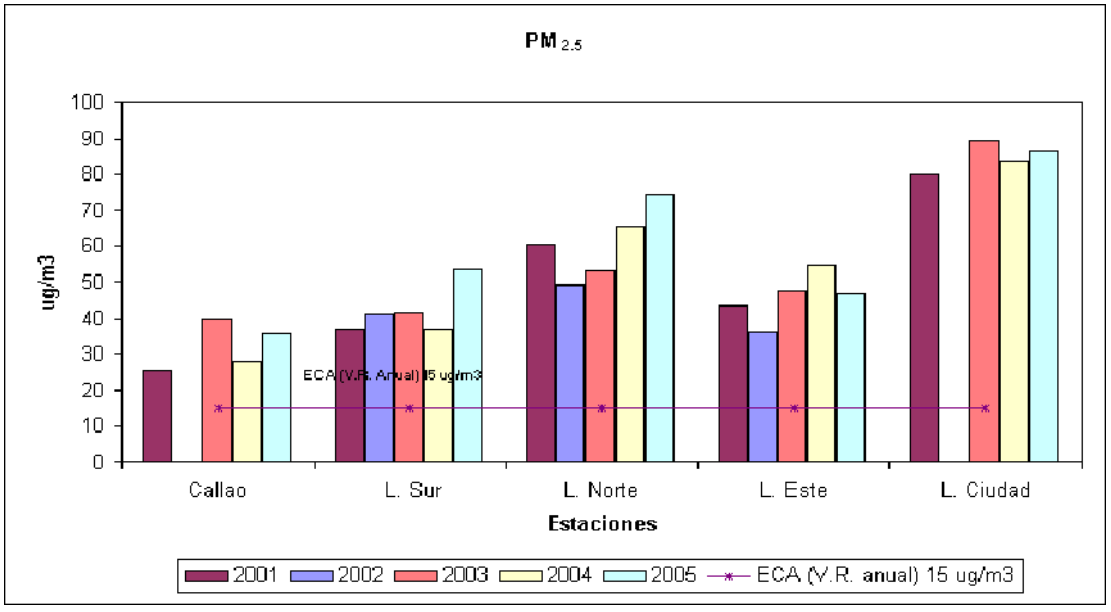


Tabla 11 - *Concentración anual de partículas en suspensión (2000 - 2005)*[39]

Zona	Ubicación	2000	2001	2002	2003	2004	2005
Callao	C.S. Pert Corea	89	70	-	137	69	76
Lima Sur	H. María Auxiliadora	177	166	150	189	174	257
Lima Norte	C.S. Laura Rodríguez	250	217	219	-	197	225
Lima Este	H. Honorio Delgado	174	140	172	237	181	164
Lima Ciudad	CONACO	210	204	-	203	221	247

Gráfico 9 - Concentración anual de partículas en suspensión (2001 - 2005)

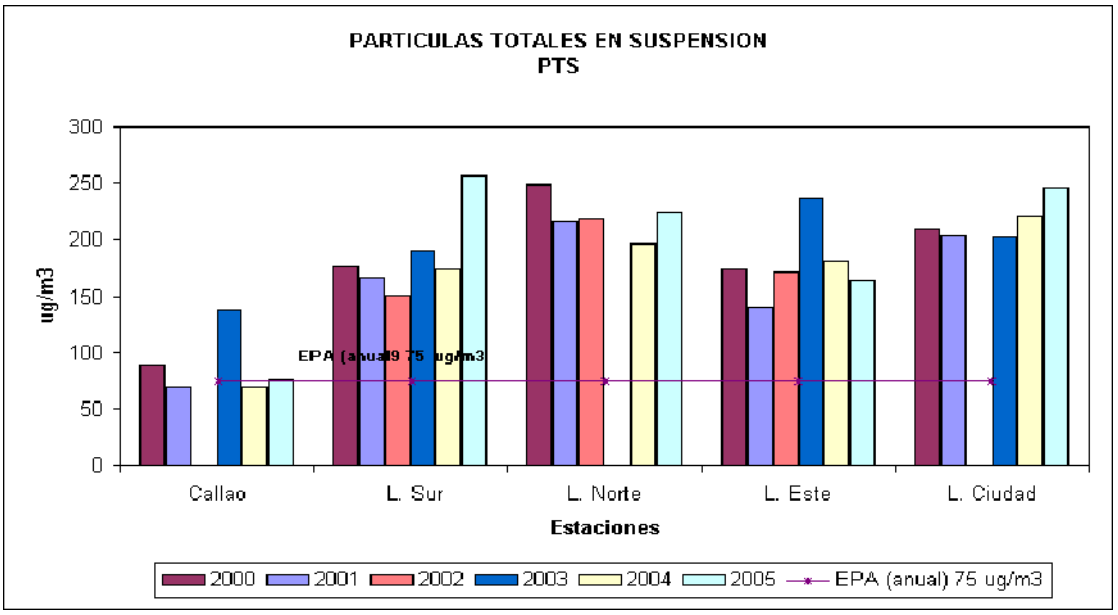
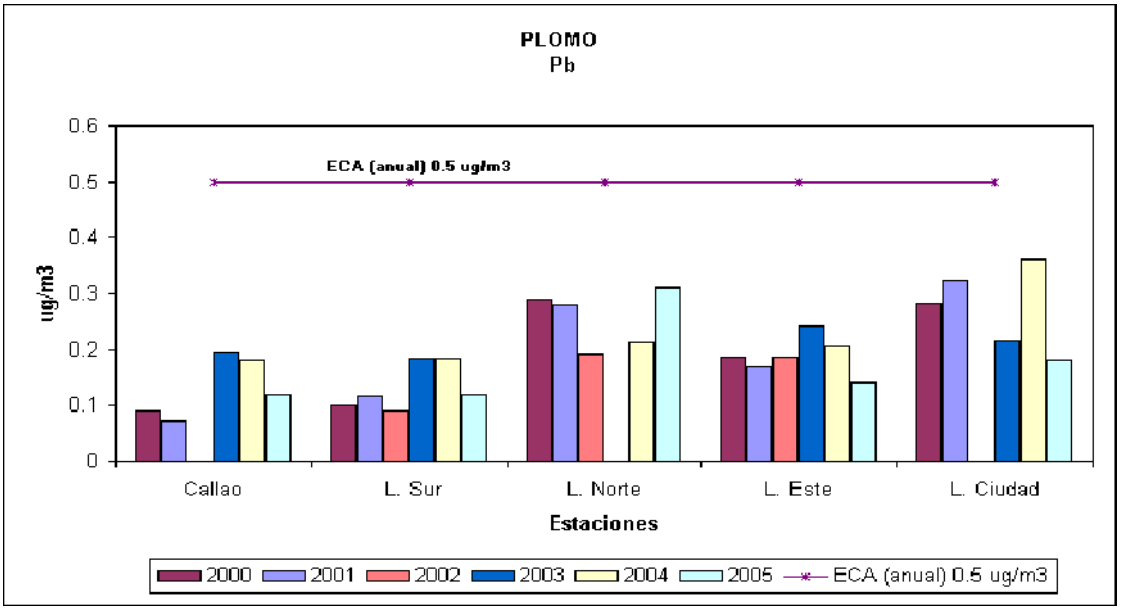


Tabla 12 - *Concentración anual de plomo (2000 - 2005)*

Zona	Ubicación	2000	2001	2002	2003	2004	2005
Callao	C.S. Pert Corea	0.1	0.1	-	0.2	0.2	0.1
Lima Sur	H. María Auxiliadora	0.1	0.1	0.1	0.2	0.2	0.1
Lima Norte	C.S. Laura Rodríguez	0.3	0.3	0.2	-	0.2	0.3
Lima Este	H. Honorio Delgado	0.2	0.2	0.2	0.2	0.2	0.1
Lima Ciudad	CONACO	0.3	0.3	-	0.2	0.4	0.2

[39] *Comparado con estándar de la USEPA (75 µg/m^3)*

Gráfico 10 - Concentración anual de plomo (2000 - 2005)



Estudios de saturación en Lima y Callao

Adicional a los datos del monitoreo de la calidad del aire reportados, durante los años 2000 y 2011 se han desarrollado dos estudios de saturación a fin de determinar los niveles de concentración de contaminantes atmosféricos a los que está expuesta la población de Lima Metropolitana y el Callao. El primer estudio de saturación fue desarrollado en el marco de las gestiones del Comité de Aire Limpio, en tanto el segundo estudio de saturación ha sido liderado por la DIGESA, quienes presentaron los resultados de dicho estudio, realizando además comparaciones del nivel de concentración de los contaminantes obtenidos en los dos estudios contra los valores de los estándares de calidad ambiental nacionales[40] y los valores guía para la calidad del aire propuestos por la Organización Mundial de la Salud en el año 2005, a fin de evaluar el comportamiento temporal de diversos contaminantes, los que a continuación se reporta en los Gráficos 11 al Gráfico 17:

[40] *Los valores se establecen en el Decreto Supremo 074-2001-PCM y Decreto Supremo 003-2008- MINAM, que en el caso del SO2 reemplaza el valor inicialmente propuesto*

Gráfico 11 - Concentración de polvo sedimentable (verano e invierno años 2000 y 2011

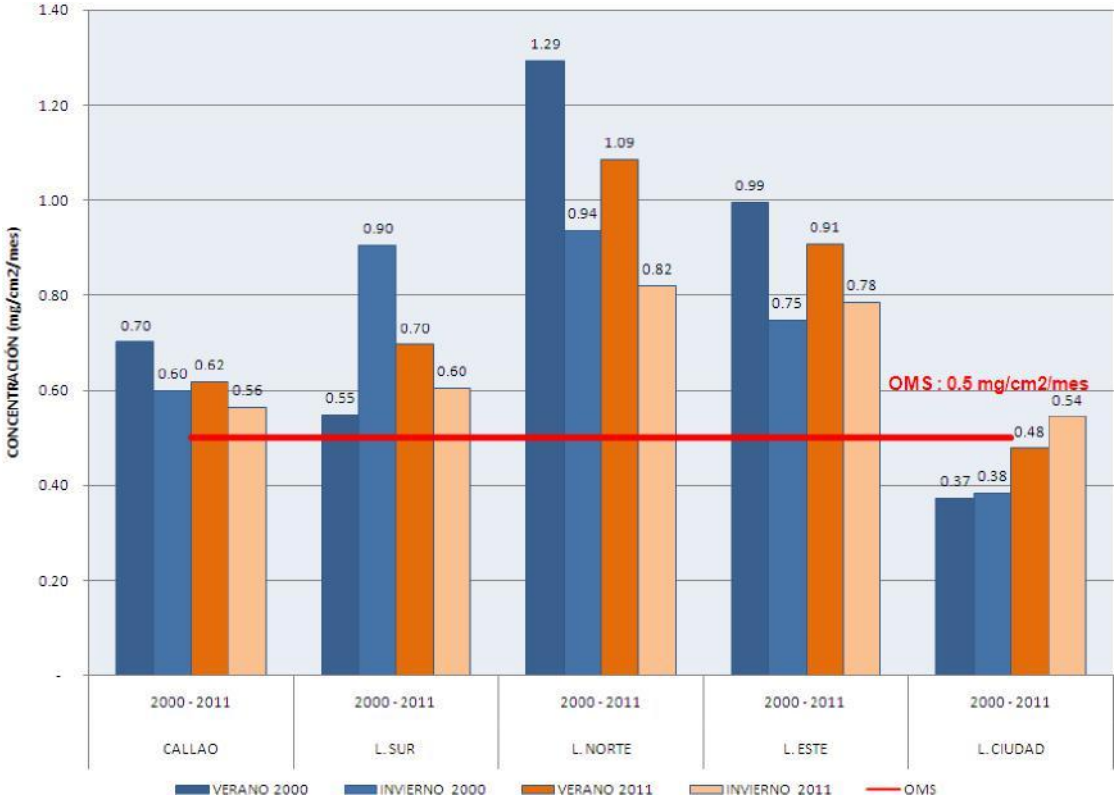


Gráfico 12 - Concentración de material particulado $_{PM10}$ (verano e invierno años 2000 y 2011)

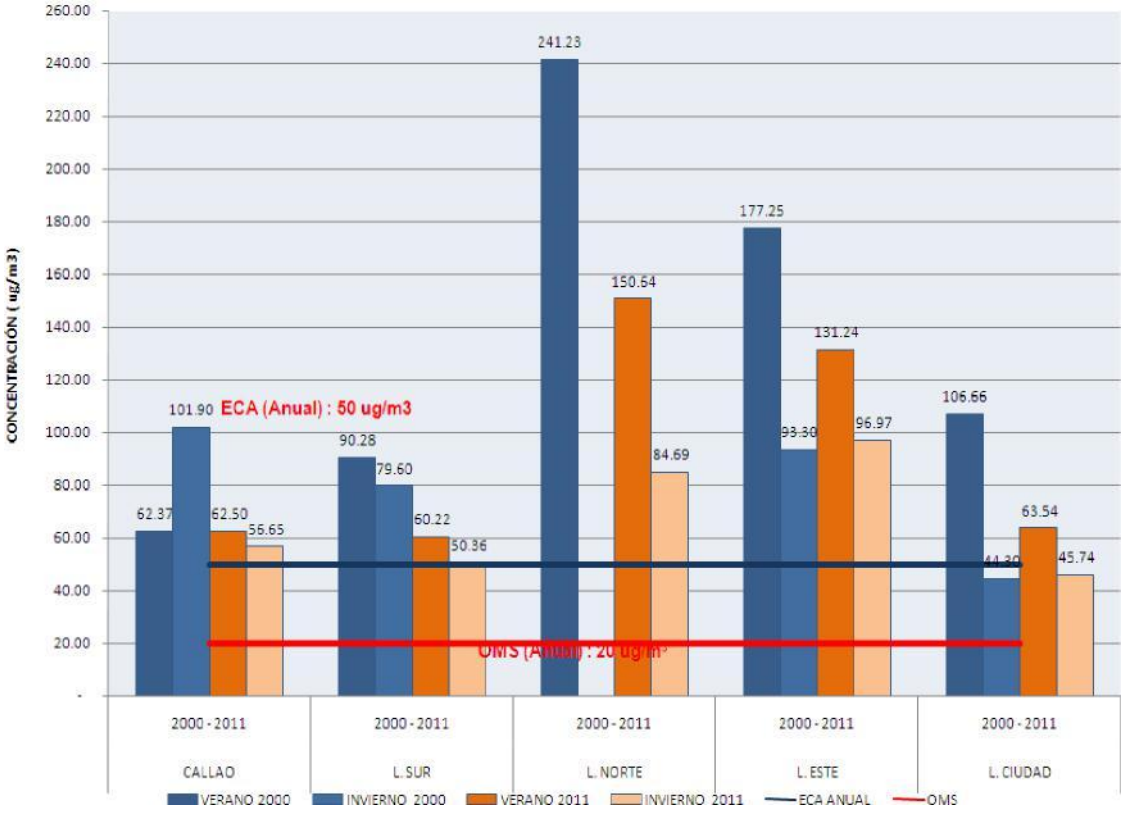


Gráfico 13 - Concentración de material particulado PM2.5 (verano e invierno años 2000 y 2011)

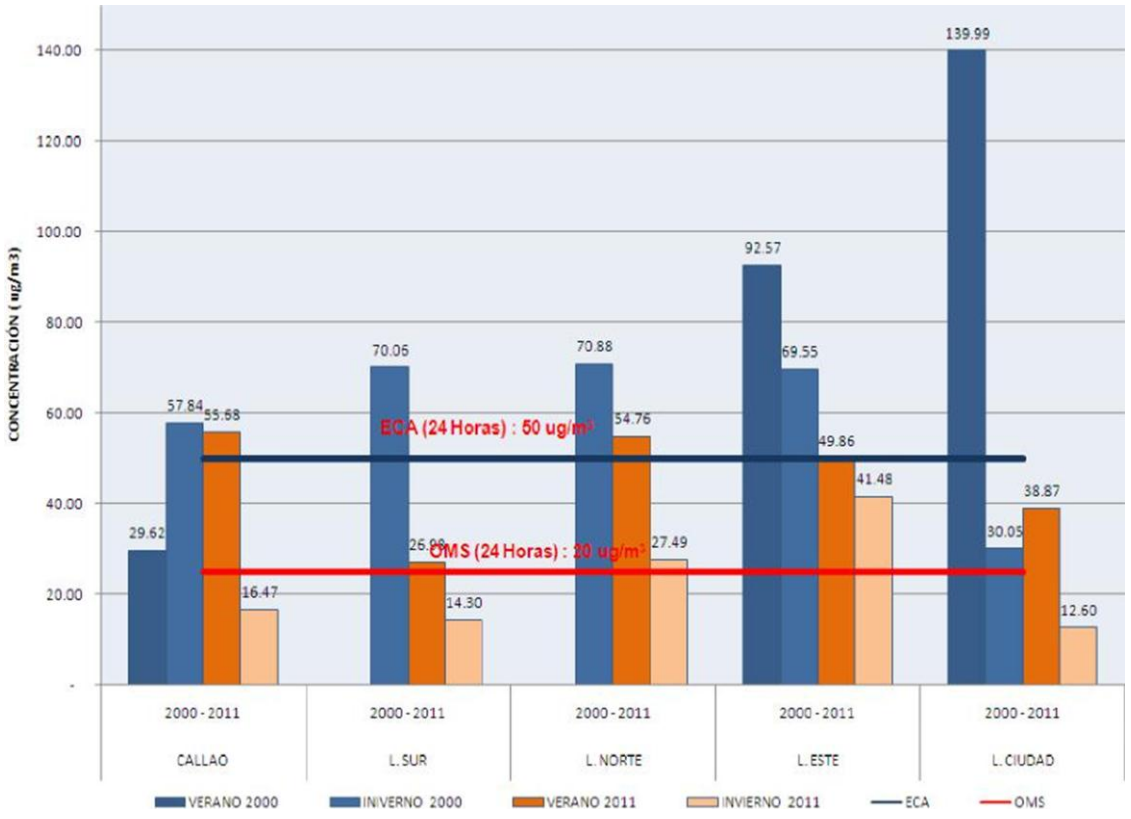


Gráfico 14 - Concentración de plomo (verano e invierno años 2000 y 2011)

Gráfico 15 - Concentración de dióxido de azufre (verano e invierno años 2000 y 2011)

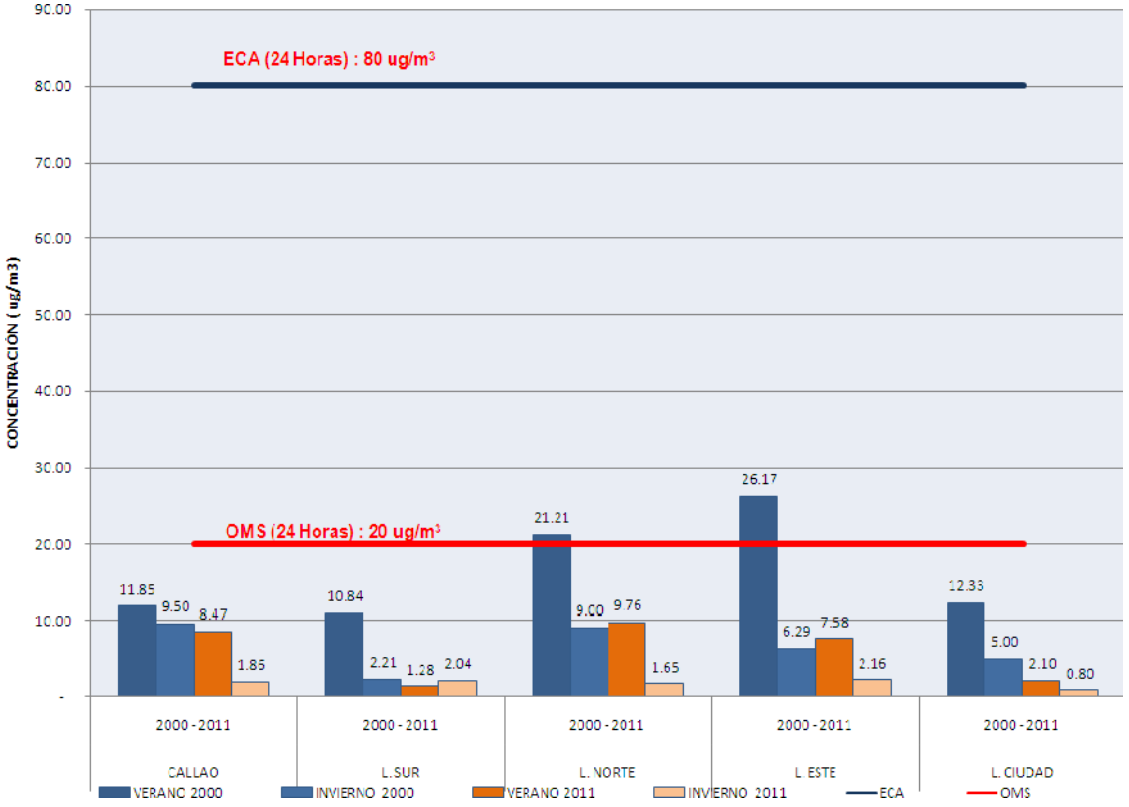


Gráfico 16 - Concentración de dióxido de nitrógeno (verano e invierno años 2000 y 2011)

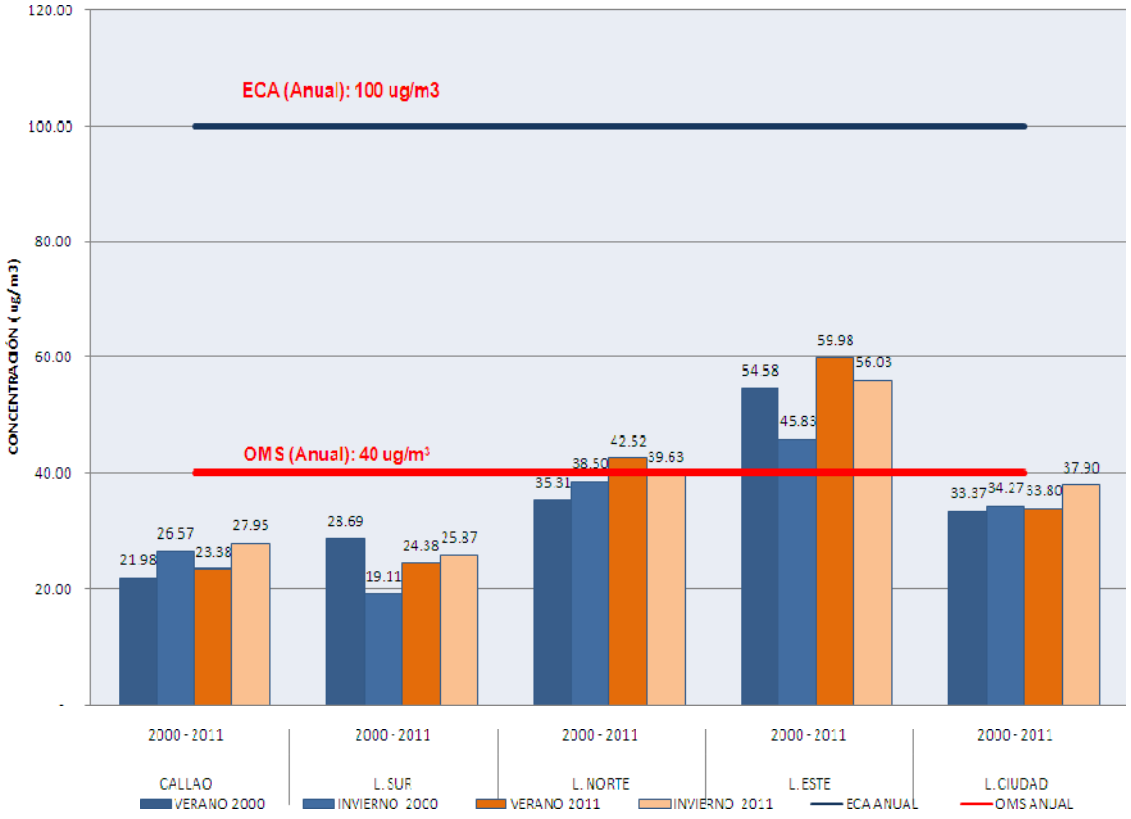
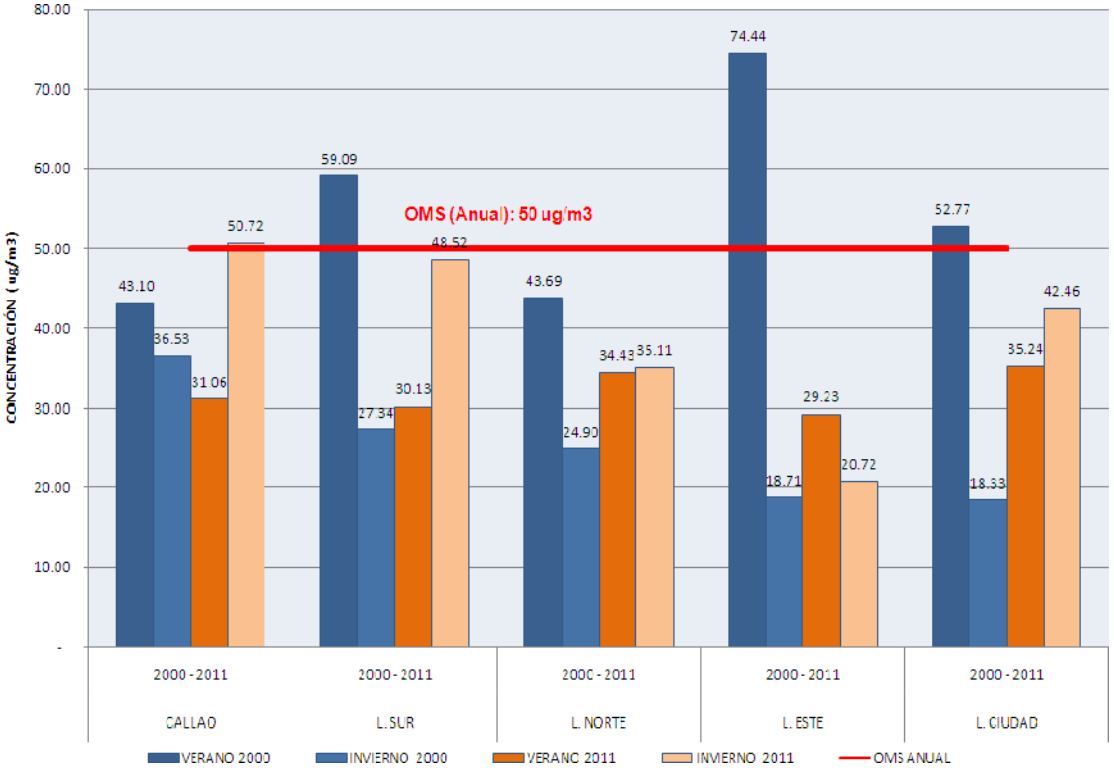


Gráfico 17 . Concentración de ozono (verano e invierno años 2000 y 2011)



Este estudio determinó que el principal contaminante presente en Lima y Callao, sigue siendo el material particulado (PM10 y PM2.5), el mismo que se dispersa de sur a nor-este por acción de los vientos, lo que podría contribuir al incremento de enfermedades respiratorias de la población expuesta en los distritos ubicados en esas zonas.

Los valores de dióxido de azufre (SO_2) han disminuido considerablemente con respecto al estudio del año 2000, debido a la disminución del azufre (ppm) en los combustibles, e introducción de combustibles más limpios como el GNV, GLP, Gasol y otros en Lima y Callao.

Los valores del dióxido de nitrógeno (NO_2), no sobrepasaron los ECAs, sin embargo al compararlos con los valores recomendados por la OMS, se observaron que en la zona de Lima Este, seguidos por Lima Norte, se supera lo recomendado, lo que puede contribuir con el incremento de procesos respiratorios.

El ozono (O_3) no sobrepasó la norma nacional ECA para 8 horas (120 µg/m^3), ni el valor recomendado por la OMS para 8 horas de exposición (100 µg/m^3).

El benceno (C_6H_6), en la mayor parte de la ciudad de Lima y Callao, se encuentra por bajo que del valor de los valores del ECA a excepción de los distritos de Lima-Este (Chaclacayo, Lurigancho-Chosica y Ate), que sobrepasaron los estándares de calidad ambiental ECA.

El polvo sedimentable (PS) presentó valores más altos en los distritos más alejados a la Costa, llamando la atención los valores registrados en los distritos de Carabayllo, Santa Anita, Ate y Comas, en relación al valor recomendado por la OMS.

El plomo (Pb) en el estudio, presentó una reducción importante, ya que se encuentra muy por debajo de los valores del ECA, y se concentran en mayores cantidades en los distritos de Ventanilla,

Carabayllo y Puente Piedra, pero sin que estos valores llegan a exceder el valor de dicho ECA. Los otros métales pesados como cromo cadmio, zinc hierro, manganeso se encuentran en concentraciones muy por debajo que establece la normatividad Canadiense

Los datos reportados por la DIGESA muestran que el material particulado es un contaminante que supera los estándares de calidad ambiental nacionales , al igual que los reportes de otras instituciones como el caso del SENAMHI (quienes realizan monitoreo continuo, al que se puede acceder en linea a través de la página Web en siguientes rutas: *Evaluación mensual de contaminantes en* http://www.senamhi.gob.pe/?p=0410 y *Pronóstico de la calidad del aire en* http://www.senamhi.gob.pe/calidadaire.php) y la Municipalidad de San Isidro (cuyos datos de monitoreo de la calidad del aire se presentan a la población en los Boletines de distribución via correo electrónico que realiza la Gerencia de Asuntos Sociales y en la página Web del Municipio). Entidades como PROTRANSPORTE y el Organismo de Evaluación y Fiscalización Ambiental (OEFA) del Ministerio del Ambiente, vienen trabajando en la recolección de la información de la calidad del aire, a través de la implementación de redes de monitoreo de la calidad el aire para la evaluación del sistema de transporte masivo en el primer caso y para la complementar la cobertura del monitoreo de la DIGESA en el segundo caso, pero a la fecha la información no se encuentra disponible. Todos los datos de calidad de aire reportados por estas entidades utilizan equipos de medición que responden a lo establecido en los decretos supremos *DS 047-2001-PCM Aprueban el Reglamento de Estándares Nacionales de Calidad Ambiental del Aire* y *DS-003-2008-MINAM Aprueban Estándares de Calidad Ambiental para Aire*; los criterios para el diseño de las redes de monitoreo se basan en lo establecido en la *RD 1404-2005-DIGESA/SA Aprueban Protocolo de Monitoreo de la Calidad del Aire y Gestión de los Datos*.

En cuanto a la relación transporte y calidad del aire, desde el año 2000 el parque automotor ha crecido en una progresión de 4% anualmente. En cuanto al transporte terrestre, el Perú cuenta con 79,883 kilómetros de carreteras y el parque automotor está conformado por 1.5 millones de vehiculos de las siguientes clases: de carga pesada (167,280), de transporte público (245,433), de carga ligera (418,065) y particulares (720,170). Al respecto, el pais tiene en circulación unidades con 15 años de antigüedad en promedio, y existe un porcentaje significativo de vehiculos con una antigüedad superior a los 20 años. Además, a inicios de la década del noventa se liberalizaron las importaciones de vehiculos usados en el territorio nacional.

Existe una relación directa entre el número de vehiculos (que en los últimos diez años ha registrado una tasa de crecimiento anual de 4%), y la contaminación del aire debido a la presencia de particulas totales en suspensión (PTS) y dióxido de azufre (SO_2) generado por el tipo de combustibles con contenido de azufre, asi como por la presencia de dióxido de nitrógeno (NO_2) producido por motores a gasolina (MINAM-SINIA, 2009).

En el caso de Lima, la principal barrera para realizar un cambio de combustible hacia otros combustibles menos contaminantes, como el gas licuado de petróleo (GLP) o el gas natural vehicular (GNV) es el aspecto técnico, pues los motores diesel no pueden ser convertidos, por lo que el cambio de combustible solo seria posible en vehiculos a gasolina salvo se realice el cambio del motor del vehiculo.

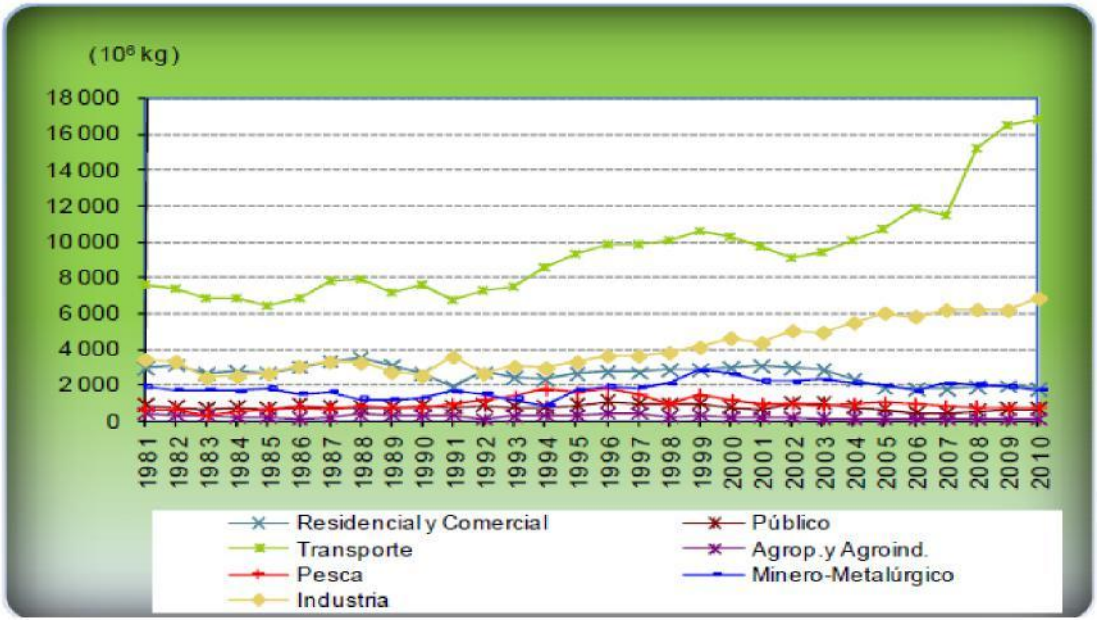
2.4.2 Emisiones al ambiente generadas por el consumo final de energía comercial

En el documento Balance Nacional de Energia 2010 de MINEM se reportan tanto las emisiones por el consumo de energia comercial como las emisiones generadas por la transformación y el uso de energia (incluyendo fuentes no comerciales como la leña, bosta, yareta y carbón vegetal).

Dióxido de carbono (CO_2)

Para el periodo 1981 - 2010, las emisiones de CO_2 provenientes de la transformación de energía primaria en energía secundaria y consumo propio se incrementaron de 4,9 a 15,35 mil millones de kilogramos (ver Gráfico 18). A partir del 2004 se observa un incremento sostenido de las emisiones asociadas a procesos de transformación y consumo propio, principalmente debido al incremento de la generación eléctrica a partir del gas natural. Este incremento pronunciado debido a la participación del gas en los procesos de transformación no se refleja en la misma magnitud en los consumos finales de energía, en los cuales predomina el consumo de hidrocarburos líquidos; en los consumos finales las emisiones de dióxido de carbono, durante el periodo de 1981 - 2010, se incrementaron de 17,46 a 28,39 mil millones de kilogramos, esta emisiones generadas se debieron mayormente al consumo en los sectores transporte e industrial.

Gráfico 18 - Emisiones de CO_2 por sectores económicos

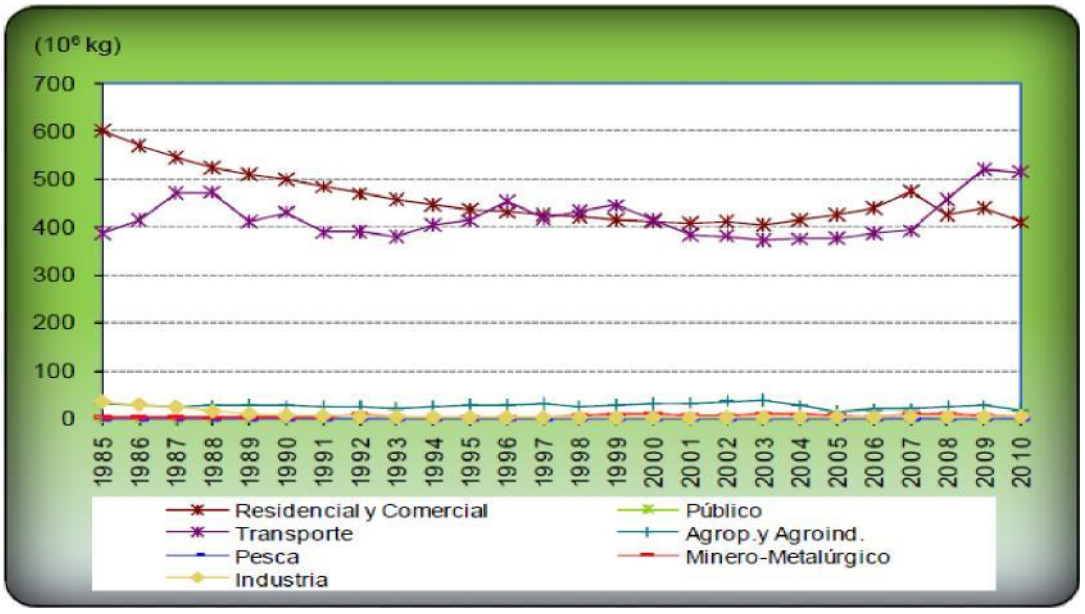


Fuente: MINEM Balance Nacional de Energía 2010

Monóxido de carbono (CO)

Para el periodo 1985 - 2010, las emisiones de CO provenientes de la transformación de energía primaria en secundaria y consumo propio, se incrementaron de 6,2 a 20,9 millones de kilogramos, siendo la transformación de leña para la producción de carbón vegetal y el uso de bagazo para la producción de electricidad los principales emisores (ver Gráfico 19). En el periodo de 1985 - 2010, las emisiones de CO se redujeron de 1060 a 951 millones de kilogramos, si bien hubo un incremento en las emisiones provenientes de los hidrocarburos líquidos en el sector transporte, la reducción del consumo de leña en el sector residencial resultó en un saldo negativo.

Gráfico 19 - Emisiones de CO por sectores económicos

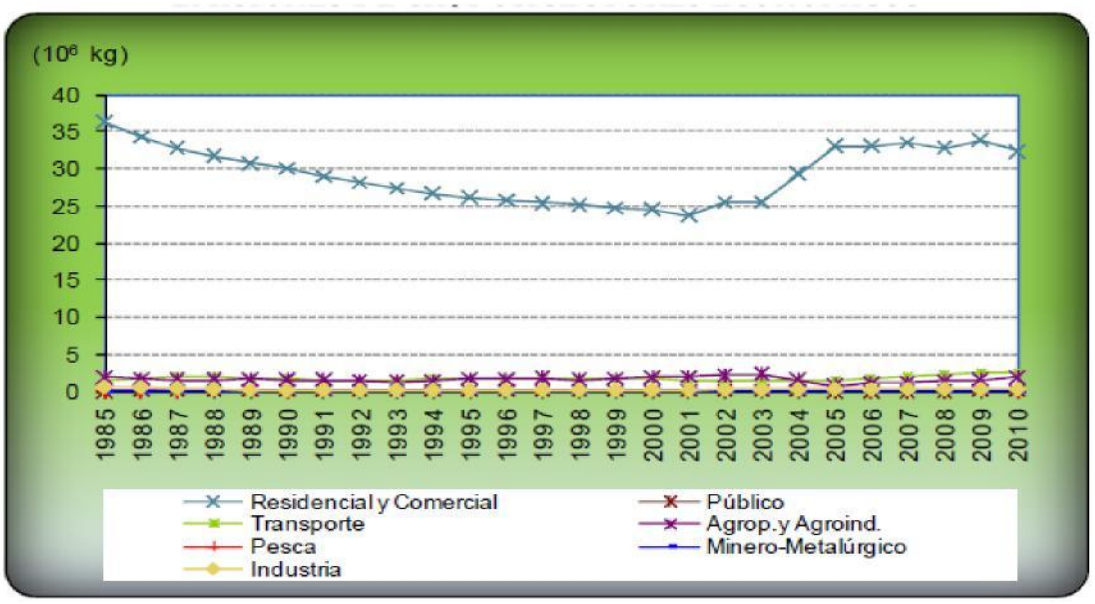


Fuente: MINEM Balance Nacional de Energía 2010

Metano (CH_4)

Para el periodo 1985 - 2010, las emisiones de CH_4 provenientes de la transformación de energía primaria en secundaria y consumo propio, se incrementaron de 0,28 a 0,75 millones de kilogramos, siendo la transformación de leña para la producción de carbón vegetal y el uso de bagazo para la producción de electricidad los principales emisores (ver Gráfico 20). En el periodo de 1985 - 2010, y durante la etapa del consumo final de energía, las emisiones de CH_4 se redujeron de 40,6 a 37,43 millones de kilogramos en los consumos finales, esto se explica principalmente por la reducción en el consumo de leña en los hogares.

Gráfico 20 - Emisiones de CH_4 por sectores económicos



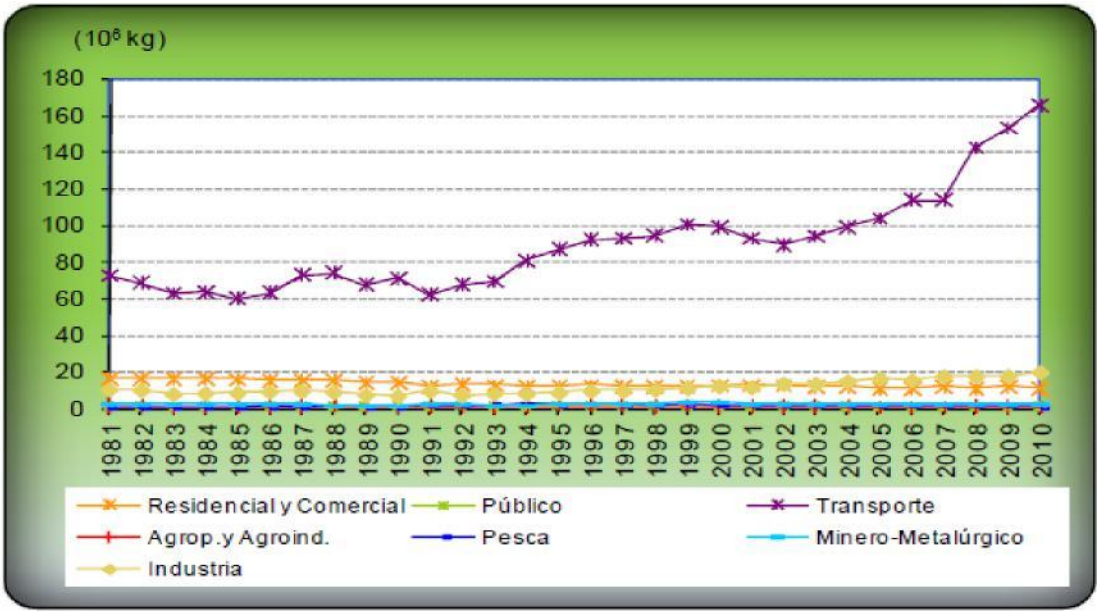
Fuente: MINEM Balance Nacional de Energía 2010

Óxidos de nitrógeno (NO_Y)

Para el periodo 1981 - 2010 las emisiones de NO_X provenientes de la transformación de energía primaria en secundaria y consumo propio, se incrementaron de 13,35 a 40,24 millones de kilogramos, por la formación de NO_X a altas temperaturas en motores de combustión interna

(motores más eficientes) y del gas para la generación de electricidad (ver Gráfico 21). En los consumos finales, las emisiones de NO_X se deben básicamente al uso de hidrocarburos líquidos en el sector transportes. En el periodo de 1981 - 2010, las emisiones de NO_X, se incrementaron de 103,2 a 200,4 millones.

Gráfico 21 - Emisiones de NO_Y por sectores económicos

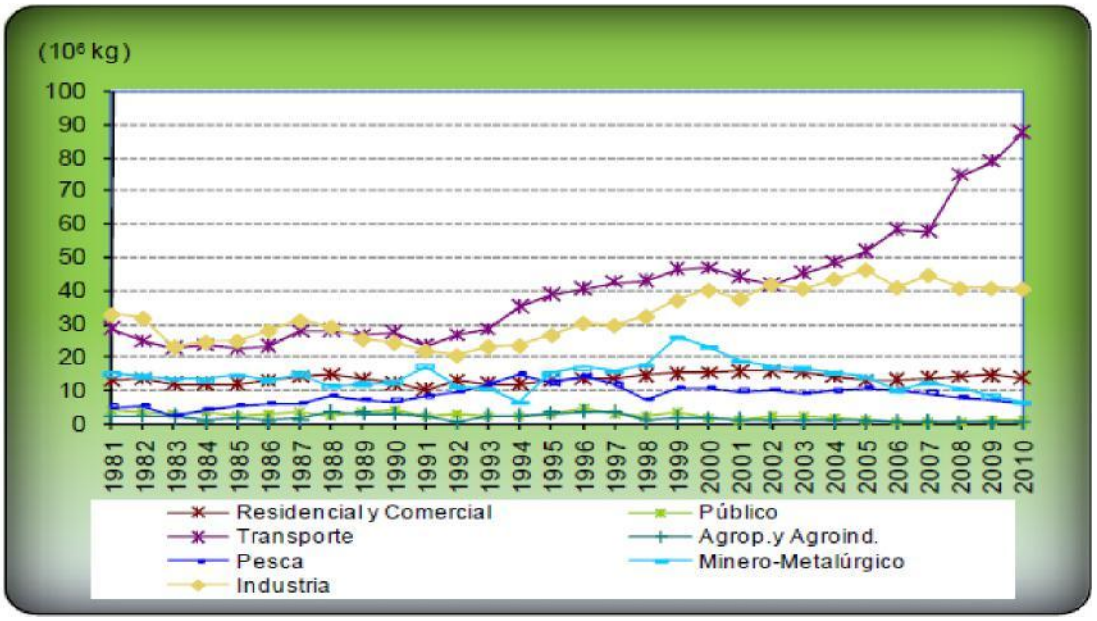


Fuente: MINEM Balance Nacional de Energía 2010

Óxidos de azufre (SO_Y)

En el periodo 1981 - 2010, para el caso del proceso de transformación de energía primaria a secundaria y el consumo propio, las emisiones de SO_X que se generaron principalmente por la generación de electricidad se incrementaron de 16,2 a 30,19 millones de kilogramos (ver Gráfico 22). En el periodo 1996-2000 puede observarse una campana debido a la mayor participación de petróleo residual en la generación eléctrica. También puede observarse que a partir del 2000 se incrementan las emisiones de SO_X, correspondientes al inicio de operación de la Central Térmica a Carbón en Ilo. En lo referente a los consumos finales de energía, las emisiones de SO_X se incrementaron de 100,0 a 154,8 millones de kilogramos en el período de 1981-2010, generados principalmente por el incremento del consumo de diesel en el transporte y de los hidrocarburos líquidos en la industria.

Gráfico 22 - Emisiones de SOx por sectores económicos

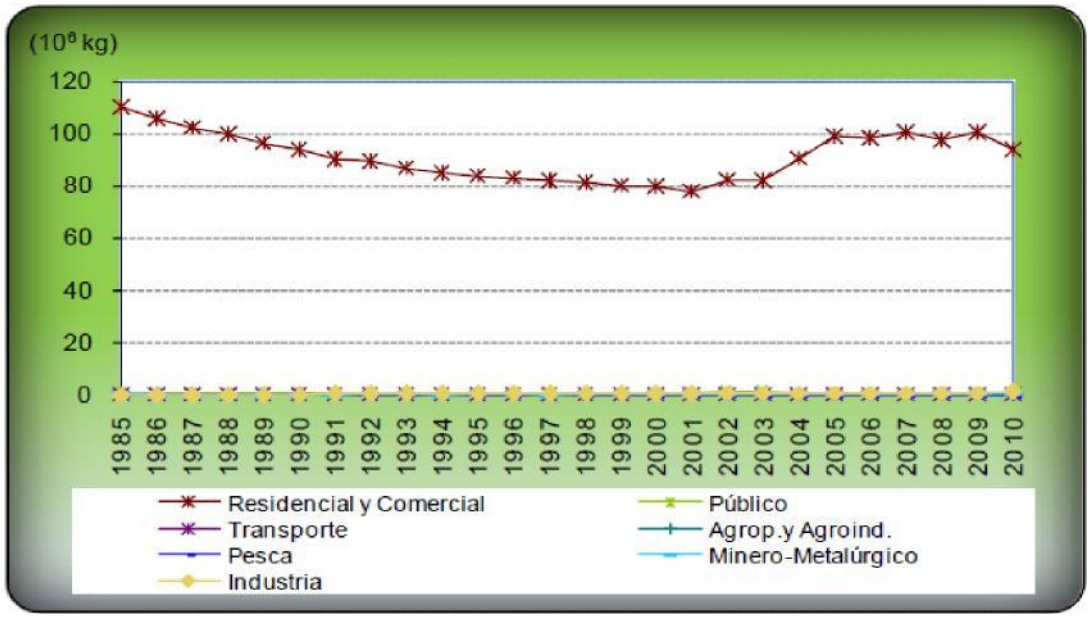


Fuente: MINEM Balance Nacional de Energía 2010

Material particulado (MP)

Para el periodo 1985 - 2010, las emisiones de partículas provenientes de la transformación de energía primaria en secundaria y consumo propio se incrementaron de 6,7 a 14,5 millones de kilogramos, generados en gran parte por el incremento del uso del bagazo para la generación de electricidad (ver Gráfico 23). En los consumos finales, para el periodo de 1985 - 2010, las emisiones de partículas se redujeron de 117,5 a 102,14 millones de kilogramos debido principalmente a la reducción del consumo de leña en los hogares, la que de no ser utilizada adecuadamente puede causar enfermedades respiratorias a las personas expuestas.

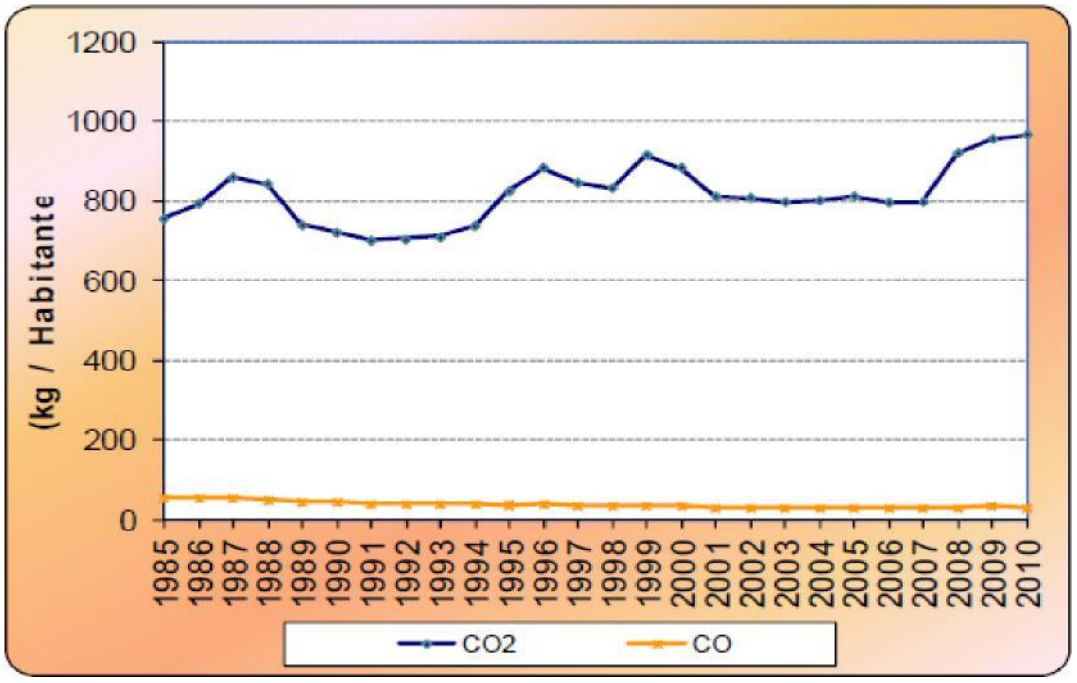
Gráfico 23 - Emisiones de partículas por sectores económicos



Fuente: MINEM Balance Nacional de Energía 2010

Como puede observarse, el sector transporte presenta una alta generación de emisiones de contaminantes primarios (óxidos de nitrógeno, óxidos de azufre y material particulado) y emisiones de gases de efecto invernadero (principalmente dióxido de carbono). Con relación a la evolución de las emisiones en relación al consumo final de energía y a la población, para el periodo 1985 - 2010 se observa una tendencia al incremento de las emisiones de CO_2 (ver Gráfico 24).

Gráfico 24 - Emisiones de gases por sectores económicos



Fuente: MINEM Balance Nacional de Energía 2010

2.5 Medidas de mitigación en el sector transporte

Aspectos considerados en el marco de la mitigación en el sector Transporte - Segunda Comunicación Nacional del Perú a la Convención Marco de las Naciones Unidas sobre Cambio Climático

Esfuerzos normativos y tributarios que propician la importación de vehículos nuevos en lugar de vehículos usados, el uso de gas natural, el retiro de vehículos a base de diesel, la imposición de mayores impuestos a vehículos más contaminantes, así como la aplicación de inspecciones técnicas vehiculares y sus limitantes a la contaminación, representan acciones de mitigación en este sector aun cuando entre sus objetivos iniciales no hayan especificado la reducción de emisiones de GEI.

2.5.1 Importaciones de vehículos

Se viene realizando esfuerzos para fomentar la importación de vehículos nuevos y para mejorar el transporte público, como el Corredor Segregado de Alta Capacidad (COSAC) en la ciudad de Lima, el cual debería ser replicado en otras ciudades.

La importación de vehículos esta reglamentada por diferentes normativas (Reglamento Nacional de Vehículos, aprobado por Decreto Supremo Nº 058-2003-MTC publicado el 12.10.2003, modificado por Decreto Supremo Nº 014-2004-MTC publicada el 28.03.2004; Reglamento Nacional de Vehículos, aprobado por Decreto Supremo Nº 058-2003-MTC), la Superintendencia Nacional de Aduanas y Administración Tributaria (SUNAT) exige la fiscalización de los registros de importación, sin embargo, no hay controles aleatorios sobre el cumplimiento de la normativa técnica.

Documentación exigible[41]:

- Declaración Única de Aduanas diligenciada en el Perú con intervención de una agenciade aduana, factura, póliza de seguro (opcional) y, según el medio de transporte utilizado, conocimiento de embarque, guía aérea o carta porte

- Para la importación de vehículos nuevos, el importador debe consignar en la Declaración Única de Aduanas, el código de identificación vehicular, el número de Registro de Homologación y las características registrables que correspondan de acuerdo al Anexo V del Reglamento Nacional de Vehículos

- Tratándose de vehículos nuevos cuya importación es efectuada por persona natural o jurídica distinta a quien efectúo la homologación, SUNAT solicita adicionalmente, una constancia del fabricante o de su representante autorizado en Perú que acredite que los vehículos a nacionalizar, corresponden al modelo vehicular homologado. Alternativamente, se podrá presentar un Certificado de Conformidad de Cumplimiento, emitido por una Entidad Certificadora autorizada por la DGCT, que certifique que el vehículo corresponde al modelo homologado *(Artículo 88º del Reglamento Nacional de Vehículos, aprobado por Decreto Supremo Nº 058-2003-MTC)*

- Ficha Técnica de Importación de Vehículos Usados y Especiales, consignando los códigos de identificación vehicular. Dicha ficha será llenada íntegramente por el importador del vehículo y suscrita en forma conjunta por él o su representante legal, según se trate de persona natural o jurídica, y un ingeniero mecánico o mecánico electricista colegiado y habilitado, el que deberá estar acreditado ante la Dirección General de Circulación Terrestre - DGCT del Ministerio de Transportes y Comunicaciones - MTC. El despachador de aduana debe presentar conjuntamente con la DUA dos ejemplares del citado documento y una copia de éste debidamente autenticada; siguiéndose el procedimiento establecido en la Circular Nº 009-2004/SUNAT/A de 04.08.2004 para su sellado y distribución. *(Artículo 94º del Reglamento Nacional de Vehículos, aprobado por Decreto Supremo Nº 058-2003-MTC publicado el 12.10.2003, modificado por Decreto Supremo Nº 014-2004-MTC publicada el 28.03.2004)*

- Reporte de Inspección en el régimen regular o Segundo Reporte de Verificación de Vehículos Usados - Revisa 2 tratándose de importaciones que proceden de los CETICOS o de la ZOFRATACNA, emitido por una entidad verificadora autorizada por el MTC, señalando que se efectuó la inspección física y documentaria del vehículo y que éste reúne las exigencias técnicas establecidas y cumple con la normativa vigente en materia de Límites Máximos Permisibles de emisiones contaminantes. Los citados reportes deben consignar el kilometraje, los valores resultantes de las pruebas de emisiones realizadas y expresar la verificación de la veracidad de la

[41] http://www.sunat.gob.pe/orientacionaduanera/importacionvehiculos/index.html#

información contenida en la Ficha Técnica de Importación de Vehículos Usados y Especiales. El Reporte de Inspección bajo el régimen regular, tratándose de importaciones por circunscripciones en las que no se hubiere autorizado a entidades verificadoras, excepcionalmente podrá ser emitido por empresas certificadoras autorizadas por el MTC. *(Artículo 94º del Reglamento Nacional de Vehículos, aprobado por Decreto Supremo Nº 058-2003-MTC modificado por Decreto Supremo Nº 014-2004-MTC; el artículo 1º, inciso b) del Decreto Legislativo Nº 843, modificado por el artículo 1º del* Decreto Supremo Nº 042-2006-MTC)

2.5.2 Sistema Nacional de Inspecciones Técnicas Vehiculares

Bajo este sistema se establece la obligatoriedad que todo vehículo automotor debe pasar por inspecciones técnicas para circular por las vías públicas, evaluando así el buen funcionamiento y operatividad que garantice la seguridad del transporte y tránsito terrestre, en armonía con las condiciones ambientales saludables (Ley del Sistema Nacional de Inspecciones Técnicas Vehiculares N° 29237, y su reglamento, Decreto Supremo N° 025- 2008-MTC). Si bien se puede considerar este sistema como una norma limitativa a la generación de GEI, no se incluye la obligatoriedad de implementar las medidas correctivas a fin de reducir las emisiones de los vehículos. El Ministerio de Transportes y Comunicaciones es la autoridad competente para realizar lo siguiente:

- Otorgar las autorizaciones de funcionamiento a los Centros de Inspección Técnica Vehicular- CITV
- Seleccionar y suscribir los contratos correspondientes con las Entidades Supervisoras
- Fijar los ámbitos territoriales que corresponderán a los Centros de Inspección TécnicaVehicular- CITV, así como determinar el número mínimo de Centros de Inspección

Clases de Inspecciones Técnicas Vehiculares

- **Inspección Técnica Ordinaria**: Es la que debe cumplir todo vehículo que circula por las vías públicas terrestres a nivel nacional, de acuerdo a la frecuencia establecida en el presente Reglamento.
- **Inspección Técnica Vehicular de Incorporación**: Es la que se exige, para la inmatriculación en los Registros Públicos, a los siguientes vehículos:
  - Usados importados
  - Vehículos especiales
  - Usado procedente de subastas oficiales
  - Otros que se establezcan posteriormente

Cronograma de Revisiones Técnicas

Las Inspecciones Técnicas Vehiculares se realizarán de acuerdo a la categoría, función y antigüedad de los vehículos. Las Inspecciones Técnicas Vehiculares se realizarán según el último dígito de la Placa Única Nacional de Rodaje de acuerdo al cronograma que apruebe la DGTT por Resolución Directora.

En la Tabla 13 se especifica la frecuencia y vigencia del certificado en función del vehículo y su antigüedad, en tanto, en la Tabla 14 se hace referencia a los diferentes Centros de Inspección Técnica Vehicular (CITV) que operan a nivel nacional.

Tabla 13 - Frecuencia y cronograma de las Inspecciones Técnicas Vehiculares y vigencia del Certificado de Inspección Técnica Vehicular

Vehículos	**Frecuencia**	**Antigüedad del vehículo**[42]	**Vigencia del certificado**
Del servicio de transporte regular de personas (ámbito provincial, regional nacional) Del servicio de transporte especial de personas (taxi, transporte turístico, transporte de trabajadores, transporte de estudiantes, transporte social, transporte en auto colectivo y transporte comunal de pasajeros por carretera) Del servicio de transporte internacional de personas, transporte colectivo de pasajeros entre Tacna-Arica y de transporte transfronterizo de pasajeros entre Perú - Ecuador	Semestral	A partir del tercer año	6 meses
Del servicio de transporte especial de personas en vehículos menores de la Categoría L5	Anual	A partir del segundo año	12 meses
Particulares para transporte de personas y/o mercancías de las Categorías L3, L4, L5	Anual	A partir del tercer año	12 meses
Particulares para transporte de personas de hasta nueve asientos incluido el del conductor de la Categoría M1	Anual	A partir del cuarto año	12 meses
Particulares de transporte de personas de más de nueve asientos, incluido el del conductor, de las Categorías M2 y M3	Anual	A partir del tercer año	12 meses
Para transporte de mercancías de las Categorías N1 y O2	Anual	A partir del tercer año	12 meses
Para transporte de mercancías de las Categorías N2, N3, O3 y O4	Anual	A partir del tercer año	12 meses
Para transporte de materiales y residuos peligrosos de las Categorías N y O	Semestral	A partir del segundo año	6 meses
Del servicio de trasporte mixto	Semestral	A partir del tercer año	6 meses

[42] *La antigüedad del vehículo se cuenta a partir del año siguiente de fabricación consignado en la Tarjeta de Propiedad o Tarjeta de Identificación Vehicular*

Tabla 14 . Lista de Plantas de Revision Técnica en el Perú

No.	Nombre CITV	Región	Domicilio	Dirección de la Planta
1	Inspecciones Técnicas Vehiculares S.A.C.- ITEV	Cajamarca	Centro Comercial Fiori , 2 Piso, 226- San Martin de Porres)	Carretera Cajamarca - Jesús, Km. 5, Distrito de Huacariz, Cajamarca
2	SO Contratistas Generales S.A. (SOCGESAC)	Huancayo - Junin	Av. Gerardo Unger 247 - of 305, Urb. Ingeniera. San Martin de Porres	Av. Alfonso Ugarte, Cuadra 4, San Agustin de Cajas , Huancayo-Junin
3	Inspecciones Técnicas Vehiculares S.A.C.-ITEV S.A.C.	Chiclayo	Av. Miguel Angel s/n Int. 241-B, Urbanización Fiori, San Martin de Porres	Km. 2.7 de la Carretera a Pomalca, Chiclayo, Región Lambayeque
4	Servicios Operativos del Sur S.R.L. -S.O.S S.R.L.	Tacna	Pasaje Jorge Chavez Nº 22 - Tacna	Av. Panamericana Sur - Sector Irrigación COPARE, Terreno "B" - Tacna
5	Centro de Inspecciones Técnicas Vehiculares Arequipa S.R.L. -CITV AQP	Arequipa	Av. Fray Martin de Porres Esq. Tarapacá. Semi Rural Pachacutec, Grupo Zonal 24-25, Zona H, Mz. 18, Lote 1. Cerro Colorado-Arequipa	Av. San Martin de Porres esq. Tarapacá, Semi Rural Pachacutec, Distrito Cerro Colorado, Arequipa, (es Fray Martin)
6	Centro de Inspecciones Técnicas Vehiculares del Perú S.A.C. -CIPESAC.	Arequipa	Calle Lambayeque Mz. F.10, Lote 02, Esquina Psje Santa Rosa, Semirural Pachacutec- Cerro Colorado -Arequipa	Entre Jirón Lambayeque y Pasaje Santa Rosa, Sector Semi Rural, Primer Canal Valle Chilli, Distrito de Cerro Colorado
7	Sistemas de Inspecciones Técnicas del Centro S.A.C. - SITEC CENTRO S.A.C.	Junin	Av. Colonial Cdra. 3, Dpto. 302, Modulo 20-Lima	Intersección de la Av. Coronel Parra y el Jr. José Olaya, Distrito de Pilcomayo, Provincia Huancayo, Junin
8	Agrupación Técnica Automotriz IRH S.A.C.	Chiclayo	Av. Victor Raúl Haya de la Torre Nº 2770-La Victoria-Chiclayo	Av. Victor Raúl Haya de la Torres Nº 2770, La Victoria-Chiclayo
9	FARENET S.A.C.	Callao	Av. Argentina Nº 1749, Callao	Av. José Gálvez Nº 1401, Bellavista - Callao (Calle Colina Nº 1050)
10	Grupo de Inversiones Trujillo S.A.C.	Trujillo	Carretera Industrial Km. 0.1, Int. 154, La Encalada	Carretera Industrial Km. 0.1, Int. 154, La Encalada
11	S.O Contratistas Generales S.A.C. - SOCGESAC	Lima - Huarochiri	Av. Gerardo Unger Nº 247-Of. 305, San Martin de Porres, Lima	Av. Inca Pachacútec cuadra 3, Mz. "O", Lote 10, Jicamarca, Provincia de Huarochiri, Lima
12	Instituto del Transporte y Vialidad de la U.N.de San Agustin de Arequipa -UNSA-	Arequipa	Calle Santa Catalina Nº 117, Cercado Arequipa; Av. Francisco Velasco Nº 123 - Parque Industrial Arequipa	Esq. Variante de Uchumayo con la Via de Evitamiento, Km. 3.5, Cerro Colorado - Arequipa

No.	Nombre CITV	Región	Domicilio	Dirección de la Planta
13	Centro de Inspección Técnica Nacional S.A.C. - CEDITEN S.A.C.	Ancash	Calle Clorinda Matto de Turner Nº 187, Urb. Ingeniería - San Martín de Porres - Lima	Calle 26, Mz. "O", Lotes Nº 4, 7 8, 9, 10 y 11 del A.H. "Los Angeles", Provincia de Nuevo Chimbote - Ancash
14	Centro de Operaciones de Revisión Técnica S.R.L. - CORTEC S.R.L.	Tacna	Av. Circunvalación Manzana S/N, Lote 03, Fundo Santa Inés, Tacna	Av. Circunvalación Manzana S/N, Lote 03, Fundo Santa Inés, Tacna
15	Inspecciones Técnicas del Altiplano S.R.L. - INSPECTEC S.R.L.	Arequipa	Pasaje. Siempre Libre, Mza C, Lte. 9, Pasaje. Loma Verde, Distrito Jacobo Hunter, Arequipa	Camino a Yura Km. 7.5, Cerro Colorado, Arequipa
16	FARENET S.A.C.	Ica	Av. Argentina Nº 1749 - Callao	Panamericana Sur Km. 304-305 - Ica
17	SENATI Zonal Lima-Callao	Lima	Av. Alfredo Mendiola s/n, Panamericana Norte Km. 15.200, Independencia, Lima	Av. Alfredo Mendiola s/n
18	CEDIVE S.A.C	Callao	Calle Los Metales Nº 120, Urb. Bocanegra - Callao	Calle "B" Los Metales Nº 120. Urb. Industrial Bocanegra Aeropuerto Callao
19	FARENET S.A.C.	Callao	Av. Argentina Nº 1749 - Callao	Av. Argentina Nº 1749 - Callao
20	Instituto del Transporte y Vialidad de la U.N.de San Agustín de Arequipa -UNSA-	Lima	Francisco Velasco Nº 123 , Parque Industrial, Arequipa	Av. Nicolás Ayllón Nºs 1570-1580, San Luis, Lima
21	CYCLOPEA S.A.C.	Trujillo	Calle Donizetti Nº 144 -San Borja -Lima	Carretera Industrial a Laredo Km. 0.5, Trujillo
22	SENATI Zonal Lambayeque	Chiclayo	Carretera a Pimentel Km. 3.5, Chiclayo	Carretera a Pimentel Km. 3.5, Chiclayo
23	SENATI Zonal La Libertad	Trujillo	Parque Industrial Lote 28-A, La Esperanza - Trujillo	Panamericana Norte Km. 555, Lote 28-A, Parque Industrial, La Esperanza
24	SENATI Zonal Arequipa Puno	Arequipa	Av. Miguel Forga Nº 246, Parque Industrial - Arequipa	Av. Miguel Forga Nº 246, Parque Industrial - Arequipa
25	SENATI Zonal Junín	Junín	Jr. Los Conquistadores Nº 1320, Distrito El Tambo, Huancayo - Junín	Av. Amargura s/n, Barrio Centro, Distrito Huraripampa, Provincia de Jauja, Dpto. de Junín
26	ISTP "Tupac Amaru"	Cuzco	Av. Cusco s/n - San Sebastián - Cusco	Av. Cusco s/n - San Sebastián - Cuzco
27	OTANOR S.A.C.	Trujillo	MZ. "H" Lote 9 Urb. Mochica -Trujillo - La Libertad	Mz. A Lit. 16-17-18, Sector VII Centro Poblado Menor de el Milagro, distrito de Huanchaco-Trujillo - La Libertad

No.	Nombre CITV	Región	Domicilio	Dirección de la Planta
28	REVISIONES TECNICAS PERUANAS S.A.C - REVITEC PERU S.A.C.	Trujillo -La Libertad	Av. General Vivanco Nº 319 - Pueblo Libre Lima	Predio Valdivia - Parcela 10421, Sector Valle de Moche, Distrito de Huanchaco, Provincia de Trujillo, Departamento de la Libertad
29	REVISIONES TECNICAS DEL PERU S.A.C.	Huarochirí - Lima	Calle Hernán Velarde Nº 231- Santa Beatriz -- Cercado de Lima	Carretera Central Km. 37.5, Distrito de Santa Eulalia, Provincia de Huarochiri - Lima
30	SYSTECH PERUANA S.R.L.	Ica	Canaval y Moreyra Nº 452 Piso 17 - San Isidro - Lima	Panamericana Sur Km. 297.2, distrito Subjantalla - Ica
31	SGS DEL PERÚ S.A.C.	Callao	Av. Elmer Faucett Nº 3348 - Callao	Av. Elmer Faucett Nº 2880, Provincia Constitucional del Callao
32	CENTRO TECNICO AUTOMOTRIZ HERSA S.R.L.	Callao	Av. Néstor Gambeta S/N (Carretera a Ventanilla) Lotes No. 4, 5, 6 y 7 - distrito de Ventanilla - Callao	Av. Néstor Gambeta S/N (Carretera a Ventanilla) Lotes No. 4, 5, 6 y 7 - distrito de Ventanilla - Callao
33	VERIFICADORA TECNICA AUTOMOTRIZ S.A.C.- VTA S.A.C.	Junín	Calle de la Puente y Cortez N° 426, Pueblo Libre - Lima	Km 8 Carretera Central Margen Izquierda (Av. San Agustín) Sector 2, Mz. A1, Lit. 19, s/n Distrito de San Agustín de Cajas - Huancayo.
34	CEDIVE S.A.C	Callao	Calle "B" Los Metales Nº 120, Urb. Bocanegra - Callao	Av. Japón (antes Av. Bertello) s/n con Calle A - Callao
35	CORAFE S.A.C.	Ancash	Jr. Buenos Amigos N° 290, Of. 202 - Ate	Panamericana Norte Km. 421.624 Zona Industrial Los Pinos, Lote G, Chimbote, provincia de Santa, departamento de Ancash.
36	CEDITEN S.A.C	Huarochirí - Lima	Calle Clorinda Matto de Turner N° 187- Urb. Ingeniería- SMP- Lima	Av. Sinchi Roca Mz. O, Lote 1- Distrito de San Antonio- Huarochiri

2.5.3 Renovación del parque automotor y el chatarreo

Debido a la obsolescencia del parque automotor y a la ineficiencia en el empleo de los combustibles o derivados de petróleo, se aprueba el Régimen Temporal de Renovación del Parque Automotor que fomenta el cambio de matriz energética (Decreto Supremo N° 213- 2007-EF), y promueve el uso de gas natural vehicular (GNV). Así también se crea el "Régimen Temporal para la Renovación del Parque Automotor de Vehículos Diesel" con el objetivo de fomentar el "chatarreo" de vehículos Diesel (reglamento D.S. N° 016-2008-MTC) para reducir gradualmente el consumo de este combustible y hacer más eficiente el uso de los hidrocarburos, promoviendo la renovación del parque automotor por el de vehículos ligeros nuevos que consuman gasolina y/o GNV. En el Perú, el "chatarreo" es el retiro de vehículos del parque automotor para su destrucción. Por otro lado, se aprobó el Registro de Vendedores de Vehículos Nuevos para la Renovación del Parque Automotor (Decreto Supremo N° 023-2008-EM) creando un registro para los vendedores de autos nuevos y haciendo efectivo el incentivo económico.

En la actualidad se viene implementando el programa de chatarreo para los vehículos de transporte público.

Requisitos y procedimiento según Protransporte

El Instituto Metropolitano Protransporte de Lima, de la Municipalidad Metropolitana de Lima, ha puesto en marcha –el Programa de Chatarreo de Unidades de Transporte Publico.

El objetivo del Programa de Chatarreo es reducir gradualmente el excedente de unidades vehiculares en Lima Metropolitana, a efecto de promover la sustitución de unidades de menor capacidad, por unidades de mayor capacidad, y contribuir con la reducción del nivel de emisiones contaminantes provenientes de los vehículos antiguos de transporte publico.

Para la primera etapa, se ha dispuesto de un fondo aproximado de US$6.1 millones, que ha sido constituido con recursos aportados por los actuales operadores del Metropolitano dando cumplimiento a sus contratos de concesión.

Los propietarios de unidades vehiculares que presten el servicio de transporte público podrán acogerse libre y voluntariamente al programa. Para ello, los propietarios interesados deberán acreditar operar en rutas de transporte público que circulan o circulaban en el área de influencia del Metropolitano, contando para este fin con Tarjeta de Circulación emitida por la Gerencia de Transporte Urbano de la Municipalidad Metropolitana de Lima.

Requisitos para ingresar al Programa:

a) Condiciones de los vehículos

- Estar habilitados para prestar servicio de transporte en la jurisdicción de Lima Metropolitana, para lo cual deberán contar con la Tarjeta de Circulación emitida por la Gerencia de Transporte Urbano de la Municipalidad Metropolitana de Lima
- Corresponder a las categorías de Camioneta Rural, Microbús u Omnibus
- Tener más de veinte (20) anos de antigüedad, contados a partir del 01 de enero del ano siguiente al de su fabricación

- No estar afecto a cargas, gravámenes o medidas judiciales que limiten o restrinjan el ejercicio al derecho de libre disposición del vehículo
- No tener multas ni papeletas
- El número de motor y del chasis deben corresponder a lo señalado en la Tarjeta de Identificación o Propiedad Vehicular

b) Requisitos documentarios requeridos

Etapa Preliminar: consiste en la presentación de documentación básica que todo transportista cuenta para su operación diaria.

- Llenar el formulario-solicitud debidamente suscrito por el propietario o propietarios del vehículo materia de chatarreo
- Copia simple del DNI del propietario o de los propietarios
- Si es persona jurídica, deberá presentarse la vigencia de poderes de la persona natural facultada para disponer del vehículo
- Copia simple de la Tarjeta de Circulación emitida por la GTU de la MML
- Copia simple de la Tarjeta de Propiedad o de Identificación Vehicular emitida por la SUNARP
- Copia simple del último Certificado de Inspección Técnica Vehicular o del último Informe de Inspección Técnica Vehicular, según corresponda
- Copia simple del Certificado SOAT o CAT vigente, según sea el caso
- Etapa Final: consiste en la presentación de 02 certificados adicionales que se solicitaran luego de la evaluación de la Etapa Preliminar
- Original del Certificado Negativo de Gravamen Vehicular, emitido por la SUNARP con una antigüedad no mayor de quince (15) días
- Original del Certificado Policial de Identificación Vehicular emitido por la DIROVE, y con una antigüedad no mayor de quince (15) días
- Declaración jurada del propietario en el sentido que el vehículo no tiene gravámenes o cargas no registrados

Incentivo Económico:

Los montos correspondientes al incentivo económico se entregan en función a la antigüedad y tipo del vehículo; y es de libre disponibilidad.

Tabla 15 - Montos estipulados

Tipo de vehículo	Antigüedad	Certificado de chatarreo (US$)
Camioneta rural (de 10 a16 asientos	De 20 a 24 años	5000
	De 25 a más años	4000
Microbús (de 17 a33 asientos)	De 20 a 24 años	7500
	De 25 a más años	6000
Ómnibus (de 34 asientos a más)	De 20 a 24 años	10000
	De 25 a más años	8000

El fondo inicial de US$6´100,000, que están en custodia de la Corporación Financiera de Desarrollo (COFIDE) permitirá sacar de circulación aproximadamente una 1000 unidades de transponerte publico, quedando pendiente definir un plan de chatarreo para vehículos particulares y taxis.

2.5.4 Régimen tributario aplicable a combustibles y su impacto en la generación de GEI

La decisión de rebajar los impuesto y el IGV (este ultimo a 10%) para la compra de vehículos nuevos que tengan encendido por chispa y máximo 08 asientos (sólo a gasolina), para ser convertidos a gas natural, representa una medida que contribuirá a la disminución de emisiones de GEI. Asimismo, la modificación en la aplicación del ISC de acuerdo a su impacto en la contaminación, incentiva el consumo de combustibles más limpios, al gravar con mayor ISC a los combustibles que más contaminación generan (Ley N° 28694 y Decreto Supremo N° 211-2007-EF); aunque en los cálculos de los índices de nocividad no se incluyen los GEI reconocidos por el Protocolo de Kioto, la norma tendrá un impacto indirecto positivo en la reducción de emisiones de GEI pues genera desincentivos al uso de combustibles más contaminantes a través de la imposición de sobrecostos.

2.5.5 Medidas Nacionales Apropiadas de Mitigación (NAMAs) en el Sector Transporte

A ser coordinadas con el Ministerio de Transportes y Comunicaciones y el MINAM, estarían enfocadas a controlar las emisiones del sector transporte, especialmente terrestre (94% de emisiones), compuesto por un parque automotor en promedio mayor a 15 años, con escaso mantenimiento y/o consumidor de diesel (60%). En tal sentido, estas NAMA deberían contemplar incentivos para la renovación del parque automotor, eficacia de mecanismos de inspección (para evitar conflictos), promoción del uso del gas natural, mejora de la calidad de los combustibles y de la tecnología de los vehículos, así como el ordenamiento en el transporte y la circulación terrestre. En particular, en el sector transporte se identificaron las siguientes medidas:

- Medida 1. Modernización del parque automotor con una antigüedad no mayor a 10 años
- Medida 2. Optimizar la eficiencia en el sistema de transporte público
- Medida 3 Promover que el 5% del parque automotor sea hibrido (gasolina/electricidad)
- Medida 4. Hacer eficiente el sistema de transporte carretero nacional
- Medida 5. Promover la conducción eficiente de vehículos

Tabla 16 - Proyección de la reducción de emisiones de CO_2 para el sector transporte[43]

Transporte	Con medida	Sin medida
Modernización del parque automotor no mayor de 10 años (al 2012)	11´879,898	7´542,383
Eficiencia sistema transporte público por día (al 2012)	11,979	10,218
5% del parque automotor híbrido (al 2012)	10´168,540	9´187,125
Eficiente transporte carretero nacional (al 2017)	2´293,612	1´803,645
Conducción eficiente de vehículos (10% de ahorro de energía en 5 años)	Reducción de 3´000,000 tCO_2/05años	

Medida 1: Al año 2012 lograr la modernización del parque automotor con una antigüedad no mayor a 10 años

En el sector transporte, se ha observado que es el que mayores emisiones de GEI genera y que más ha crecido respecto a su nivel de emisiones de 1994. La principal causa de que el sector trasporte sea el mayor emisor de GEI es la baja renovación del parque automotor. En base al inventario nacional de emisiones del 2000 se tiene que los vehículos en el Perú se encuentren entre 10 a 15 años de antigüedad, los cuales originando menor rendimiento, mayor consumo de combustible y mayor generación de GEI.

Sin embargo, conocido esto, no se están realizando acciones que lleven a renovar el parque automotor, al contrario en diciembre del 2008 se amplió el plazo de funcionamiento del CETICOS-Tacna, hasta el 31 de diciembre del 2010; los cuales tienen beneficios tributarios para la importación de vehículos usados, en desmedro de la importación de vehículos nuevos.

Otra acción que debe implementarse de manera que se garantice la real renovación del parque automotor es la eliminación de los vehículos antiguos y obsoletos. Esto puede dinamizarse a través del Bono de Chatarreo, el cual es un instrumento financiero que permitirá el retiro de los vehículos antiguos del mercado automotor y adquirir autos nuevos que puedan ser convertidos al uso del gas natural vehicular (GNV). Este mecanismo cuenta con un fondo US$ 50 millones. Con la aplicación de esta actividad se logrará eliminar las unidades antiguas del parque automotor.

Asimismo, debiera analizarse la pertinencia de la creación de fondos para acceder a créditos vehiculares con tasas preferenciales, ya que actualmente los créditos resultan no muy convenientes, y prefieren permanecer con su mismo auto o adquirir autos usados.

Se calculó las emisiones por tecnología para vehículos y así demostrar cuánta es la reducción de emisiones; se ha contemplado el comportamiento de las emisión de un vehículo antiguo y uno nuevo, "Sin Medida" el parque automotor tiene una antigüedad mayor a 10 años, por lo que se considera CO_2, N_2O y CH_4 los factores de emisión[44] 399, 2.04 y 0.15 g/Km, respectivamente. Para un escenario "Con Medida" donde el parque automotor ha sido modernizado y en promedio la antigüedad de los autos ya cuenta con convertidor catalítico se considera para CO_2, N_2O y CH_4 los factores de emisión 254, 066, 0.05 g/Km, respectivamente. Se tendrá una reducción de 2'292,286 g GEI por auto al año (para mayor detalle ver Tabla 17).

[43] *Fuente: Segunda Comunicación Nacional del Perú a la Convención Marco de las naciones Unidas sobre Cambio Climático*

[44] *Air Pollution 1996, The World Bank*

Tabla 17 - Cálculo de reducción de emisiones GEI para un auto en un año[45]

Escenario	Recorrido promedio	CO_2		N_2O		CH_4		Total emisión
		Factor emisión	Emisión CO_2	Factor emisión	Emisión CO_2	Factor emisión	Emisión CO_2	
	Km/auto/año	g/Km	g	g/Km	g	g/Km	g	GEI (g)
Sin medida	15649.14	399	6244008	2.04	31924	0.15	2347	6278280
Con medida	15649.14	254	3974882	0.66	10328	0.05	782	3985983
Reducción (g GEI por auto al año)								**2292287**

Para el año 2012 se proyecta que el parque automotor estará compuesto de 1´892,222[46] autos a nivel nacional, los cuales reducirían 4'337,514 toneladas de GEI al año.

Medida 2: Al año 2012 optimizar la eficiencia en el sistema de transporte público

El Transporte público en el Perú es deficiente y de muy baja calidad, lo cual origina que los GEI se generen prácticamente sin ningún control. Actualmente el *Modo de Uso* de la población sobre el transporte público nacional está repartido básicamente entre las Combis (44.5%), Custer (36%) y Buses (19.5%)[47]con un 50 Km de recorrido promedio por ruta.

La medida propuesta busca establecer criterios para adjudicar rutas de transporte público, como el óptimo estado de las unidades; así como establecer límites en la antigüedad de los vehículos, tipo de combustible a usar, capacidad de carga de pasajeros de cada unidad, frecuencia de circulación adecuada a las horas de mayor flujo de pasajeros; de modo que se tenga un servicio de transporte seguro, ordenado y haciendo uso óptimo del combustible, permitiendo en consecuencia la reducción de GEI.

Las adquisiciones vehiculares del estado hasta el momento no se basan en criterios técnicos que resulten menos contaminantes, por ello se puede ver en las calles de Lima, vehículos 4x4 o 4x2 de las municipalidades y de la PNP, los cuales tienen alto consumo de combustible y su utilidad en la ciudad es innecesaria.

Se debiera promover, en particular en el sector público, la adquisición de vehículos que usen combustibles limpios como el gas y que asimismo se encuentren dentro de los parámetros técnicos que aseguren un buen funcionamiento, optimizando combustible y con las menores emisiones al ambiente. Establecer con la legislación peruana que para realizar adquisiciones públicas de vehículos, en las bases se incluyan criterios como: rendimiento, emisiones, entre otros asociados.

Para cuantificar las reducciones de las emisiones GEI se estableció que para el año 2012 la participación de los buses aumentaría, ya que tienen mayor capacidad para transportar a los pasajeros, la distribución del *Modo de Uso* de los ciudadanos según tipos de vehículos de transporte público serían: Combi (14.50%), Custer (6%) y Buses (79.50%).

En un escenario "Sin Medida" se generaría 11,979.70 toneladas de CO_2 al día, pero implementando la medida en un día se estaría generando 10218.07 toneladas de CO_2, reduciendo 1761.63 Toneladas de CO_2 diarios

[45] *Fuente: Segunda Comunicación Nacional del Perú a la Convención Marco de las naciones Unidas sobre Cambio Climático*

[46] *MINEM Proyecciones de Variables Socioeconómicas y Energéticas*

[47] *Plan Maestro de Transporte Urbano para el Área Metropolitana de Lima y Callao en la República del Perú*

Medida 3: Al 2012 el 5% del parque automotor es híbrido (gasolina/electricidad), diversificando la Matriz Energética.

Actualmente es posible acceder a vehículos con rendimientos bastante altos producto de la tecnología de fabricación de los motores de combustión interna súper eficientes, e incluso la combinación de éstos con motores eléctricos que logran rendimientos por encima de los 80 km/galón de gasolina.

Reducir emisiones de GEI en el transporte también es posible de contar con mayor número de vehículos de este tipo, sobre todo en ciudades como Lima donde la contaminación del aire está alcanzando niveles alarmantes.

Estas tecnologías debieran tener ciertos beneficios e incentivos para ingresar a nuestro país, por ejemplo liberar de ciertos impuestos a la importación, ya que esto implicaría la reducción de emisiones de GEI.

La introducción de vehículos híbridos en nuestro país generaría reducciones significativas de GEI. Como ejemplo podemos mencionar que de lograr que sólo el 5% del parque automotor sean vehículos híbridos se reduciría 981,414 toneladas de CO_2. Para esto se considera que en el escenario "Sin Medidas" para el año 2012 ya se ha implementado las medidas demodernización del parque automotor y las emisiones hayan disminuido a un factor de emisión de 254 g CO_2/Km[48] promedio.

Medida 4: Al año 2017 hacer eficiente el sistema de transporte carretero nacional

Actualmente muchas de las carreteras que interconectan a los principales destinos nacionales se ven congestionadas, ocasionando retrasos en los viajes, accidentes, etc. Hacer eficiente el sistema de transporte carretero a nivel nacional lograría una reducción en los tiempos de viaje, con la consecuente reducción en el consumo de combustible. Mejorar la eficiencia de las carreteras implicaría la ampliación de carriles, lo que lograría hacer más fluido el tránsito y a su vez mejorar la eficiencia de los vehículos.

Para el caso urbano, se debe promover que los municipios realicen proyectos que mejoren la gestión del tránsito, a través de por ejemplo, la instalación de semáforos inteligentes. Un gran porcentaje de los semáforos del Perú tienen una antigüedad entre 20 a 30 años, creando caos en el tráfico por la mala sincronización y a su vez mayor producción de GEI.

La eficiencia del sistema de transporte carretero ha sido cuantificada utilizando datos de recorridos promedios anuales considerando el porcentaje en que se usa las carreteras según el tipo de vehículo; en un escenario "Sin Medida" cada vehículo en la carretera emiten 189.54 g/Km[49], para el año 2017 se proyecta que existirán 2'383,970 vehículos que generarían 2'293,612 Toneladas de CO_2, mientras que en el escenario "Con Medida" donde el sistema carretero nacional es más eficiente, cada vehículo emite 149.05 g/Km y un total de 1'803,645, que representaría una reducción anual de 489,967 Toneladas de CO_2.

[48] *Air Pollution 1996, The World Bank*

[49] *Air pollution from motor vehicles*

Medida 5: Promover la conducción eficiente de vehículos

Una de las formas más rentables para que un vehículo ahorre combustible es a través de una operación eficiente, que contemple tanto el conocimiento de la tecnología automotriz que se utiliza, como la puesta en práctica de una serie de recomendaciones sencillas dirigidas primordialmente al operador de la unidad.

La mayoría de los conductores en Perú carece de instrucción suficiente para operar esa tecnología en forma adecuada. Por ello en los años 1996 -2000 el Proyecto de Ahorro de Energía (PAE) en coordinación con la Municipalidad de Lima y en particular con el Servicio de Taxi Metropolitano SETAME, realizaron una campaña de capacitación a los conductores de las unidades de servicio de taxis como de las empresas de transportes de pasajeros sobre el tema de conducción eficiente, la que iba en paralelo con las gestiones ante el Ministerio de Transporte, para que se introdujera en los exámenes de otorgamiento de licencia de conducir, el tema de eficiencia energética. Dicha capacitación sólo se realizó en el periodo mencionado, debido a que el PAE dejo de operar. En ese sentido al tenerse ya una experiencia en el tema de capacitación de eficiencia en la conducción de vehículos, esta medida sería factible de aplicarse a nivel nacional, con altas probabilidades de obtener los ahorros de energía estimados ya que en otros países fue un éxito.

Para cuantificar la medida propuesta se ha utilizado los cálculos del Plan de Eficiencia Energética 2009 - 2018, con lo que se determina que la medida planteada permitiría obtener un 10% de ahorro de energía en un periodo de cinco años, dejando así de emitir al ambiente unos 3 millones de toneladas de CO_2 en dicho periodo. En la Tabla 18 se señalan las estimaciones en el periodo de 05 años que permitieron al sector energía establecer el nivel de reducción en 3¨000,000 toneladas de CO_2.

Tabla 18 . Ahorro de energía en sector transporte[50]

Criterio de ahorro/reducción	2009	2010	2011	2012	2013
Ahorro energía por conducción eficiente (TJ/año)	1.2	2.4	3.8	5.2	6.8
Ahorros por restricción vehicular 1 día/semana (TJ/año)	3.7	3.9	4.1	4.3	4.4
Total ahorro de energía (TJ/año)	4.9	6.3	7.8	9.5	11.2
Ahorro económico por conducción eficiente (x 10^6 US$)	28	59	92	128	167
Ahorro económico por restricción vehicular 1 día/semana (x 10^6 US$)	96	99	104	109	113
Total ahorro económico (x 10^6 US$)	124	158	196	237	280
Reducción emisiones por conducción eficiente (TM CO_2/año)	81651	169841	266615	371290	482731
Reducción emisiones por restricción vehicular 1 día/semana (TM CO_2/año)	265570	276205	289055	301906	314017
Total reducción emisiones (TM CO_2/año)	347222	446047	555670	673195	796748

Criterio de ahorro/reducción	2014	2015	2016	2017	2018
Ahorro energía por conducción eficiente (TJ/año)	8.5	10.2	12.2	14.3	16.4
Ahorros por restricción vehicular 1 día/semana (TJ/año)	4.6	4.8	5.0	5.2	5.3
Total ahorro de energía (TJ/año)	13.1	15.0	17.2	19.4	21.8
Ahorro económico por conducción eficiente (x 10^6 US$)	208	251	299	350	402
Ahorro económico por restricción vehicular 1 día/semana (x 10^6 US$)	117	121	127	132	136
Total ahorro económico (x 10^6 US$)	325	372	425	481	539
Reducción emisiones por conducción eficiente (TM CO_2/año)	601620	726685	865737	1012373	1165730
Reducción emisiones por restricción vehicular 1 día/semana (TM CO_2/año)	326129	337650	351977	365861	379154
Total reducción emisiones (TM CO_2/año)	927749	1064335	1217714	1378234	1544884

Como se puede ver la medida con mayor impacto en la reducción de emisiones de CO_2 es la modernización del parque automotor, que incluye una propuesta de vehículos híbridos que calzan dentro de la misma lógica.

[50] *Fuente: Informe Final Opciones de mitigación de emisiones de GEI de los sectores Energía, Industria y Transporte a Nivel Nacional y Regional*

3. EFICIENCIA ENERGÉTICA EN VEHÍCULOS PARA PASAJEROS

3.1 Definición

La eficiencia energética en vehículos se define como la relación entre las energías consumidas y el volumen o cantidad producida o movilizada. La eficiencia energética implica poder realizar el mismo trabajo, con igual o menos energía mediante la reducción de las pérdidas de energía y el aumento del rendimiento energético, es decir: el trabajo que se obtiene, para la misma energía consumida.

Debido al progresivo aumento del costo, tanto de los combustibles como de la energía eléctrica, de la dependencia de los combustibles fósiles y de la demanda creciente de energía, poco a poco, las empresas están empezando a tomar conciencia de la relevancia de la eficiencia energética.

Las regulaciones pueden basarse en la economía de combustible, emisiones de dióxido de carbono o emisiones de GEI, por ejemplo, algunos de los indicadores ampliamente usados son los siguientes:

- Gramos de CO_2 / kilometro recorrido
- Gramos de CO_2 / potencia desarrollada (KW)
- Kilómetro recorrido / litro de combustible consumido (o su equivalente en galones)

Los estándares de CO_2 (g/Km) pueden convertirse a estándares de economía de combustible (Km/L) dividiendo el contenido el carbón del combustible por la economía del combustible. Los diferentes combustibles presentan distintos contenidos de carbono, por ejemplo, el diesel tiene un contenido de carbono mayor en 12% a 15% con relación a la gasolina. Los estándares de gases de efecto invernadero, también conocidos como estándares de dióxido de carbono equivalente (CO_2eq), incluyen emisiones diferentes al CO_2 de acuerdo a sus factores de potencial de calentamiento global: 01 para dióxido de carbono (CO_2); 23 para metano (CH_4) y 296 para óxidos nitrosos (N_2O). Las emisiones de gases de efecto invernadero proveniente de hidrofluorocarbonos (HFC) provenientes de sistemas de aire acondicionado están incluidas en las normas de la Unión Europea y los Estados Unidos, basado en nuevas tecnologías que brindan reducción de emisiones en ciclo apagado.

3.2 Terminología

A continuación se incluye una lista de definiciones relacionadas a la eficiencia energética en vehículos para pasajeros, las que se basan en el documento de propuesta de reglamento para el establecimiento de normas de comportamiento en materia de emisiones de los vehículos, como parte del enfoque integrado de la comunidad para reducir las emisiones de CO_2 de los vehículos ligeros, preparado por la Comisión de la Comunidad Europea.

- Certificado de conformidad: registro por el que consta que un tipo de vehículo se ajusta a las disposiciones técnicas de las directivas específicas y ha pasado los controles previstos.
- Certificado de conformidad CE: documento que expide el titular de la homologación deltipo de vehículo, acreditativo de que es conforme con la homologación CE (Comunidad Europea)
- Consumo oficial de combustible: consumo de combustible homologado por la autoridad responsable de la homologación, el que se adjunta al certificado de homologación o figura en el certificado de conformidad. En caso de que se agrupen en un modelo distintas variantes o versiones, el valor dado al consumo de combustible del modelo se basará en la variante o versión que tenga el consumo oficial de combustible más elevado dentro del grupo
- Emisiones específicas de CO_2: emisiones de un vehículo ligero medidas de conformidad con el Reglamento (CE) N° 715/2007 y descritas como emisión másica de CO_2 (combinada) en el certificado de conformidad
- Etiqueta de consumo de combustible: etiqueta que contiene información dirigida al consumidor relacionada con el consumo oficial de combustible y las emisiones oficiales específicas de CO_2 del vehículo al que acompaña
- Fabricante: persona u organismo responsable ante las autoridades de homologar todos los aspectos relacionados al procedimiento de homologación de tipo CE y de garantizar la conformidad de la producción
- Guía de consumo de combustible: recopilación de los datos oficiales de consumo de combustible y emisiones oficiales específicas de CO_2 para cada modelo disponible en el mercado de vehículos nuevos
- Homologación de tipo CE: el acto por el cual un Estado miembro de la Unión Europea hace constar que un tipo de vehículo se ajusta a las prescripciones técnicas establecidas en las directivas específicas y ha pasado los controles y comprobaciones previstos en los correspondientes certificados de homologación de tipo CE
- Impresos de promoción: impresos utilizados para la comercialización, publicidad y promoción de vehículos entre el público en general. Este concepto abarca, como mínimo, manuales técnicos, folletos, anuncios en periódicos, revistas, prensa especializada y carteles
- Marca: denominación comercial del fabricante que aparece en el certificado de conformidad y en los documentos de homologación
- Masa: masa del vehículo con carrocería y, en caso de vehículo tractor no perteneciente a la categoría M1, con dispositivo de enganche, si lo ha instalado el fabricante, en orden de marcha, o masa del bastidor o del bastidor con cabina, sin carrocería ni dispositivo de enganche si el fabricante no los instala (incluidos líquidos, herramientas y rueda de repuesto, si están instalados, el conductor y, en caso de autobuses y autos, un miembro de la tripulación si el vehículo dispone de un asiento para él)
- Modelo: descripción comercial de la marca, tipo y, en este caso, variante y versión del vehículo ligero
- Objetivo de emisiones específicas: valor medio de las emisiones específicas de CO_2 autorizadas respecto al vehículo para pasajeros nuevo que haya fabricado
- Punto de venta: lugar (local de exposición de automóviles o un espacio abierto) en el que se expongan vehículos para pasajeros nuevos o se ofrezcan a la venta o

en arrendamiento financiero. Se incluyen en la definición las ferias comerciales, donde se presenten vehículos nuevos

- Tipo, variante y versión: los vehículos diferenciados de una marca determinada declarados por el fabricante, conforme se define en el anexo II B (modelo de certificado de homologación relativo a un vehículo de motor) de la Directiva 70/156/CEE, e identificados distintivamente por caracteres alfanuméricos de tipo, variante y versión
- Vehículo ligero: cualquier vehículo de motor de la categoría M1 definido en el reglamento nacional de vehículos
- Vehículo ligero nuevo: cualquier automóvil de pasajeros que no se haya vendido previamente a una persona que lo haya comprado con una finalidad que no sea la de venderlo o suministrarlo

3.3 Comparación de diferentes enfoques a nivel mundial

En la Unión Europea, el promedio de la nueva economía de combustible del vehículo se ajusta para alcanzar 19 kilómetros por litro (45 millas por galón) (147 gr/CO_2 Km en vehículos a gasolina y 164 gr/CO_2 Km en vehículos a diesel) y seguirá reduciéndose, en respuesta a las regulaciones que establecen un objetivo final de 120 gramos de CO_2 / kilómetro recorrido. Las normas de carácter estricto son más fáciles de cumplir en Europa debido a los altos impuestos al combustible y el predominio de los vehículos pequeños más eficientes en combustible (a motor diesel) lo que implica una mayor economía con base en el combustible. A diferencia de los Estados Unidos, que tiene normas separadas para automóviles y camiones, la Unión Europea tiene una serie de regulaciones para toda la flota ligera, pero la denominada curva de valor límite permite a los vehículos más pesados generar emisiones superiores comparado con los vehículos más ligeros, mientras el valor promedio de dichas emisiones se preserve para el total de la flota. Las sanciones de la Unión Europeas por incumplimiento se aplicarán en una escala móvil hasta el 2018 como parte de la introducción gradual de la nueva normativa, con penalidades bajas de 5 € para el primer gramo por kilómetro que se exceda de la norma, aumentando hasta € 95 para el cuarto gramo por kilómetro y en mayor cantidad para el caso de valores excedentes de emisiones mucho mayores.

China ha fijado estándares máximos de consumo de combustible para cada vehículo en base al peso en lugar de estándares para la flota promedio, en tanto, Japón ha establecido diferentes estándares de eficiencia de combustible para los vehículos a diesel y gasolina, diferenciados por categoría de peso; si bien los objetivos son obligatorios, el cumplimiento parece depender en gran medida de las presiones sociales, pues las sanciones monetarias son bajas. Canadá por su parte, ha amoldado sus normas de economía de combustible en base a las de los Estados Unidos, aunque la regulación es de carácter voluntario.

Los programas se están volviendo más flexibles en otros países, se observa el movimiento hacia la base de las normas en base al peso. La Unión Europea también permite a los fabricantes cumplir en forma conjunta con la norma de emisiones con respecto al peso,

poniendo en común sus objetivos; asimismo, Japón permite a los fabricantes acumular créditos en una categoría de peso para su uso en otra.

3.3.1 Comunidad Europea

Una breve historia de los vehículos de la UE y la política de emisiones de CO_2

El objetivo de la UE para reducir las emisiones medias de vehículos nuevos a 120 g CO_2/Km fue propuesta por primera vez por Alemania en una reunión de ministros europeos de Medio Ambiente en octubre de 1994. Se presentó como meta reducir el consumo de combustible de los vehículos nuevos a gasolina a 5 litros por 100 Km y para los vehículos nuevos a diesel a 4,5 litros por 100 Km. El objetivo fue anunciado formalmente en una comunicación de 1995 de la Comisión Europea (COM (95) 689), y representaba una reducción del 35% con respecto al nivel de 1995 de 186 g CO_2/Km.

Originalmente la fecha límite se fijó para 2005, pero antes de que fuera jurídicamente vinculante, el objetivo fue pospuesta o debilitado en cuatro ocasiones. El primer aplazamiento se produjo en 1996 cuando el Consejo de Medio Ambiente introdujo el término *para el año 2005 o 2010 a más tardar*. El segundo aplazamiento se produjo en 1998 cuando la Asociación de Fabricantes Europeos de Automóviles (ACEA) se comprometió con la UE a reducir las emisiones promedio de CO_2 de los automóviles nuevos vendidos en la UE a 140 g CO_2/Km para el 2008. La Comisión acordó posponer la fecha límite para el cumplimiento de la meta de 120 g CO_2/Km para el 2012. El tercer debilitamiento fue en diciembre de 2007, cuando la Comisión Europea propuso cambiar el objetivo para 2012 de 120 a 130 g CO_2/Km. La Comisión dijo que los 10 g CO_2/Km deberían ser asumidos por el automóviles no relacionados con las medidas como el uso de biocombustibles, los neumáticos y por la reducción de emisiones en vehículos. El cuarto debilitamiento tuvo lugar cuando la ley se aprobó finalmente en diciembre de 2008, pues dicha ley también aplazó el cumplimiento de 130 g CO_2/Km en el 2012 al 2015, y añadió varios vacíos que incluso permitirían una flota promedio de emisiones de CO_2 de aproximadamente 140 g/Km sin ser sancionada.

En total, todas estas medidas han dado lugar a un retraso de 10 años y un debilitamiento de la meta en aproximadamente 20 g/Km (15%). Por el lado positivo, la ley ahora aprobada ofrece un marco jurídicamente vinculante, incluidas las sanciones, para hacer frente a las emisiones de CO_2 de los automóviles. Significativamente, también añade una meta de 95 g CO_2/Km para el 2020.

La legislación 130 g CO_2/Km y de destino

La ley del 2009 nominalmente se esfuerza por reducir las emisiones promedio de CO_2 de los vehículos nuevos a 130 g CO_2/Km en 2015 (aproximadamente 5.6 litros por 100 Km para vehículos a gasolina y 5,0 litros por 100 Km para vehículos a diesel). Es decir, 18% por debajo del promedio para 2007 y 7% por debajo del promedio para 2010.

Para el periodo 2012-2014, la llamada "fase" está prevista, en la que el 65% (al año 2012), 75% (al año 2013) y 80% (al año 2014) de los vehículos de cada fabricante tendrán que cumplir. Los fabricantes de automóviles son libres de elegir los vehículos de cumplimiento

y, por lo tanto, dejar de lado los vehículos más lejos de la meta, es decir, los grandes consumidores de gasolina como los SUV. El efecto es un aplazamiento de la meta de 130 g CO_2/Km al año 2015. Significativamente, la ley añade 95 g CO_2/Km para el 2020, los mecanismos y los aspectos de aplicación tendrán que ser revisadas por la Comisión en enero de 2013. El objetivo es un promedio para todos los automóviles vendidos, no un límite fijo que ningún vehículo puede exceder.

Los fabricantes pueden promediar las emisiones de CO_2 de todos los vehículos que venden, los objetivos para los fabricantes individuales se diferencian sobre la base del peso de los vehículos que producen en el año objetivo. Por ejemplo, si los vehículos de un fabricante para el 2015 son 100 kg más pesado que la media del sector, se les permite 4,6 g/Km de CO_2 por encima del objetivo (134,6 en lugar de 130 g/Km de CO_2 en promedio). Por el contrario, si sus vehículos son más ligeros que el promedio obtienen una meta más difícil.

Los fabricantes también pueden solicitar el cumplimiento conjunto con otros fabricantes, con el fin de hacer un promedio de sus emisiones en un mayor número de vehículos. Este mecanismo de flexibilidad que se llama "fondo común".

La aplicación se llevará a cabo a través de un sistema de multas. Por cada g/Km que un fabricante supere su objetivo como empresa, en principio, tiene que pagar una multa de € 95 por vehículo vendido. La ley también incluye varios vacíos:

- Hasta 7 g/Km para los créditos por "eco-innovaciones ', fuera de ciclo de créditos de CO_2 no medidos que pueden ser intercambiados para la reducción de medición en el ciclo de prueba oficial

- Súper créditos para vehículos con emisiones muy bajas, que permiten a los fabricantes contar cada vehículo de bajas emisiones, como más de un vehículo y por lo tanto haría que se reduzcan las emisiones totales de CO_2 porque se basan en los promedios de la flota

- Sanciones mucho más leves por no cumplir el objetivo en unos cuantos gramos (hasta el año 2018). Las sanciones por el primer, segundo y tercero gramo/ Km por encima del objetivo son sólo € 5, 15 y 25 por g/Km, respectivamente, en lugar de € 95

- Excepciones para los fabricantes de automóviles con ventas entre 10,000 y 300,000 en la Unión Europea. Pueden aplicar un objetivo predeterminado de una reducción del 25% en comparación con el 2007 (Tata, el dueño de Jaguar/Land Rover, es un candidato probable, así como algunas marcas japonesas como Mazda y Suzuki que podrían también aplicar)

- Excepciones para los fabricantes de automóviles con menos de 10,000 ventas en la Unión Europea, que pueden negociar su propio objetivo con la Comisión

Todos estos vacíos implicarían que la meta para el año 2015 es cercana a 140 g CO_2/Km, en lugar de 130 g/Km.

Progreso de los grandes fabricantes de automóviles de Europa para reducir el CO_2

- La industria en su conjunto redujo un promedio de emisiones de CO_2 de 3.7% el año pasado, siguiendo la tendencia de reducciones mucho más rápidas desde la adopción de objetivos obligatorios de CO_2 de la Unión Europea para los vehículos. La industria alcanzó un promedio de emisiones de CO_2 de 140 g CO_2/Km

- El progreso fue más parejo para todos los fabricantes de automóviles, los ocho más grandes fabricantes de automóviles de Europa redujeron CO_2 en no menos del 2% de la media de acuerdo a sus ventas, es decir, entre el 2% y el 6%. La empresa Volvo fue una de las que redujo 9%, en tanto Mazda y Honda obtuvieron valores extremos negativos, con pequeños incrementos en las emisiones
- Los cuatro primeros en términos de promedio de emisiones de CO_2 por flota se mantienen sin cambios. Fiat lidera con 126 g CO_2/Km, seguida de Toyota, PSA y Renault. Daimler sigue siendo último en la lista, después de haber reducido emisiones de CO_2 en 2010 3% por debajo de su media
- La industria en su conjunto está sólo a 7% de distancia de alcanzar su objetivo de 130 g CO_2/Km para el año 2015, el año pasado presenta una brecha de 11% por cerrar
- Toyota está nuevamente cerca de alcanzar los objetivos de regulación de CO_2, la empresa está prácticamente a punto de lograrlo, cinco años antes de tiempo. PSA y Fiat están muy cerca también con 3% y 5% menos respectivamente. Daimler está aún alejado con un vacío del 15% aún por cerrar
- Las cifras de distancia al objetivo no permiten vacíos como eco-innovaciones, súper créditos y provisiones para los fabricantes de automóviles por debajo de 300,000 ventas. Los fabricantes de automóviles están por lo tanto, aún más cerca de cumplir los objetivos que estas cifras sugieren
- Todas las pruebas disponibles apuntan a que los fabricantes de automóviles en Europa se dirigen al sobre cumplimiento de la regulación de CO_2 y por lo tanto están a puertas de alcanzar los 130 g CO_2/Km al año 2015, tras varios años de avance.

Costos de cumplimiento

Los estudios realizados diez y cinco años atrás predijeron que la reducción de las emisiones de CO_2 de los automóviles nuevos a un nivel medio de 140 g CO_2/Km implicaría un aumento en el precio de € 2400 y € 1.200, tomando como referencia las líneas de base del 1995 y 2002 respectivamente; esto implica que los estudios estimaron los costos marginales de uno por ciento de reducción de emisiones de CO_2 hacia la meta de 140 g CO_2/Km, lo que es aproximadamente el 0,5% del precio de venta de un vehículo. Durante los últimos ocho años se observó que los vehículos nuevos son 13% más económicos, lo que significa que un vehículo a € 20,000 en el 2003 se vende actualmente a € 17,400.

Probablemente es coincidencia que los precios de automóviles hayan caído más rápidamente desde que se iniciaron las reducciones de emisiones de CO_2, de un promedio anual de 0,7% para el período 2002-2006 pasaron a un promedio anual de 2,4% para el período 2007-2010. Cabe señalar la compleja serie de factores que componen el precio de venta de un vehículo y que los costos de cumplimiento normativo es sólo uno de estos factores, sin embargo, el análisis muestra que los temores de que la reducción de las emisiones de CO_2 haría que los vehículos estuvieran fuera del alcance el comprador han sido infundados.

Además, la ausencia de cualquier relación entre la reducción del CO_2 y el aumento de los precios al por menor (si acaso se encontrara una relación inversa) y la importancia de las cifras de costos estimados (todos los porcentajes de reducción de CO_2 costarían alrededor del 0,5% del precio de venta de un vehículo) sugieren que los costos para reducir las emisiones de CO_2 a un promedio de 140 g CO_2/Km fueron considerablemente sobrestimados. Sobre las consecuencias de la aplicación de una norma basada en los estándares de CO_2

Transport & Environment (T&E) ha argumentado que las normas de CO_2 basadas en el peso hace que los objetivos de reducción sean más difíciles de alcanzar debido a que desalienta la reducción de peso, si se compara con la reducción de emisiones de CO_2 pro kilómetro recorrido. Para la mayoría, en particular los fabricantes de automóviles del Grupo Volkswagen, PSA, GM, Toyota y Hyundai, el cambio estaría en el rango de 0-1%.

3.3.2 Estados Unidos

En los Estados Unidos, el consumo promedio de combustible por empresa (CAFE - Corporate Average Fuel Economy) se introdujo en 1975 con el objetivo de reducir la dependencia del petróleo extranjero. Inicialmente, el programa requirió de una flota de automóviles de vehículo para cumplir con un promedio ponderado de ventas de 18 millas por galón (MPG), criterio que aumentó progresivamente a 27,5 millas por galón en 1985; se estableció un estándar para camiones ligeros (camionetas, minivans y vehículos para uso deportivos o SUV), que en 1980 fue de 16 millas por galón y que en el 2008 pasó a 22,5 millas por galón. La razón de que esta norma fuera menor se debió a que los camiones eran utilizados principalmente por las empresas y los agricultores, aunque éste, obviamente, ya no es el caso.

Después de la ley de independencia energética y seguridad de 2007 y la acción administrativa del gobierno de Barack Obama en 2009, las normas se proyectaron a ser más estrictas entre 2011 y 2016. De hecho, actualmente existen dos reglamentos distintos: uno del Departamento de Administración de Transporte Nacional de Seguridad Vial (NHTSA[51]) cuya regulación rige la economía del combustible y una regulación de la Agencia de Protección Ambiental de los Estados Unidos (USEPA[52]) que limita las emisiones de CO_2 por kilómetro. Las normas son esencialmente equivalentes, salvo por el requisito poco estricto de la USEPA que permite a los fabricantes de automóviles obtener créditos de cumplimiento por la modificación del refrigerante del aire acondicionado para reducir los GEI. La norma de la USEPA representa un estándar de combustible medio para vehículos ligeros nuevos de 35,5 millas por galón (250 gramos de CO_2 por kilómetro) al año 2016 (sin el crédito del acondicionador de aire), en comparación con un estándar combinado que implicaría un estándar de 25 millas por galón para el año 2008. Los fabricantes de automóviles en la actualidad pagan una multa de US$ 55 por vehículo por cada milla por gramo que la flota promedio sobrepasa a la norma correspondiente, aunque presumiblemente esta multa tendrá que ser incrementada para hacer cumplir las normas más estrictas.

La estructura del programa CAFE también está siendo reformada radicalmente (algunos detalles se están ultimando). Cada vehículo se enfrentará a un objetivo de ahorro de combustible por separado en función a su tamaño o huella. Vehículos y camiones ligeros tienen diferentes funciones matemáticas que mapean las huellas de los modelos individuales dentro de los objetivos de ahorro de combustible, estos objetivos se utilizan luego para calcular las ventas y las normas ponderadas para los vehículos de cada fabricante de automóviles y la flota de camiones livianos. Otros cambios pendientes en el programa CAFE incluyen la ampliación de oportunidades para solicitar créditos de economía de combustible por parte de los fabricantes de automóviles, lo que les permitiría transferir

[51] *National Highway Traffic Safety Administration*

[52] *United States Environmental Protection Agency*

créditos entre sus vehículos y las flotas de camiones ligeros, además del intercambio de créditos entre empresas.

Una de las cuestiones que se avecina es cómo los estándares de economía de combustible pueden ser adaptados para los vehículos eléctricos y de combustible alternativo, que cada vez más se proyectan como parte de las estrategias energéticas en todo el mundo. La norma adecuada para los vehículos que usan la electricidad de la red no es tarea fácil porque requiere atribuir un cierto nivel de emisiones a la electricidad, es decir, que las emisiones dependen del combustible utilizado para generar electricidad adicional, que varía mucho según la ubicación y la hora del día. Los reguladores aún no han establecido una forma de medir el consumo real de gasolina o las emisiones de CO_2 para el caso de vehículos que utilizan combustibles alternativos. Al año 2020, los estándares CAFE cuentan con una laguna jurídica con respecto a los vehículos de combustible flexible, los que son capaces de quemar con gasolina o etanol, y que se asume utilizarán etanol el 50% del tiempo a pesar de que, en la práctica, estos vehículos rara vez utilizan el combustible en esta proporción.

Emisiones de GEI y normas de eficiencia de combustible para camiones de servicio pesado

La USEPA y el NHTSA adoptaron regulaciones para reducir GEI y mejorar la eficiencia de los combustibles en camiones de servicio pesado; las normas se aplican a modelos del año 2014-2018 como vehículos medios y pesados, desde camiones medianos hasta camiones grandes y furgonetas, así como todo tipo y tamaño de camiones de trabajo y autobuses. Para los propósitos de este programa, la flota de carga pesada incorpora todos los vehículos de carretera nominal de un peso bruto vehicular (PBV) igual o superior a 8.500 libras, incluyendo los correspondientes motores, excepto para aquellos comprendidos en las normas actuales de emisiones de GEI y en la economía de combustibles para empresas promedio (vehículos ligeros modelo 2012-2016).

La USEPA y la NHTSA han adoptado normas para las emisiones de CO_2 y consumo de combustible, para tres categorías reglamentarias principales: (1) tractores de combinación, (2) camiones pesados y furgonetas, y (3) vehículos especiales (buses escolares, vehículos de bomberos etc.).

Las normas para tractores de combinación alcanzarán de 9% a 23% de reducción de misiones y consumo de combustible (dependiendo de la clase del vehículo) de los tractores afectados sobre las líneas de base al año 2010 (se prevé que las reducciones serán alcanzadas plenamente en el año 2017). Las agencias están estableciendo estándares corporativos promedio para camionetas de trabajo pesado y furgonetas, similar al enfoque adoptado para los vehículos ligeros, pero con diferentes estándares para vehículos a gasolina y diesel. Las últimas normas de la NHTSA representan en promedio por vehículo una mejora en el consumo de combustible del 15% para los vehículos diesel y 10% para los vehículos de gasolina, en comparación con una línea de base común. Las normas para los vehículos especiales representan reducciones de emisiones de 6% a 9%, a partir de una línea de base al año 2010.

Además de las normas de CO_2, la USEPA ha adoptado normas de emisiones para N_2O y CH_4, que actúan para asegurar que los fabricantes no sobrepasen los límites de emisiones de estos gases en sus motores y así evitar a futuro un aumento significativo por encima de los niveles

bajos actualmente controlados. La USEPA también ha adoptado un estándar para fugas de refrigerante HFC de los sistemas de aire acondicionado.

Las normas para tractores (camiones con remolque) combinados y vehículos especiales incluyen tanto las emisiones basales de CO_2 de vehículos y los límites de consumo de combustible. El cumplimiento de los límites de emisiones de motores será determinado a través de pruebas del motor con dinamómetro, mientras que el cumplimiento de las normas basadas en los vehículos será determinado en base a un modelo de vehículo de simulación personalizado, denominado modelo de emisión de GEI desarrollado por la USEPA específicamente para esta regulación. En lugar de utilizar un dinamómetro de chasis como una forma indirecta de evaluar el funcionamiento y rendimiento reales, varias características del vehículo se medirán y se utilizarán como entradas para el modelo. Estas características se refieren a tecnologías clave adecuadas para esta sub categoría de camiones, incluyendo las características aerodinámicas, la reducción del peso, la resistencia a la rodadura de los neumáticos, la presencia de tecnología de reducción de marcha en vacío y limitadores de velocidad del vehículo.

Según la USEPA, los costos para la industria son pequeños y será más que compensado por el ahorro de combustible que se espera. Por ejemplo, las mejoras a un camión tractor con remolque tendrán un costo de US$ 6,220 y le ahorrará un estimado de US$ 73,000 durante la vida útil del camión. Para los camiones y furgonetas los costos adicionales podrían ser US$ 1,050 y para los vehículos profesionales sólo US$ 380. El desarrollo del programa se llevó a cabo en colaboración con Medio Ambiente de Canadá, quien realizó las pruebas de emisiones de camiones en sus instalaciones, en el marco del Comité de Calidad del Aire Canadá-Estados Unidos, Medio Ambiente de Canadá espera adoptar una economía de combustible y normas de emisiones de GEI armonizadas para los camiones.

La USEPA y la NHTSA están pensando en una próxima fase para las normas de este sector, ya que hay más oportunidades para reducir las emisiones de GEI y el uso de combustible de la flota de carga pesada para modelos de años posteriores al año 2018. Los objetivos incluyen la innovación, así como estimular la actualización de la evaluación de las emisiones y el uso de combustible de este sector. Esta futura normativa también será diseñada para alinearse con programas similares desarrollados fuera de los Estados Unidos.

3.3.3 Japón

Para alcanzar reducciones significativas de las emisiones de CO_2 en el transporte terrestre, la Asociación de Fabricantes de Automóviles de Japón (JAMA) propone la adopción de un enfoque integrado, aplicable a cuatro áreas: incremento de la eficiencia del combustible de los vehículos, diversificar los proveedores de combustible, mejorar el flujo de tráfico y el uso más eficiente de los vehículos. Estas iniciativas involucran los esfuerzos aunados tanto de los tomadores de decisiones de los sectores como de los fabricantes de vehículos, proveedores de combustible, gobierno y usuarios.

Tendencias en el desempeño de la eficiencia de los combustibles

Comprometidos a alcanzar las metas de eficiencia de combustibles a la brevedad, los fabricantes de vehículos japoneses han venido introduciendo al mercado vehículos que cumplen con las metas antes de la fecha de aplicación. De todos los vehículos para pasajeros a gasolina japoneses (2.5 toneladas o menos) vendidos en el año 2010, cerca del 96% cumplió con la referente a la categoría peso basado en las metas de eficiencia del combustible al 2010. Adicionalmente, el promedio de eficiencia del combustible de los vehículos ligeros a gasolina alcanzó el valor de 18.7 kilómetros/litro, sobrepasando largamente la meta establecida para el año 2010.

Certificación del desempeño ambiental del vehículo

El sistema de certificación del desempeño ambiental para vehículos fue introducido en Japón en abril de 2004, con el fin de promover una mayor conciencia de la población e interés en la mayor eficiencia del combustible y bajas emisiones de vehículos a través del uso del etiquetado en vehículos certificados.

El certificado inicialmente caracterizaba aquellos vehículos que cumplían con los objetivos de combustible eficiente de un 5% o más. En abril de 2008 se introdujeron nuevas etiquetas que identificaban a los vehículos de combustible eficiente al año 2010 fuera superior al 15% y en el mejor de los casos aquellos superiores al 25%.

Adicionalmente se encuentra en proceso de aplicación un esquema de impuesto verde que brinde incentivos a los compradores de vehículos de combustible eficiente y bajas emisiones cumpla con los niveles de desempeño estipulados. Este sistema de certificación ha tenido un impacto muy significativo en el mercado, como lo demostró el hecho de que más del 96% de los vehículos ligeros a gasolina vendidos el año 2010 en Japón fueron certificados como vehículos de combustible eficiente y bajas emisiones (en el año 2010 sólo se certificó el 18.5%).

Las compañías miembros de JAMA están expandiendo su producción de vehículos de combustible altamente eficiente que cumpla con los más recientes estándares de emisiones.

Emisiones de CO_2 y vehículos ligeros marca japonesa en el mercado europeo

Las emisiones promedio de CO_2 provenientes de los vehículos ligeros vendidos por los fabricantes miembros de JAMA en la Comunidad Europea has disminuido, alcanzando un valor de 141 g CO_2/Km en el año 2010, de acuerdo a los datos proporcionados por JAMA (al año 2010 las emisiones reportadas eran de 180 g CO_2/Km). Los fabricantes están trabajando fuerte para poder cumplir con las metas propuestas por la Comisión Europea de 130 g CO_2/Km al 2012 para vehículos ligeros nuevos a ser vendidos en la Unión Europea, lo que implica la implementación de mejoras en la tecnología del motor de los vehículos. La meta será complementada por medidas adicionales adoptadas en base a un enfoque integrado, que es alcanzar una reducción adicional de 10 g CO_2/Km.

3.3.4 Chile

Sistema de certificación de eficiencia energética para vehículos motorizados

Chile actualmente no fijo un limite de emisiones de CO_2 por kilometro, el sistema de certificación de eficiencia caracteriza cada vehículo según su eficiencia energética por

categoría, siendo la categoría A la más eficiente. Este modelo voluntario promueve la compra de vehículos más eficientes.

En diciembre de 2010, los Ministerios de Transportes y Medio Ambiente presentaron la Etiqueta de Eficiencia Energética para Automóviles diseñada de manera conjunta con el fin de que las personas que compren automóviles lo hagan lo más informados posible, sobre todo en cuanto al rendimiento y emisiones de CO_2; es así que a todos los vehículos livianos de pasajeros -es decir con un peso vehicular menor de 2,700 kilogramos- se les aplicará este etiquetado y serán certificados en eficiencia energética. En ese sentido, el etiquetado incluye el rendimiento, expresado en kilómetros por litro; las emisiones de CO_2, expresadas en gramos de CO_2 emitidos por kilómetros recorridos, y las normas de emisiones que cumple el vehículo; así, el sello permitirá que los usuarios conozcan los vehículos más eficientes, considerando que a mayor rendimiento se produce un menor impacto al medio ambiente.

De acuerdo a lo estipulado por el Gobierno de Chile, la etiqueta entraría en vigencia, de manera voluntaria entre el primer y segundo trimestre de 2011, pasando a ser obligatoria para todos los automóviles comercializados en el país -cuyo modelo haya sido homologado desde 2008-, en septiembre del 2012. El etiquetado de vehículos va en la línea del mejoramiento de la calidad del aire en las ciudades del país, lo que permitirá que el crecimiento del parque automotriz no se traduzca en un aumento de la contaminación.

La propuesta del Gobierno Chileno fue desarrollada por la empresa consultora DEUMAN en el año 2007[53], en el marco del desarrollo de una iniciativa de normativa y homologación para la promoción de un sello de eficiencia energética para vehículos, como parte de la política nacional energética del país del sur. El estudio refiere que la propuesta responde a la necesidad de reducir los consumos específicos de combustible en vehículos motorizados, así como las emisiones de CO_2, principalmente debido la dependencia energética que tienen en mayor o menor grado los países y al daño global que producen los GEI, que en el caso de la combustión es principalmente el CO_2.

De acuerdo a lo especificado en la propuesta, el programa de certificación de eficiencia energética aplicada a vehículos debe contener dos elementos principales:

- información al usuario, con el objeto de influir sobre la decisión de compra, incorporando la variable eficiencia energética y el costo operacional en su decisión
- la introducción de una nueva exigencia, adicional a la ya existente, en cuanto a emisiones de contaminantes locales; para los vehículos nuevos que ingresan al país a ser comercializados, consistente en informar la eficiencia energética de cada modelo a ser vendido

El indicador de eficiencia energética propuesto se planteó en base al consumo energético expresado en kilómetro recorrido/litro de combustible; la certificación de eficiencia energética se obtendría a través de la determinación del indicador de consumo de combustible señalado anteriormente, y al estar éste en función de las emisiones, el procedimiento de certificación propuesto es el mismo que actualmente se lleva a cabo para certificar emisiones de vehículos.

[53] *Análisis e implementación de un sistema de certificación de eficiencia energética para vehículos motorizados, DEUMAN 2007*

El número de ensayos necesarios para la certificación de cada marca y modelo que se comercialice en el país será mayor al actual proceso de certificación de emisiones, debido a que este último agrega categorías vehiculares seleccionando los modelos con mayores emisiones de cada clase.

Dada la proyección de la demanda para ensayos de emisiones, producto de la proyección de ventas y el aumento de vehículos a ensayar en cada marca - modelo, se estima oportuno considerar una etapa de transición, en la cual se acepten certificados de eficiencia energética provenientes de programas llevados a cabo en los países de origen de los vehículos que se comercializan en el país. Esto es, se propone aceptar los valores de indicador de eficiencia energética asignados en origen, los que serán considerados en la elaboración de sello diseñado localmente.

Considerando que la difusión es una de las estrategias clave para el éxito del programa, se plantean dos alternativas complementarias para el despliegue de la información: un sello Informativo removible o folleto en papel y un sello permanente.

La implementación del programa de certificación de eficiencia energética se llevará a cabo en dos etapas:

- En la primera etapa la certificación del consumo de combustible se realizará en base a los ensayos realizados en forma rutinaria en el 3CV para la homologación de vehículos más la recepción de certificados de consumo de combustible internacionales. Los programas de difusión permanente y de fiscalización formarán parte de los siguientes estudios a realizar en esta línea de trabajo, ya que se propone formular un programa de fiscalización que está asociado a la aplicación de la normativa a generar y a la difusión de ésta.

- Para la segunda etapa se contempla, además de lo indicado anteriormente, la instalación de una planta de homologación y pruebas adicionales a realizar.

Madificataria a la ley N° 19.496, que establece narmas sabre pratección de las derechas de las cansumidares, can el abjeta de establecer un etiquetada sabre cansuma y emisianes de CO_2 en vehículas matarizadas livianas

Considerando

Que las evidencias científicas acerca de la aceleración del proceso de calentamiento global permiten asegurar con certeza, que como consecuencia de éste, nos encontramos frente a un cambio profundo del clima producto de los gases de efecto invernadero derivados de la masiva intervención humana en los ciclos naturales del planeta, tal como lo afirma el Panel Intergubernamental sobre el Cambio Climático (IPCC). Estos gases son: vapor de agua (H_2O), dióxido de carbono (CO_2), óxido nitroso (N_2O), metano (CH_4) y ozono (O_3). De éstos, el que provocaría, por su abundancia en la atmósfera, un mayor aumento de la temperatura es el CO_2.

Que el calentamiento global conlleva a que el incremento de la temperatura se acentuará en las próximas décadas, generando alteraciones en los perfiles climáticos que pueden afectar severamente nuestro actual modo de vida y el de las generaciones futuras.

Que aunque no se saben las consecuencias exactas, sí se puede predecir que existirán cambios en la futura frecuencia, amplitud y patrón espacial de los fenómenos de El Niño y La Niña. Ello implica que muchas regiones de nuestro país podrían experimentar largos períodos de sequía o altas precipitaciones severas. Que en este contexto, en la lucha contra el cambio climático, la reducción de emisiones de CO_2 es una de las principales medidas adoptadas por los países desarrollados en el marco del Protocolo de Kioto para frenar el impacto de los llamados gases de efecto invernadero. Si bien no todos los países son generadores de los mismos niveles de contaminación, el fenómeno del calentamiento global y su efecto directo, el cambio climático, conlleva consecuencias económicas, sociales y medioambientales globales que impactarán fuertemente sobre nuestro país.

Que es importante tener en cuenta que las fuentes de emisión del dióxido de carbono son, entre otras, la quema de combustibles fósiles, la producción de energía, la quema de deshechos, las llamaradas producidas por el gas natural consumo de combustible de los vehículos de transporte.

Que conscientes del impacto de tales vehiculos en el aporte de CO_2, en la experiencia extranjera nos encontramos con estrategias como las del estado de California en Estados Unidos, de Australia, Canadá y de la Unión Europea, tendiente a la aplicación de medidas de control de las emisiones de CO_2 en los automóviles nuevos.

Que nuestra normativa recoge las recomendaciones en materia de fijación de normas que realizan estados más industrializados que Chile y de los cuales nuestro pais se beneficia, entre las que se encuentran normativas sobre la emisión de CO_2 desde automóviles particulares y comerciales livianos.

Que en Chile la tasa de crecimiento en emisiones de CO_2 supera la de los demás paises latinoamericanos y la de los demás paises en via de desarrollo, y que la estrategia ambiental de nuestro pais aparece como insuficiente para disminuir los gases de efecto invernadero.

Es por eso que sobre la base de éstos antecedentes vengo en someter a vuestra consideración el siguiente, PROYECTO DE LEY

Articulo primero. Agréguese a la Ley 19.496, que establece normas sobre protección de los derechos de los consumidores, los siguientes articulos:

1. Articulo 32 bis:

Todo vehiculo motorizado liviano, ya sea con motor a gasolina o diesel y cuya primera inscripción se realice con posterioridad a la puesta en vigencia de la presente disposición, deberá contar con un certificado que dé cuenta del total de sus emisiones de dióxido de carbono (CO_2), expresadas en gramos por kilómetro (g/Km), y de su rendimiento combinado (rendimiento en ciudad y rendimiento en carretera) de combustible, medido en kilómetros por litro (Km/l). Para ello, cada fabricante o armador de estos vehiculos o sus representantes legales en Chile deberán entregar la información sobre las emisiones de CO_2 y sobre el rendimiento de combustible de todos sus modelos de venta en Chile.

Los vehiculos motorizados livianos nuevos deberán exhibir de forma visible la información sobre su rendimiento (en Km/l) y sobre las emisiones de CO_2, información que deberá ser

publicada en todos los soportes de información de referencia del vehiculo y que debe estar visible para el comprador hasta el momento de su entrega material por parte del vendedor. Esta información será publicada de forma permanente con un rótulo en la parte inferior izquierda del parabrisas, con un minimo de 8 centimetros de alto por 6 de ancho y sólo podrá ser removida por el comprador una vez que reciba materialmente el vehiculo en propiedad.

2. Articulo 32 ter:

Asimismo, todos los folletos y soportes publicitarios de vehiculos motorizados livianos nuevos a la venta, deberán contar con la información sobre su rendimiento de combustible y sobre su aporte de CO_2, utilizando como minimo un 20% del espacio publicitario respectivo con la información gráfica del rendimiento, su expresión numeral expresada en kilómetros por litro (Km/l) y también sus emisiones de CO_2, expresadas en gramos por kilómetro (g/Km), de forma claramente visible.

Las etiquetas y folletos informativos deben contener el valor numérico del consumo oficial de combustible, expresado (Km/l), y de las emisiones especificas oficiales de CO_2 (g/Km). Con esta información se elaborará una escala dividida en siete secciones, a cada una de las cuales se le asignará una letra, desde la letra A (menos contaminante) hasta la letra G (más contaminante).

Las etiquetas y rótulos deberán llevar además información acerca de la marca, modelo, categoria, centimetros cúbicos, año de fabricación y tipo de combustible que utiliza el vehiculo.

Las etiquetas deberán llevar la siguiente frase: El consumo de combustible y las emisiones de CO_2 dependen del rendimiento del vehículo y del estilo de manejo. El CO_2 es el principal gas de efecto invernadero responsable del calentamiento del planeta.

3.3.5 Suiza

La norma de eficiencia energética se incluye en la Ley Federal para la reducción de emisiones de CO_2 donde regulan estas emisiones en base a la norma europea, la que entrará en vigencia a partir del 01 de Mayo de 2012.

Principio de aplicación

Las emisiones de CO_2 de los vehículos ligeros, que son introducidos por primera vez al mercado, deben reducirse en un promedio a 130 CO_2 g/km al año 2015. Para el cálculo se tomará en cuenta:

- Las características de los vehículos ligeros importados o fabricados en Suiza, como el peso bruto, área de superficie e innovaciones con fines ecológicos
- La normativa europea

El Concejo de Ministros calculará las metas para importadores y fabricantes para cada año (los fabricantes pueden unirse en agrupaciones por marca o por importadores):

- Metas individuales según el articulo 11e (las metas para las agrupaciones que pueden variar siempre y cuando sean agrupaciones de pequeños importadores)
- El promedio de emisiones de la flota

- Para el cálculo promedio se tomará en cuenta el promedio mas bajo de las emisiones de los años 2012 al 2014
- Para el año 2012, el 65% de la flota
- Para el año 2013, el 75% de la flota
- Para el año 2014, el 80 % de la flota
- Para los vehículos ligeros, que son matriculados por primera a partir del 01 de Mayo de 2012 en Suiza, el 65% de los montos mencionados deberán ser pagados si se sobrepasa el límite de 130 g CO_2/Km.

Sanciones por sobrepasar la meta[54]

- Por el primer gramo, CHF 7.5
- Por el segundo gramo, CHF 22.5
- Por el tercer gramo, CHF 37.5
- Por el cuarto y cada gramos adicional, CHF 142.5
- En caso de entrega de información falsa se sancionará con una multa de CHF 30000 *Implicancias*

Ejemplo de costos adicionales a los vehículos a partir del 01 de mayo de 2012:
- Desde 140 gramos de emisiones de CO_2, mínimo CHF 692
- Desde 150 gramos de emisiones de CO_2, mínimo CHF 1619
- Desde 170 gramos de emisiones de CO_2, mínimo CHF 3471
- Desde 200 gramos de emisiones de CO_2, mínimo CHF 6250
- Desde 250 gramos de emisiones de CO_2, mínimo CHF 10881
- Desde 300 gramos de emisiones de CO_2, mínimo CHF 15512

Para vehículos con menos de 130 gramos de CO_2 por kilometro no está previsto un incentivo.

Metas de Suiza y la Comunidad Europea

Actualmente, el promedio de emisiones de CO_2 para los vehículos importados en Suiza es más alto comparado con el promedio de la Comunidad Europea (ver Gráfico 25); para el año 2015 se espera que Suiza alcance la meta de la Comunidad Europea.

[54] *1 CHF corresponde a aproximadamente 1.08 US$*

Gráfico 25 . Evolución de las metas de emisiones (g CO_2/Km) en el tiempo

3.3.6 China

El país se convirtió en el pionero a nivel mundial que adoptó normas de economía de combustible (FES[55]) para vehículos, impulsados por la preocupación ante el aumento de las importaciones de petróleo ocasionado por un sector de transporte cada vez grande, así como el interés por atraer a las empresas de producción de autos, traer tecnologías avanzadas y eficientes a China, así como el interés de impulsar su propia industria automotriz para mejorar su oferta de productos y competir con empresas internacionales. Después de un proceso de formulación bastante rápido, China emitió su norma de economía para vehículos ligeros (LDPV) en Setiembre de 2004. La primera fase entró en vigencia el 01 de julio de 2005, y la segunda fase entró en vigencia el 01 de enero de 2008. La norma China ocupa el tercer lugar en severidad a nivel mundial, antecedida por los estándares japoneses y europeos. El estándar chino tuvo éxito en reducir el consumo de combustible promedio (medido como litros/100 km recorridos) de la nueva flota de vehículos ligeros en 11,5%, adicionalmente estimuló al despliegue cada vez mayor de las más avanzadas tecnologías de vehículos.

Política de economía de combustible

En general, China cuenta con más autos pequeños que los países más desarrollados, considerando que los autos más grandes están teniendo una mayor cuota de mercado. En el año 2008, la mayor parte de la flota tenía motores de 1200 - 1600 cc (alrededor del 40% del mercado), mientras que los autos con motores de 1600 a 2000 cc tenían alrededor del 22% del mercado. El crecimiento anual de ventas está entre el 20% y 30 %, lo que implica una demanda cada vez mayor de combustible.

[55] *Fuel Economy Standards*

Estado de las emisiones de CO2 consumo de combustible flota de vehículos ligeros

Europa y China utilizan el "nuevo ciclo europeo de prueba" (o NEDC), que es un ciclo que consta de 04 pasos y se repite con un ciclo de la ciudad a una velocidad media de 18,7 Km/h y un ciclo de carretera a una velocidad media de 62.6 Km/h y una velocidad máxima de 120 Km/h. China ha atraído a tecnologías avanzadas y eficientes al sector de la industria automotriz, además introdujo normas de economía de combustible para vehículos de ligeros y de carga en Setiembre de 2004; siendo la primera introducida desde Julio de 2005 y la segunda fase desde Enero de 2008.

La Fase 1 (año 2005) incrementó la eficiencia de los combustibles de vehículos ligeros en aproximadamente 9%, pasando de 26 mpg[56] en el año 2002 a 28,4 mpg en el año 2006, a pesar del incremento en el desplazamiento de motor y peso bruto. Se estima que se ahorraron unas 575,000 toneladas de petróleo y 1´700,000 toneladas de emisiones de CO_2 entre los años 2002 y 2006. Esto convirtió a la norma de economía de combustibles de China en la tercera más exigente del mundo, precedida por las normas de la Unión Europea y Japón, y ha llevado a la exitosa reducción del consumo promedio de combustible (L/100 km) al 11.5% para la flota de vehículos ligeros. Sin embargo, existe preocupación en caso el creciente tamaño de la flota de vehículos en China pueda echar a perder estas ganancias iniciales.

Política Nacional

China implementó estándares de economía de combustible que deben ser cumplidos por cada fabricante, los vehículos que no cumplan con estos estándares no podrán ser comercializados en el país. La Fase 1 entró en vigencia el 01 de Julio de 2005 para los nuevos modelos de vehículos y el 01 de Julio de 2006 para modelos de vehículos de producción continua. La Fase 2 entró en vigencia el 01 de Enero de 2008, para los nuevos modelos y el 01 de Enero de 2009 para los modelos de vehículos de producción continua.

Las normas clasifican los vehículos en 16 clases según el peso, las que van desde vehículos de menos de 750 kg de peso (aproximadamente 1500 libras) hasta vehículos de más de 2.500 kg de peso (aproximadamente 5500 libras). Las normas abarcan los autos de pasajeros, camionetas SUV[57] y camionetas multiusos, con distintos estándares para autos con transmisiones manuales y automáticas. Al año 2015, estas normas tendrán como meta un promedio de flota de 42,2 kilómetros por galón. Con fines de comparación, en la Tabla 19 se muestran los límites máximos de consumo de combustibles considerando como comparativo el equivalente estadounidense en economía de combustibles.

La restricción de importación para vehículos nuevos no aplica, en tanto la importación de vehículos usados está prohibida.

Tabla 19 - Comparación de estándares

[56] Millas por gramo
[57] *Sport Utility Vehicle*

Peso (libras)	Límite máximo de consumo de combustible basado en el ciclo NEDC (L/100-Km)			
	Fase I (2005)		Fase II (2008)	
	Manual	Auto SUV	Manual	Auto SUV
1667	7.2	7.6	6.2	6.6
1922	7.2	7.6	6.5	6.9
2178	7.7	8.2	7.0	7.4
2422	8.3	8.8	7.5	8.0
2678	8.9	9.4	8.1	8.6
2933	9.5	10.1	8.6	9.1
3178	10.1	10.7	9.2	9.8
3422	10.7	11.3	9.7	10.3
3689	11.3	12.0	10.2	10.8
3933	11.9	12.6	10.7	11.3
4178	12.4	13.1	11.1	11.8
4444	12.8	13.6	11.5	12.2
4689	13.2	14.0	11.9	12.6
5066	13.7	14.5	12.3	13.0
5578	14.6	15.5	13.1	13.9
5578	15.5	16.4	13.9	14.7

Peso (libras)	Límite máximo de consumo de combustible basado en el equivalente CAFE de USA (millas por gramo)			
	Fase I (2005)		Fase II (2008)	
	Manual	Auto SUV	Manual	Auto SUV
1667	36.9	35.0	42.9	40.3
1922	36.9	35.0	40.9	38.5
2178	34.5	32.4	38.0	35.9
2422	32.0	30.2	35.4	33.2
2678	29.9	28.3	32.8	30.9
2933	28.0	26.3	30.9	29.2
3178	26.3	24.8	28.9	27.1
3422	24.8	23.5	27.4	25.8
3689	23.5	22.2	26.1	24.6
3933	22.3	21.1	24.8	23.5
4178	21.4	20.3	23.9	22.5
4444	20.8	19.5	23.1	21.8
4689	20.1	19.0	22.3	21.1
5066	19.4	18.3	21.6	20.4
5578	18.2	17.1	20.3	19.1
5578	17.1	16.2	19.1	18.1

Fuente: Feng 2004: 14

Medidas fiscales

Como parte del plan para reducir el consumo de combustible de la flota de vehículos más grande del mundo, China tiene planificado invertir, para el año 2012, al menos 12 millones de yuanes (US$ 1´760,000) para subvencionar autos más pequeños, es decir, automóviles eficientes a combustible. Para autos con motores de 1.6 litros o más pequeños, que consumen un 20% menos de combustible que los estándares actuales, se ofrecerán 3000 yuanes. La Comisión de Reforma y Desarrollo Nacional de China anunció que serán elegibles para el subsidio 71 modelos entre híbridos, eléctricos y eficientes en combustible. Se estima que para el año 2012, unos 04 millones de vehículos serán promovidos.

Con relación a las sanciones, China ha puesto en marcha una estructura tributaria que penaliza a los autos con motores grandes e incentiva la compra de vehículos a combustible eficientes.

Tabla 20 - Estructura de impuestos en China[58]

Categoría por tamaño de motor (Litros)	Impuesto antes del 4/1/2006 (%)	Impuesto 4/1/2006-8/31/2008 (%)	Impuesto desde 9/1/2008 (%)
<1.0	3	3	1
1.0-1.5	5	3	3
1.5-2.0	5	5	5
2.0-2.5	8	9	9
2.5-3.0	8	12	12
3.0-4.0	8	15	25
Desde 4.0	8	20	40

[58] *http://www.unep.org/transport/gfei/autotool/casestudies/apacific/china/csapchina.asp*

4. PROPUESTA PARA LA CERTIFICACION DE LA EFICIENCIA ENERGÉTICA EN VEHÍCULOS LIGEROS EN EL PERÚ

4.1 Estructuración del programa de certificación de eficiencia energética

La propuesta para la evaluación de la eficiencia energética en vehículos ligeros en el Perú toma como referencia los lineamientos de la normativa de la Comunidad Europea, así como la propuesta para la implementación del sistema de certificación de eficiencia energética para vehículos motorizados del Gobierno Chileno.

4.1.1. Objetivo general

El objetivo de un esquema de certificación de la eficiencia energética en vehículos ligeros nuevos en el Perú es que el usuario disponga de información confiable con relación al indicador de eficiencia energética establecido por el sector competente, de modo que le permita escoger por aquella alternativa que no sólo cumpla con los lineamientos de control de operación y de rendimiento del vehículo, sino que además emite GEI (para el caso CO_2) como valor de cumplimiento normativo que busca reducir los efectos que estos contaminantes viene produciendo en el ambiente.

La presente propuesta se enfoca al establecimiento de un límite medio de emisiones de CO_2 aplicable a los lotes de automóviles fabricados e importados, a fin de alcanzar al año 2018[59] el objetivo de 130 g CO_2/Km para los vehículos nuevos matriculados en el país, ajustándose el valor planteado a 120 g CO_2/Km al año 2020.

4.1.2. Campo de aplicación

Este límite de emisiones de CO_2 se aplica a los automóviles nuevos (vehículos de categoría M1 - de ocho asientos o menos, sin contar el asiento del conductor, tal como se indica en el DS 058-2003-MTC Aprueban el Reglamento Nacional de Vehículos) de cada fabricante.

El nivel de emisión de CO_2 se mide de conformidad con lo establecido en el Reglamento de la Comunidad Europea (CE) No. 715/2007 sobre homologación de vehículos (referido a las emisiones contaminantes). El valor límite de emisión no se aplica a cada vehículo de manera individual, sino que se aplica en base al valor medio de todos los vehículos nuevos reportados por un fabricante y registrados por el importador en el país. Considerando que los documentos normativos de la Comunidad Europea han sido tomados como referencia para la elaboración de la propuesta, éstos han sido anexados al presente documento para un mayor detalle.

[59] *Se toma como referencia el año 2018, considerando que el Plan referencial del uso eficiente de la energía del MINEM culmina ese año*

4.1.3. Características del parque automotor

La venta de vehículos a nivel nacional se ha ido incrementando en los últimos años, esto debido al crecimiento económico que el sector automotriz viene experimentando (a excepción del año 2009 que fue más lento por la incertidumbre en los mercados mundiales), tal como se puede observar en la Tabla 21 y Gráfico 26:

Tabla 21. Parque vehicular nacional estimado, según clase de vehículo 2002-2011[60]

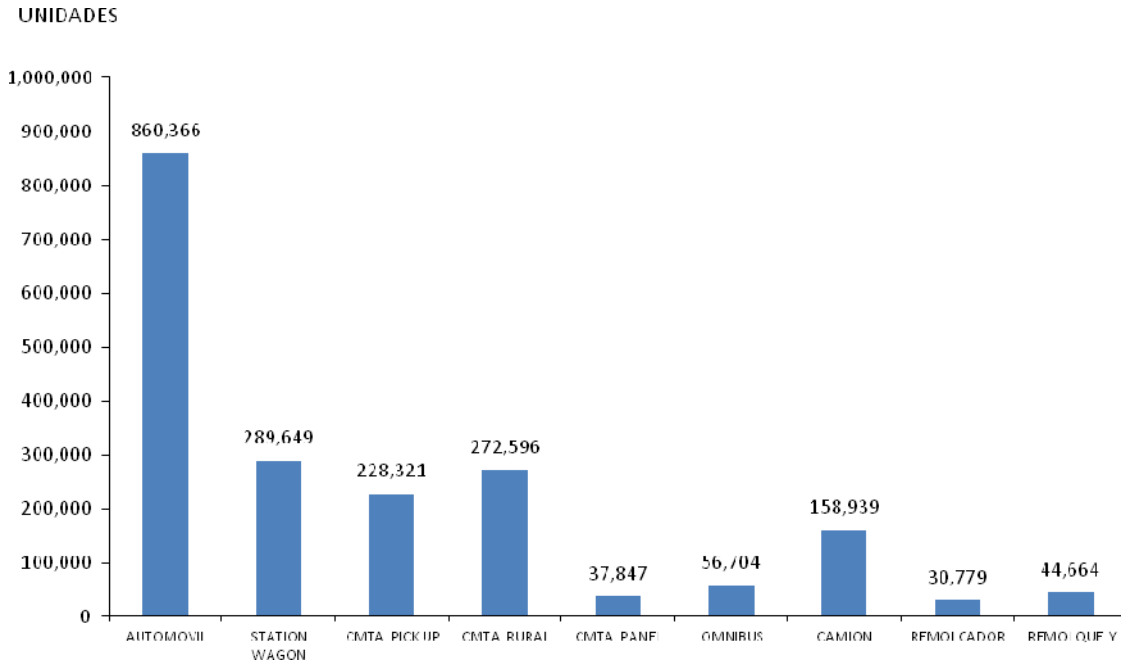
Clase de vehículo	2002 R/	2003 R/	2004 R/	2005 R/	2006 R/
Automóvil	610270	643848	646497	673647	681538
Station Wagon	173315	197700	209908	227338	237562
Camioneta Pick Up	144454	155251	155951	165875	168756
Camioneta rural	118934	126391	129077	137941	146434
Camioneta panel	21729	23515	24930	26850	28177
Omnibus	44337	46198	45851	47788	47873
Camión	102714	109862	109019	115576	116485
Remolcador	15312	17107	17282	17602	18319
Remolque y semi-remolque	17447	21416	22888	27400	28386
Total	**1209006**	**1342288**	**1361403**	**1440017**	**1473530**

Clase de vehículo	2007 R/	2008 R/	2009	2010	2011
Automóvil	696897	735314	766742	809967	860366
Station Wagon	230979	261441	274566	285300	289649
Camioneta Pick Up	176111	187940	196833	210988	228321
Camioneta rural	159829	184328	207067	235889	272596
Camioneta panel	29684	32490	34172	36184	37847
Omnibus	48542	49882	51563	54389	56704
Camión	120661	129295	137407	147293	150939
Remolcador	20872	24890	26457	28679	30779
Remolque y semi-remolque	30728	35382	38027	41001	44664
Total	**1534303**	**1640970**	**1732834**	**1849690**	**1979865**

R/: Cifras revisadas, reajustadas por haberse detectado mayor incremento de inscripciones vehiculares a partir del año 2002

[60] *Fuente: Superintendencia Nacional de los Registros Públicos - SUNARP Fuente OGPP - Oficina de Estadística*

Gráfico 26 - Parque automotor por clase del vehículo al 2011



En la tabla 22 se observa el crecimiento del parque automotor a nivel departamental:

Tabla 22 - Parque vehicular estimado, según departamento o región (2002 - 2011)[61]

Departamento	2002 R/	2003 R/	2004 R/	2005 R/	2006 R/
Amazonas	1801	1900	1975	2020	2103
Ancash	19065	19055	19293	19382	19757
Apurímac	3167	3608	3730	3816	3879
Arequipa	76267	78162	78858	79544	81293
Ayacucho	3804	3832	3882	3919	3969
Cajamarca	7905	8365	8882	9501	10256
Cusco	33603	34993	35342	37705	36204
Huancavelica	1028	1036	1043	1061	1080
Huánuco	10795	11088	10968	10886	10836
Ica	22290	22614	22692	22753	22834
Junín	43272	43488	43468	43648	44454
La Libertad	41312	98217	97590	153777	152847
Lambayeque	37266	37739	37967	38263	38744
Lima y Callao	829214	851360	866881	885636	912763
Loreto	5477	5413	5336	5215	5154
Madre de Dios	695	806	823	819	827
Moquegua	8697	9004	9417	9622	10394
Pasco	4048	4383	4772	5232	5514
Piura	30851	31391	31731	31734	31828
Puno	24304	25135	25642	25874	26452
San Martín	4846	10384	10277	10156	10033
Tacna	29688	29959	30549	31119	32011
Tumbes	2934	2954	2958	3009	3025
Ucayali	6183	7402	7327	7255	7212
Total	**1248512**	**1342288**	**1361403**	**1440017**	**1473530**

Departamento	2007 R/	2008 R/	2009	2010	2011
Amazonas	2168	2218	2292	2390	2407
Ancash	20354	21001	21309	22086	23322

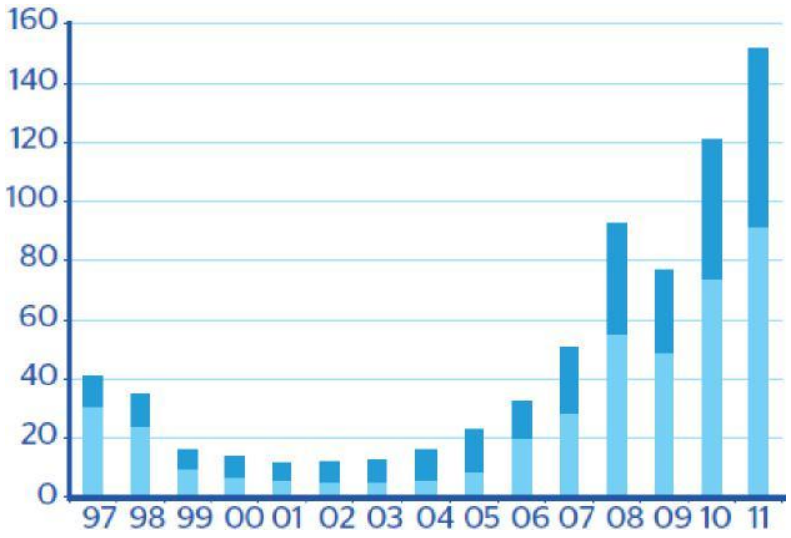
[61] *Fuente: Superintendencia Nacional de los Registros Públicos - SUNARP Fuente OGPP - Oficina de Estadística*

Apurímac	3916	3934	3973	3969	3966
Arequipa	84829	91674	98270	106521	118985
Ayacucho	4153	5404	5572	5716	5784
Cajamarca	11255	12383	13563	15107	17320
Cusco	37592	39688	42175	45090	48491
Huancavelica	1103	1216	1291	1319	1317
Huánuco	10892	11255	11382	11864	12576
Ica	23170	25498	25691	26135	26419
Junín	46091	47769	49404	51094	53118
La Libertad	153251	155411	156646	158672	162026
Lambayeque	39930	41920	43689	45881	49440
Lima y Callao	957368	1036850	1106444	1195353	1287454
Loreto	5132	5132	5089	5089	5211
Madre de Dios	870	913	941	986	1027
Moquegua	11418	12202	12692	11348	14003
Pasco	6075	6807	7187	7351	7292
Piura	32314	33497	34650	36367	39099
Puno	28062	29889	31645	34169	37074
San Martín	9969	9917	9977	10151	10418
Tacna	33944	35911	38457	40465	42318
Tumbes	3042	3040	3054	3086	3119
Ucayali	7383	7441	7441	7481	7679
Total	**1534303**	**1640970**	**1732834**	**1849690**	**1979865**

R/: Cifras revisadas, reajustadas por haberse detectado mayor incremento de inscripciones vehiculares a partir del año 2002

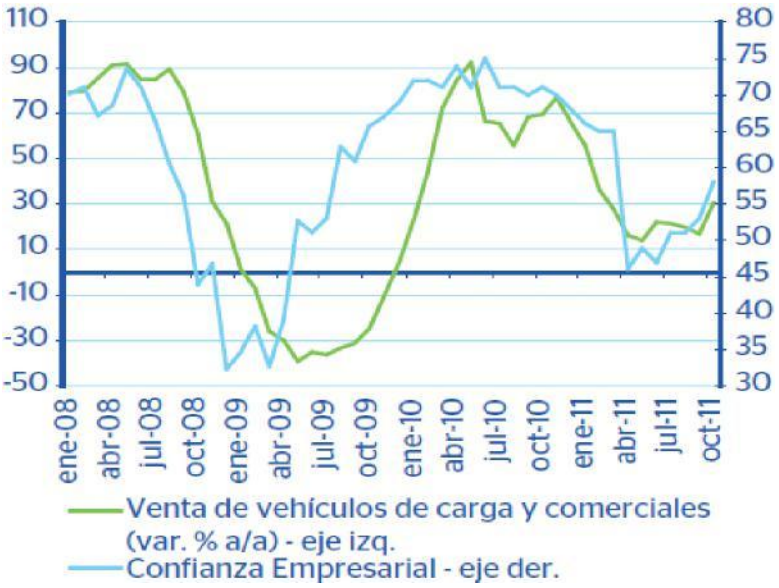
La tendencia positiva que ha mostrado en los últimos años el mercado automotor en Perú continuó en el año 2011, al mes de octubre, las ventas de autos nuevos alcanzaron las 122,000 unidades, y se estima que al cerrar el año superarán las 150,000, representando una expansión de más de 25% anual (ver Gráfico 27). Este resultado se debe a dos elementos: el primero fue el temporal desabastecimiento que sufrieron marcas japonesas líderes del mercado producto del terremoto en ese país, y el segundo, la natural incertidumbre que generó el contexto electoral y que llevó principalmente a las empresas y a las familias de mayores ingresos a posponer compras de vehículos, comportamiento que se ha empezado a corregir en los últimos meses (ver Gráfico 28).

Gráfico 27 - Venta de autos nuevos (miles de unidades)



Fuente: Araper y BBVA Research Perú

Gráfico 28 - Confianza empresarial venta de vehículos



Fuente: Araper y BBVA Research Perú

Por el lado de la demanda, el dinamismo del mercado se apoyó en la expansión del empleo formal urbano, lo que impulsó la capacidad adquisitiva de las familias y el engrosamiento del segmento de hogares de ingresos medios. Como resultado, se proyectó que las ventas de vehículos ligeros se incrementaron en aproximadamente 24% en 2011[62]. De manera similar, la favorable evolución de la inversión empresarial en minería, servicios, agroindustria y manufactura le dio soporte al mercado de vehículos comerciales y de carga, y ello se reflejó en un incremento de ventas que se estima alrededor de 27% al cierre del año.

Por el lado de la oferta, las condiciones siguieron acomodándose a esta expansión del mercado automotor. Así, la red de concesionarios y puntos de venta y post venta (centros de mecánica mantenimiento y ventas de repuestos) continuó ampliándose, tanto en la capital del país como en las provincias. Esto último es de especial importancia pues el ritmo de crecimiento en las ciudades del interior ha sobrepasado al de Lima, aumentando su participación en las ventas de autos nuevos de 20% en el año 2009 a 25% en el año 2011. Las inversiones realizadas ascenderían a US$ 60 millones este año, triplicándose con respecto al año anterior, según la Asociación de Representantes Automotrices del Perú (Araper). A ello se añade la mayor frecuencia con la que se realizan salones de exhibición, buscando un mayor acercamiento al cliente final. Un tercer elemento que favoreció el comportamiento positivo del mercado automotor en el año 2011 fue la disminución del precio promedio de los vehículos. De un lado, es cada vez mayor la competencia entre marcas (existen alrededor de 100 registradas). Destaca aquí la mayor penetración de las marcas chinas, que si bien aún cuentan con una pequeña participación en el mercado, vienen gradualmente atrayendo a más consumidores con precios que se ubican por debajo del promedio. Las marcas líderes del mercado (ver Tabla 23) han empezado en este contexto a desarrollar estrategias que se adapten a las características de cada segmento de clientes, facilitando así su alcance y, por lo tanto, favoreciendo las ventas.

Un segundo factor que ha apoyado la disminución de los precios es la reducción de impuestos. En este sentido, durante la primera mitad del año se redujo en un punto porcentual el impuesto general a las ventas a 18%. Por el lado de los aranceles, a principios del

[62] *BBVA Research Situación Automotriz Perú*

año 2011 éstos disminuyeron de 9% a 6% para los vehículos ligeros, mientras que la entrada en vigencia del Tratado de Libre Comercio con Corea del Sur en el año 2011 favoreció a los autos de esa procedencia.

Tabla 23 - Ventas acumuladas de autos nuevos en 2011 (hasta octubre)

Marca	Total general	Participación (%)
Toyota	19357	15,9
Hyundai	16645	13,7
Kia	11082	9,0
Nissan	10665	8,8
Chevrolet	10709	8,8
Volkswagen	6179	5,1
Suzuki	5787	4,8
Mitsubishi	3241	2,7
Renault	2538	2,1
Volvo	1837	1,5
Otros	33696	27,7
Totales	121736	100%

Fuente: Araper y BBVA Research Perú

4.1.4. Normativa

En el marco de la implementación de un sistema de evaluación y certificación de la eficiencia energética de los vehículos ligeros nuevos que ingresan al país, se requiere de un marco normativo que establezca las metas de las emisiones de dióxido de carbono (gramos) por kilómetro recorrido.

El marco normativo deberá contemplar, mediante un Decreto Supremo, que la competencia para fiscalizar el cumplimiento de la norma a ser implementada será responsabilidad del Ministerio de Transportes y Comunicaciones (MTC); adicionalmente, se deberá considerar la participación del Ministerio de Energía y Minas (MINEM) en el marco de las políticas relacionadas a la eficiencia energética del país que este sector desarrolla, así como la participación del Instituto Nacional de Defensa de la Competencia y de la Protección de la Propiedad Intelectual (INDECOPI) quien participaría, por una parte, en la formulación de la norma técnica de eficiencia energética en vehículos ligeros nuevos a través del Comité de Normas Técnicas del sector competente, y, de otro lado, evaluando y otorgando el reconocimiento a la entidad responsable de la certificación a nivel nacional a través del Servicio Nacional de Acreditación, en caso se considere la creación de una entidad a nivel local que identifique y homologue los vehículos nuevos que ingresen al país.

La autoridad a cargo de la fiscalización del cumplimiento de la norma de eficiencia energética deberá ser quien fiscalice la implementación del programa de etiquetado (el sello de eficiencia energética).

4.1.5. Indicador de eficiencia energética

Se define como indicador de eficiencia energética las emisiones de dióxido de carbono que emite un vehículo por kilómetro recorrido.

Expresión del indicador:

Gramos de CO_2 / kilómetro (g CO_2/Km)

4.1.6. Mecanismo de aplicación

Los estándares de eficiencia energética en vehículos se implementarán de manera gradual con el fin de alcanzar una meta propuesta al año 2020, con la posibilidad de fijar un estándar de control más exigente a ser alcanzado al año 2025 (ver Tabla 24):

Tabla 24 . Cronograma de aplicación del estándar de eficiencia energética

Año	Meta	Campo de aplicación	Medida
2011	160 g CO_2 / Km	Autos y camionetas	Revisión de documentos de importación
2016	Diesel y gasolina de bajo azufre	Toda la cadena de distribución	Límites Máximos Permisibles actualizados
	130 g CO_2 / Km	Autos y camionetas	Revisión de certificados de homologación
2018	130 g CO_2 / Km	Autos y camionetas	Etiqueta, cumplimiento de valores de CO_2 y homologación en planta
2020	120 g CO_2 / Km	Autos y camionetas	Cumplimiento de valores de CO_2 y homologación en planta
2025	95 g CO_2 / Km	Autos y camionetas	Cumplimiento de valores de CO_2 y homologación en planta

Los importadores tendrán la posibilidad de formar agrupaciones de empresas con el fin de cumplir con los objetivos. Esta agrupación se considerará como un solo fabricante a la hora de verificar el cumplimiento de los objetivos. Para no perjudicar a la competencia, el intercambio de datos entre agrupaciones se deberá limitar a las emisiones de CO_2, a los objetivos en materia de emisiones de gases contaminantes y al número de vehículos matriculados.

Los importadores deberán recopilar desde el presente año la información referente al número de vehículos matriculados, las emisiones medias de CO_2 de estos vehículos, así como la distribución de datos por variante de vehículo, y a partir del año 2018 deberán comunicar al Ministerio de Transporte y Comunicaciones (MTC) esta información. Basándose en estos datos, el MTC elaborará y pondrá a disposición del público un registro con todos los datos recopilados, con especial atención a las emisiones medias de CO_2 del año anterior. A partir del año 2018, el MTC publicará una lista indicando los resultados reportados por los fabricantes.

A partir del año 2018, los importadores que no respeten el objetivo de emisiones de CO_2 propuesto deberán pagar una prima por exceso de emisiones. Esta prima se calculará en base al:

- Número de gramos por kilómetro en que un importador sobrepase el objetivo por las emisiones medias de este fabricante
- Número de vehículos fabricados por este fabricante y matriculados durante el año

La prima ascenderá según el año en cuestión (20 nuevos soles en el año 2018, 35 nuevos soles en el año 2019, 60 nuevos soles en el año 2020 y 95 nuevos soles en el año 2021 y así sucesivamente en los años siguientes) a la cuota establecida para el año por cada gramo excedido multiplicado per el número de vehículos comercializados.

Durante un máximo de 05 años, puede haber excepciones para los importadores que importen menos de 10 vehículos al año y que no estén vinculados a otro importador. El importador en cuestión deberá solicitar un valor de emisiones de CO_2 compatible con su potencial de reducción, en concreto, con su potencial tecnológico de reducción de emisiones de CO_2. Esta solicitud será evaluada por el MTC antes de conceder o no una excepción.

Al año 2018, el MTC deberá presentar un informe sobre la homologación en el marco de la estrategia de reducción de emisiones de CO_2 de los vehículos ligeros y evaluar si se ha producido algún cambio con relación a las emisiones de CO_2 de los vehículos entre el año 2017 y el año 2018, para adaptar los criterios de cálculo del límite de emisión, en caso necesario.

A partir del 01 de enero de 2018, los fabricantes deberán indicar la información para el consumidor relacionad a los vehículos, en qué medida las emisiones de CO_2 del vehículo comercializado difieren del objetivo de emisiones establecido para dicho vehículo.

4.1.7. Muestreo para la certificación

El proceso de certificación de eficiencia energética busca determinar el valor representativo de indicador para un tipo de vehículo que debe tener ejemplares de características homogéneas.

Para la medición de las emisiones de CO_2 por kilómetro se considerará como representativo un modelo de vehículo por lote de vehículos con especificaciones idénticas.

4.1.8. Capacidad de certificación

En una primera etapa, considerando que no se dispone de capacidad local para certificar las emisiones de CO_2 de vehículos nuevos, se aceptarán certificados de centros de homologación (laboratorios) acreditados cuyo reconocimiento haya sido otorgado por una entidad certificadora de los países de origen de los vehículos u otro país que cuente con centros de homologación que cumplan los criterios internacionales establecidos para organismos certificadores. En el anexo 3 del documento se incluye una lista de centros internacionales que cuentan con reconocimiento para la certificación.

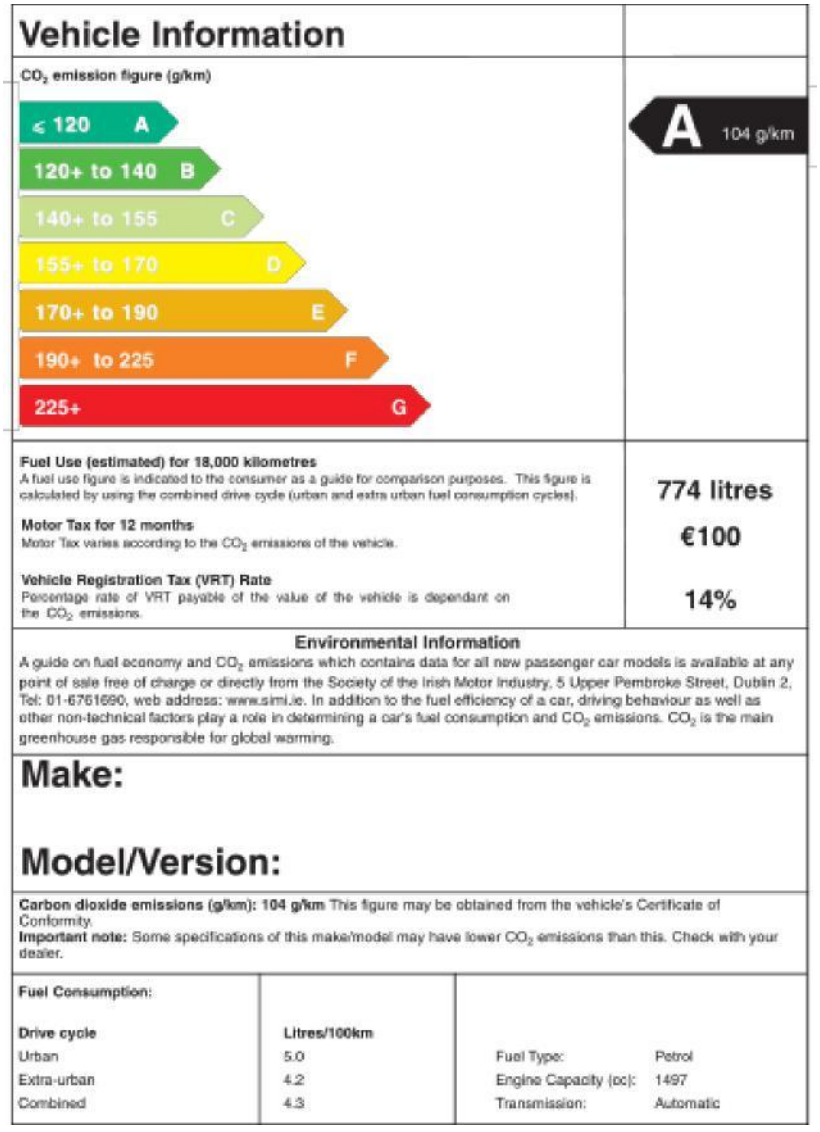
En una segunda etapa, que estaría en función del tiempo que demore la implementación de un centro de homologación que certifique las emisiones de CO_2 en vehículos nuevos, se podrá realizar la certificación a nivel nacional, promoviendo la acreditación de un organismo nacional que puede homologar y realizar las pruebas de conformidad para la certificación en eficiencia energética para vehículos ligeros nuevos.

4.1.9. Implementación del sello de certificación

El diseño del sello de certificación deberá tomar en cuenta la información que se desea brindar al consumidor, así como otros aspectos como sus dimensiones y la ubicación en el vehículo en el que deberá ser colocado.

Como referencia, el sello europeo y el norteamericano incluyen una base de comparación de los datos de eficiencia con otros vehículos de su propia clase. En el caso europeo se compara y clasifica dentro del nivel de emisiones de monóxido de carbono (ver Gráfico 29), en tanto en el sello norteamericano se comparan los consumos de combustible y se da una referencia del nivel al que se encuentra el vehículo en cuestión. En ambos sellos incluyen el componente de costo entre la información que entregan, esto basado en datos referenciales permite al usuario armarse de una proyección de gastos en combustible cuando adquiere un vehículo energéticamente más eficiente.

Grafico 29. Modelo de etiquetado europeo



Fuente: Internet

Este sistema de etiquetado es el mecanismo que se utiliza como una guía para compradores de vehículos nuevos, el que se aplica únicamente a vehículos nuevos. Es así que, de la mano de una campaña de difusión, el cliente tendrá la libertad de elegir el vehículo de su elección aun cuando éste sea de una categoría con alto consumo de combustible.

4.1.10. Mecanismo de difusión del programa

La publicación de información acerca de la eficiencia energética de los vehículos disponibles en el mercado es una práctica cada vez más común en el mundo, ya que constituye una herramienta para ayudar al consumidor a la adquisición de vehículos más eficientes y, por ende, que emiten menos emisiones de GEI.

A pesar de que ciertos estudios muestran que los aspectos ambientales de un vehículo (rendimiento y sistema contaminante) no son los más importantes al momento de elegir uno nuevo, gran parte de los consumidores sí toman en cuenta el ahorro de combustible, el cual

está directamente relacionado con la eficiencia energética y a su vez con las emisiones de dióxido de carbono.

Entre los países que han llevado a cabo este tipo de prácticas se encuentran los Estados Unidos, y gran parte de los miembros de la Comunidad Europea, como Bélgica, Finlandia, Portugal, Austria, Italia, Reino Unido, Dinamarca, Alemania, Noruega, Suiza, entre otros. Estos países han provisto de información acerca de la eficiencia energética de los vehículos, a través de diferentes instrumentos como guías, carteles y en algunos países etiquetas informativas en los autos.

Los resultados que han mostrado los países participantes de la Comunidad Europea en un período de 05 años (1998 a 2002) son la disminución de emisiones de dióxido de carbono, una mejora en la eficiencia de los vehículos nuevos y un cambio en la composición del parque vehicular. Como ejemplo de las experiencias en Europa, tenemos lo siguiente:

- En Dinamarca, el rendimiento de los autos a diesel se incrementó en un 26.1% y los degasolina en un 4.5%. Se incrementó la proporción de autos más eficientes
- En Francia, el rendimiento promedio de los autos aumentó en un 12%. La proporción de autos más eficientes aumentó 10% en vehículos a diesel y 0.89% en vehículos a gasolina
- En Holanda aumentó la proporción de los autos clasificados como más eficientes en 3% y 4.3% para diesel y gasolina, respectivamente

Es por ello que en el marco de la estrategia de difusión del programa, se deberá considerar en primer lugar un trabajo de incidencia a nivel de las autoridades de los sectores directamente involucrados, a fin de poder desarrollar un programa que cuente con el compromiso de todas las partes, en plazos que puedan ser realmente cumplidos y que no conlleven a postergaciones en el cumplimiento del indicador de eficiencia energética, lo que implicaría que el programa pierda credibilidad.

Otro aspecto importante a considerar es la difusión es la población, pues los usuarios deben estar informados de los beneficios de la implementación del programa, por ello se recomienda una etapa previa de validación de los diferentes mecanismos de difusión a la población, de modo que la información que se difunda sea de fácil acceso y comprensión para los compradores de vehículos nuevos, de modo que se entienda que como comprador está en el derecho de conocer en qué medida el vehículo que adquirirá estará afectando el ambiente.

4.2 Análisis costo - beneficio

La implementación del programa de certificación de eficiencia energética se llevará a cabo en dos etapas:

- En una primera etapa, la certificación del consumo de combustible se realizará en base a la recepción de certificados de consumo de combustible internacionales emitidos por centros de homologación (laboratorios) acreditados
- En una segunda etapa se propone implementar un centro de homologación de vehículos que permita realizar ensayos de la eficiencia energética en emisiones de forma rutinaria para comprobar que los vehículos cumplen con los valores reportados en los certificados. Estos ensayos se realizarán por lo menos en un vehículo de cada

modelo nuevo que se introduzca al mercado; adicionalmente, la autoridad podrá tomar muestras aleatorias de los lotes que los importadores comercializan en el país

Dentro de los costos de implementación se distinguen los estudios preliminares para el diseño del programa y los programas de difusión y fomento iniciales; en cuanto a los costos de operación, se han identificado los costos por verificación de antecedentes (US$ 175.00). En el caso del análisis e implementación del sistema de certificación de eficiencia energética para vehículos motorizados, adicional a los programas de difusión permanente, se deberá considerar los costos referidos a la fiscalización de la norma.

Los costos de programas de difusión permanente y de fiscalización formarán parte de los siguientes estudios a realizar en esta línea de trabajo, ya que es necesario formular un programa de fiscalización que está asociado a la aplicación de la normativa a generar y a la difusión de ésta. Para la segunda etapa se contempla, además de los costos anteriores, los costos de inversión asociados a la instalación de un nuevo centro de homologación (laboratorio) y los costos de operación asociados a pruebas adicionales a realizar. Los costos anteriores se estiman según datos proporcionados por la planta 3CV localizada en Chile en relación sus actuales costos para proceso de homologación:

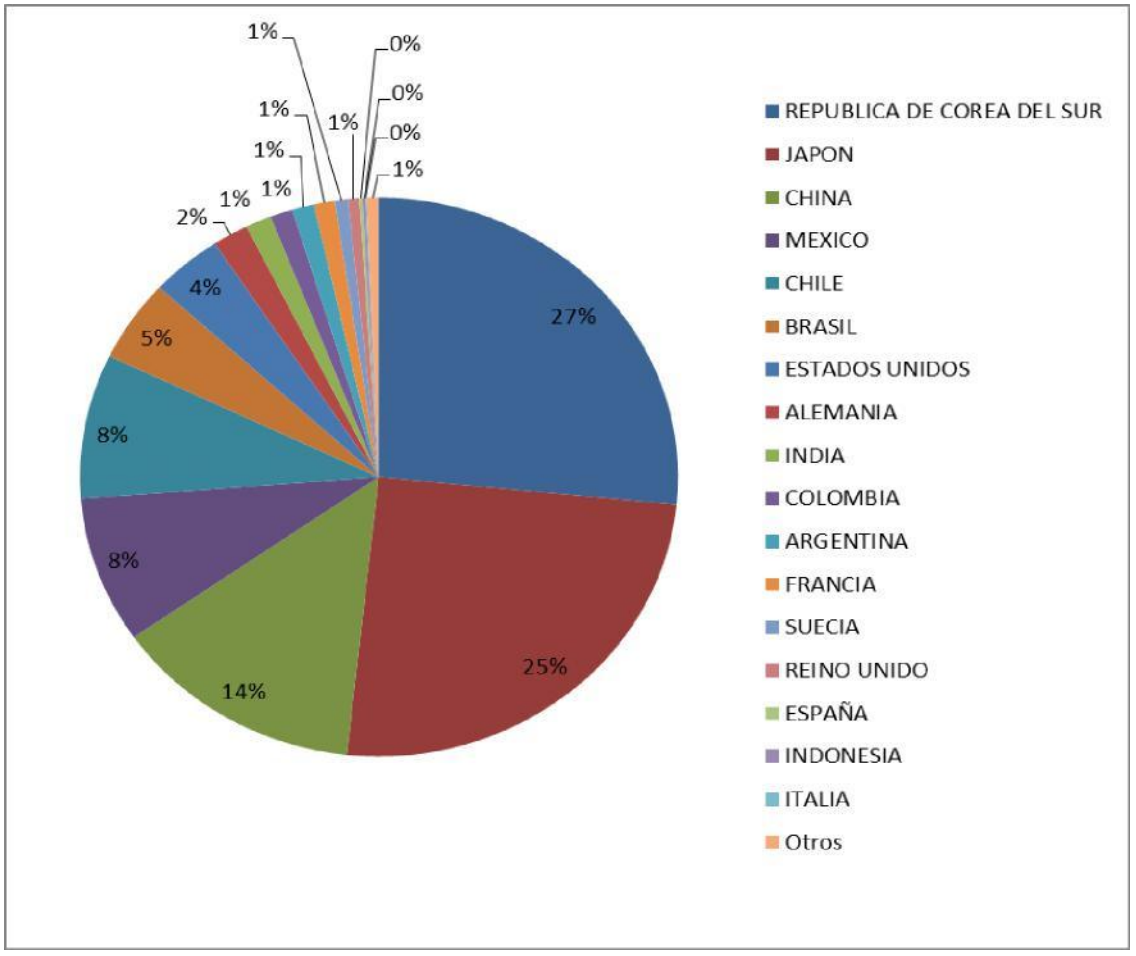
- Costos de implementación
- Equipos, instrumentos, infraestructura (US$ 1´430,000)
- Costos de operación correspondientes al proceso de homologación Verificación de antecedentes (US$ 17,500/ proceso/vehículo) Costos Indirectos US$ 400
- Costos de Operación US$ 125

Con relación a la cantidad de pruebas, el proceso de homologación varía entre dos y tres, es así que se tiene un costo total de operación para cada proceso de homologación que varía entre los US$ 1280 y US$ 1860.

En el Gráfico 30 se presentan los datos de emisiones y consumo comparativo para los años 2009 y 2011, estos datos reportados corresponden a información para el caso de vehículos nuevos, no habiéndose incluido los datos de vehículos de procedencia China, pues no se encuentra disponible la información referente al consumo de combustible. Hoy los vehículos de procedencia China tienen una participación del 14 % en el mercado[63].

[63] *Datos de los registros de la Asociación Automotriz del Perú, año 2011*

Gráfico 30 . Porcentaje de participación en el mercado según procedencia



Fuente: : Asociación Automotriz del Perú, 2011

En la Tabla 25 se presenta información relacionada a la importación de automotores por combustible y estado para el año 2011, así como un comparativo de los datos de emisiones y consumo entre los años 2009 y 2011.

Tabla 25 . Importación de automotores por combustible y estado 2011

Estado	Diesel	Gasolina	GLP	GNV	Petróleo	Total
Nuevos	38973	98970	0	664	15501	**154108**
Usados	116	13002	278	9	56	**13461**
Total	**39089**	**111972**	**278**	**673**	**15557**	**167569**

Los datos del cálculo del consumo de combustible presentados en la Tabla 26 se basan en la información disponible en los sitios Web de la United Kingdom Vehicle Type Approval y United States Department of Energy. Los datos de vehículos nuevos, no incluyen vehículos de procedencia China, se asume que se encuentran en el mismo rango, pues se han importado vehículos pequeños.

Tabla 26 - Datos de emisiones y consumo 2011

Año **Tipo de vehículo**	**Cantidad de autos**	**Promedio litro/100 Km**	**Promedio CO_2/Km**
2011			
Autos	58,282	5.66	132
Camionetas	54,978	8.17	190
Promedio	113,260	6.97	**160**
2009			
Autos	7,535	7.32	173
Camionetas	3,740	14.08	334
Promedio	112,75	9.56	**223**

Para la estimación de los costos asociados se han considerado diferentes escenarios de indicadores de eficiencia energética, tomando como referencia los valores cada vez menores que la Comunidad Europea propone en el marco de un programa eficiencia energética para vehículos ligeros nuevos. Cabe señalar que la ponderación se ha desarrollado considerando el precio de 11 nuevo soles por galón de combustible (ver Tabla 27).

Tabla 27 - Escenarios para diferentes indicadores de eficiencia energética

Escenarios	**Importación anual de vehículos**	**Combustible en litros**	**Promedio litros/100 Km recorrido**	**Costo Km/100000 vehículos (nuevos soles)**	**gr CO_2/Km**
Escenario actual	100000	697000	6.97	20256	160
Escenario futuro 1 (2018)	100000	557940	5.58	16215	130
Escenario futuro 2 (2020)	100000	515021	5.15	14968	120
Escenario futuro 3 (posterior a 2020)	100000	407725	4.08	11849	95

En base a los datos de costos asociados se ha elaborado una estimación del costo-beneficio para el caso de un propietario de un vehículo ligero con 15,000 Km de recorrido por año, tal como se muestra en la Tabla 28, así mismo, en la Tabla 29 se muestra la estimación de beneficio con las diferentes medidas en ahorro de combustible y dinero.

Tabla 28 - Estimación costo-beneficio para un vehículo ligero con un recorrido promedio de 15,000 Km por año

Norma de emisiones gr CO_2/Km	Km/año	Litros/ 100 Km	Precio Combustible (nuevos soles)	Costo anual (nuevos soles)	Beneficio (nuevos soles)	Comentarios
190	15,000	8.17	11	3479	511	Camionetas 2011
160	15,000	6.97	11	2968	0	Promedio 2011
130	15,000	5.58	11	2376	-592	Autos 2011
120	15,000	5.15	11	2193	-775	
95	15,000	4.08	11	1737	-1231	

Tabla 29 - Estimación de beneficio con las diferentes medidas en ahorro de combustible y dinero

Cálculo para 100,000 vehículos con un recorrido de 15,000 Km anuales	Actual (Promedio de 160 gr/km)	Máximo 130 gr/Km	Máximo 120 gr/Km	Unidad
Consumo de combustible	104´550,000	83´700,000	77´250,000	Litros
Costo de combustible por 100000 vehículos	304´246,032	243´571,429	224´801,587	Nuevos soles
Ahorro en combustible con medida a 130 g/Km		20´850,000		Litros
Ahorro en combustible con medida de 130 a 120 g/Km			6´450,000	Litros
Ahorro en dinero medida 130 g/Km		60´674,603		Nuevos soles
Ahorro en dinero medida 130 g/Km		22´472,075		Dólares americanos
Ahorro en dinero medida 120 g/Km			18´769,841	Nuevos soles
Ahorro en dinero medida 120 g/Km			6´951,793	Dólares americanos

El cambio de una norma de eficiencia energética promedio de 160 g/Km a 130 g/Km para 100,000 vehículos representa un ahorro en combustible de 20´850,000 litros/año, si se considera el galón de combustible a un precio de 11 nuevos soles, lo que representa un

ahorro de 60´674,603 nuevos soles o su equivalente US$ 22´472,075[64] por año. Como puede observarse, la medida no sólo tiene un impacto a nivel ambiental y social, sino también a nivel económico.

El beneficio monetario en calidad del aire es difícil de estimar, pues se correlaciona directamente con las normas de emisiones de contaminantes atmosféricos (contaminantes criterio) que con las normas de eficiencia energética.

Con relación a la implementación de un proceso de homologación a nivel nacional, en la Tabla 30 se presenta la estimación de costos relacionada a dicho proceso.

Tabla 30 - Estimación de costos del proceso de homologación

Costo de la medida	**Costos (US$)**	**Cantidad de vehículos homologados por año**	**Costo anual (US$)**	**Etapa**
Costos por verificación de Certificados y antecedentes	175	289	50,575	Fase 1
Equipos, instrumentos, infraestructura	1´430,000		286,000	Fase2 (depreciación en 05 años)
Costos por verificación de Certificados y antecedentes	175	289	50,575	Fase 2
Costos Indirectos / prueba	400	289	115,600	Fase 2
Costos de operación por prueba	125	289	36,125	Fase 2
Costos totales anuales Fase 2			488,300	Fase 2
Tarifa de homologación (US$)	1860	289	537,540	
Margen de utilidad			49,240	Por año

Un precio de homologación de aproximadamente US$ 1860 por vehículo permite cubrir los costos de operación y depreciación de la infraestructura. En el año 2011, 47 marcas importaron 239 modelos sin diferenciar entre caja automática y caja manual, asumiendo que 50 modelos deberán ser homologado adicionalmente con caja automática se tiene un total de 289 homologaciones por año, lo que ocuparía la planta en el 100% de su capacidad.

Para la fase 2, que debería ser implementada en un plazo no mayor del año 2020, se propone buscar una alianza público-privada, de modo que una entidad invierta en un centro de homologación. Las entidades que realizan satisfactoriamente la revisión técnica vehicular y el Servicio Nacional de Adiestramiento en Trabajo Industrial (SENATI) podrían ser invitadas a presentar propuestas.

[64] *A un tipo de cambio de 2.7 nuevos soles*

5. COMENTARIOS FINALES

Existen diferentes iniciativas para la implementación de programas de certificación de la eficiencia energética en vehículos ligeros, alrededor del 75% del mercado mundial de vehículos ligeros cuenta con normas relacionadas a la economía de combustibles, consumo de combustibles o de emisiones de dióxido de carbono. Las normas para los más grandes mercados se resumen en la Tabla 31, en la que se puede observar a nivel de comparación las normas relacionadas a la economía de los combustibles para varias regiones.

Tabla 31. Estándares de eficiencia en grandes mercados de automóviles

País / Región	Ventas 2009 en millones anuales (% ventas mundiales)	Unidades de regulación	Forma del estándar	Detalles, reducción en emisiones CO_2/Km
Unión Europea	14 (30%)	Emisiones GEI (130 g CO_2eq/Km en 2015 95 g CO_2eq/Km en 2020)	Peso, lineal continua	Objetivo fijado: reducción 18% 2009 - 2015 Objetivo indicativo: reducción 40% 2009-2020
Estados Unidos	10 (22%)	Rendimiento de combustible (34,1 mi/gal) Emisiones GEI (250 g CO_2eq/mi)	Sombra, lineal continua (02 categorías)	Reducción 20% 2011 - 2016 Ciclo FTP[65]
China	8 (16%)	Consumo de combustible (7,0 L/100 Km)	Clases de peso, por vehículo, promedio de las clases	Reducción 12% 2008 - 2015 NDEC
Japón	6 (10%)	Rendimiento de combustible (16,8 Km/L)	Clases de peso	Reducción 19% 2006 - 2015 Ciclo japonés

El programa de certificación de eficiencia energética aplicado a vehículos ligeros incorporará un indicador de cumplimiento relacionado con las emisiones de dióxido de carbono por kilómetro recorrido para cada modelo comercializado y brindará información al usuario de modo que el indicador de eficiencia energética sea una de las variables que le permita tomar la decisión al momento de la compra de un vehículo nuevo.

[65] *Federal Test Procedure*

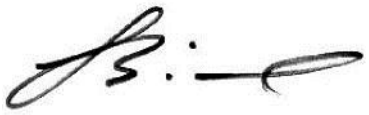
Se recomienda evaluar la efectividad del programa tanto en su meta de reducción de las emisiones de GEI como la de poner a disposición de usuario la información para la toma de decisiones. Para ello se deberá elaborar una línea de base de la situación previa a la implementación del programa, para luego ser comparada con los escenarios posteriores a la implementación (el año 2018 para un indicador de 130 g CO_2/Km; el año 2020 para un indicador de 120 g CO_2/Km; año 2020; y así sucesivamente).

[35] *New European Driving Cycle*

Es importante tener en cuenta que el consumo de combustible es evaluado en el centro de homologación (laboratorio) bajo un ciclo definido; en la práctica, el consumo varía según la forma de manejar, el tráfico, la carga de vehículo y el estado de las carreteras.

En general, los vehículos pesados nuevos son comprados con el criterio de eficiencia energética ya que este mecanismo representa el factor de costos más importante durante la vida útil del vehículo. Las normas de emisiones para esta categoría están fuertemente vinculadas con las emisiones contaminantes. Todos los vehículos que se importan al Perú deben cumplir con los límites máximos permisibles estipulados en el Decreto Supremo 047-2001-MTC, siendo la entidad encargada de velar su cumplimento es el Ministerio de Transportes y Comunicaciones.

Lima, 24 de abril del 2012



Jon Bickel

Representante

Swisscontact Perú

6. REFERENCIAS

Documentos

- Anderson et al, October 2010. Automobile Fuel Economy Standards: Impacts, Efficiency, and Alternatives
- BBVA Research, 2011, Análisis Económico Situación Automotriz Perú
- Consejo Mundial de Energía, ADEME, Julio 2004. Eficiencia Energética: Estudio Mundial Indicadores, Políticas, Evaluación
- DEUMAN, Marzo 2005. Informe final Análisis e implementación de un sistema de certificación de eficiencia energética para vehículos motorizados
- Dirección General de Salud Ambiental, Marzo 2012 Presentación del Estudio de Saturación Lima Metropolitana y Callao 2011
- Gärtner, Andrea. 2005. Study on the effectiveness of Directive 1999/94/ED relating to the availability of consumer information on fuel economy and CO_2 emissions in respect of the marketing of new passenger cars. European Commission, Directorate-General for Environment Contract
- ICCT, Vehicle Efficiency Fundamentals Handout
- Japan Automobile Manufacturers Association, Inc. November 2011. 2011 Report on environmental protection efforts, Promoting sustainability in road transport in Japan
- Ministerio de Energía y Minas – Dirección General de Eficiencia Energética, Balance Nacional de Energía 2010
- Ministerio de Energía y Minas – Dirección General de Electricidad, Plan Referencial del Uso Eficiente de la Energía 2009 - 2018
- Ministerio de Energía y Minas. Decreto Supremo Nº 064-2010-EM Aprueban la Política Energética Nacional del Perú 2OLO-2O4O
- Ministerio de Transportes y Comunicaciones, Decreto Supremo Nº 058-2003-MTC Aprueban el Reglamento Nacional de Vehículos
- Ministerio del Ambiente, 2010. Segunda Comunicación Nacional del Perú a la Convención Marco de las naciones Unidas sobre Cambio Climático
- PACIFIC PIR, Mayo 2009, Opciones de mitigación de emisiones de GEI de los sectores Energía, Industria y Transporte a Nivel Nacional y Regional
- Propuesta de Reglamento del Parlamento Europeo y del Consejo, de 19 de diciembre de 2007, por el que se establecen normas de comportamiento en materia de emisiones de los turismos nuevos como parte del enfoque integrado de la Comunidad para reducir las emisiones de CO2 de los vehículos ligeros
- SENAMHI - Dirección General de Investigación y Asuntos Ambientales, Enero 2012. Vigilancia de la calidad del aire en la zona metropolitana de Lima y Callao
- Transport & Environment, September 2011. How clean are Europe's cars? An analysis of carmaker progress towards EU CO2 targets in 2010

Páginas Web visitadas:

- http://araper.pe
- http://carfueldata.direct.gov.uk
- http://nats.sct.gob.mx
- http://www.dft.gov.uk/vca
- http://www.dieselnet.com
- http://www.digesa.minsa.gob.pe/DEPA/aire_lc/lima_callao.asp
- http://www.fueleconomy.gov/feg/bymake/1999MakeList.shtml
- http://www.mtt.gob.cl
- http://www.senamhi.gob.pe/?p=0410
- http://www.senamhi.gob.pe/calidad_aire.php
- http://www.sunat.gob.pe/orientacionaduanera/importacionvehiculos/index.html#
- http://www.unep.org/transport/gfei/autotool/case_studies/apacific/china/cs_ap_china.asp

Appendix VI Lima Green Zones

British Embassy in Lima

Lima Green Zones

Vision Report

223884-00

Issue 2 | 13th April 2012

Ove Arup & Partners Ltd
13 Fitzroy Street
London W1T 4BQ
United Kingdom
www.arup.com

Job number 223884-00

ARUP

Contents

Page

1 INTRODUCTION 195

1.1 ARUP SCOPE 19595
1.2 SITE VISIT ACTIVITIES 195
1.3 REPORT STRUCTURE 196

2 FROM GLOBAL TO LOCAL: OPPORTUNITIES FOR GREEN ZONES IN LIMA 197

2.1 PERU'S NAMAS: A RESPONSE TO THE GLOBAL CARBON AGENDAS 19797
2.2 URBAN RESPONSES TO THE REGIONAL COMPETITION 198
2.3 CREATING A RESPONSE TO THE LOCAL NEEDS 19999

3 CASE STUDIES 202

3.1 TIANJIN ECO-CITY, TIANJIN, CHINA 202
3.2 HAMMARBY, STOCKHOLM, SWEDEN 204
3.3 LINHA VERDE, CURITIBA, BRAZIL 205
3.4 KEY FINDINGS 207

4 PRINCIPLES FOR GREEN ZONES IN LIMA 210

4.1 VISION 210
4.2 ENVIRONMENTAL ADVANTAGES 211
4.3 ECONOMIC ADVANTAGES 213
4.4 PROPOSED SITES 214

5 DELIVERY MECHANISMS 219

5.1 KEY VARIABLES FOR SITE DEVELOPMENT 219
5.2 KEY VARIABLES FOR A DELIVERY MODEL 220
5.3 KEY VARIABLES FOR CARBON MEASUREMENT 223
5.4 A DELIVERY ROUTE MAP 225

6 CONCLUSIONS AND NEXT STEPS 227

Executive Summary

The green zones project is an initiative of the British Embassy in Peru to assist the Municipality of Lima and the Peruvian national government to formulate a draft transport plan to control carbon emissions.

The 'green zones' proposal is an ambitious and innovative idea, that can only be achieved through a joint effort at both the metropolitan and national levels.

This report comprises the main findings compiled during our visit to Lima, as well as a set of recommendations to assist in the conceptualisation of the green zones. Following the introduction, the second chapter provides a summary of strategic global, regional and local opportunities that should be addressed from the outset. These include: Peru's voluntary commitments to reduce carbon emissions; the competition amongst cities in the Latin American region; and a series of local challenges identified during our site visit.

The third chapter comprises an analysis of three relevant international case studies that illustrate key aspects of the implementation of low carbon initiatives. These include, Tianjin Eco-City in Tianjin (China); Hammarby Sjöstad in Stockholm, and Linha Verde in Curitiba. The analysis of these case studies demonstrates the relevance of strategic approaches to city making when provided in conjunction with a robust infrastructure plan.

The fourth chapter includes our initial vision for the development of a low carbon initiative in Lima. This includes a summary of key principles and the advantages these plans provide. In this context, we provide a high level analysis of the sites proposed so far, and identify the main constraints and opportunities for each of them. In parallel, we provide a similar analysis for some specific sites with development potential which were identified during our visit.

In the fifth chapter we provide our strategic recommendation on possible methods and procedures to address the delivery of the project as well as the integration of carbon issues into the planning process. We propose that the manner in which this initiative is implemented is critical to its success, thus great attention needs to be given from the outset. Consequently, we outline an initial route map to guide the feasibility, planning and implementation stages.

Finally, we have concluded that the proposal for low carbon development zones in Lima has an enormous potential. However, this potential can only be achieved by addressing two critical issues: the lack of a governance and delivery framework to coordinate the actions of local and national governments (including innovative incentives for investment) as well as the definition of preliminary project-specific objectives associated with carbon accounting and sustainability.

1 Introduction

This report has been prepared by Arup with the objective of providing an overview of sustainable urban plannig strategies applicable to Lima. Our input is part of an initiative funded by the British Embassy in Lima, which aims at assisting the Municipality of Lima and the Peruvian government to formulate a "draft transport plan to control carbon emissions"[66].

Arup's advice is focused on developing a rationale for the creation of a "green zones" initiative in Lima, which will be the seed for a new pattern and distribution of land uses and densities across the city. This idea originates from the principle that addressing land uses in tandem with urban transport is fundamental within a comprehensive strategy for the reduction of carbon emissions.

1.1 Arup Scope

This report is intended to capture the key observations and recommendations arising from our visit to Lima in March 2012. Findings from our visit have been further refined through discussions with specialists in Arup, including transport planners and city designers.

In summary, the purpose of this report is to:

- Identify underlying opportunities for the creation of green zones in Lima.
- Review three case studies in developing countries (Tianjin, China and Curitiba, Brazil) as well one from the developed world (Stockholm in Sweden).
- Propose a series of principles for the creation of green zones in Lima, including an initial proposal of methodological criteria to measure carbon emissions control.
- Provide an overview of the sites currently proposed for the green zones as well as identifying other potential sites suggested during our visit.
- Suggest next steps in the formulation of green zones and integration with other planning agendas.

1.2 Site visit activities

Arup carried out a site visit from March 11-14th, 2012 which included the following meetings:

- Initial meeting with Mrs. Patricia Iturregui, Climate Change advisor, British Embassy in Lima.
- Visit to IMP (*Instituto Metropolitano de Planificacion*) and meeting Mr. Jorge Alberto Mesa (Director of IMP); Mrs. Mariela Pardo (Planner) and

[66] (Iturregui, 2012)

the Vice-manager of Natural Resources and Environment Department at the Municipality of Lima, Mrs.Anna Zucchetti.

- Meeting with IMP's planning team, including Mrs. Carmen Barreda and Mr. Juan Alvarez.
- Meeting with IMP's transport specialist, Eng. Guillermo Tamayo.
- Lunch meeting with private consultants URVIA, Mr. Manuel Zubiate and Mr. Raul Florez.
- Meeting with Mr. Miguel Romero Sotelo, Vice-Minister of Housing and Urbanism of Peru.
- Meeting with the real estate specialist lawyer, Mr. Hildebrando Castro-Pozo.
- Meeting with Mr. Domingo Arzubialde, Vice- manager of Private Investment Promotion department of Municipality of Lima.
- Meeting with Mr. Javier Roca Fabian, General director of International affairs, Competition and Productivity at the Peruvian Ministry of Economy and Finances.

The focus of the above meetings was to understand, from multiple perspectives, the opportunities and constraints for the implementation of green zones in Lima.

1.3 Report Structure

The report reflects the key findings of the visit and our further research as follows:

- Defining the opportunities for the creation of green zones in Lima (section 2).
- Review of three key case studies (section 3), and gathering lessons for the implementation of green zones in Lima.
- Identifying a preliminary vision as well as environmental and economic advantages to be considered in the formulation of a green zones initiative for Lima (section 4).
- Providing a brief overview of key considerations for the implementation of low carbon strategies in an urban context, including key variables for site development; delivery model; and carbon measurement (section 5).

2 From global to local: opportunities for green zones in Lima

Low carbon initiatives in cities can be understood as responses to agendas that encompass external and internal forces, for example climate change; national policies; city-specific problems and vulnerabilities; and real estate markets. Within this varied context, the following sections illustrate a few strategic drivers that should be taken into consideration in the creation of green zones in Lima.

2.1 Peru's NAMAs: A response to the global carbon agendas

As a result to the 2007 Conference of the Parties (COP 13) in Bali, the international community agreed on the creation of voluntary mitigation actions by developing countries. These initiatives, elaborated in Cancun 2010 (COP16), are known as Nationally Appropriate Mitigation Actions, or NAMAs. In general terms, NAMAs present the following characteristics:

- Any government-sponsored and prioritized policy, program, or project that results in measurable GHG reductions can be a NAMA
- NAMAs are enabled in part by domestic investments and in part by international financial support
- NAMAs are performance based and the stringency of their monitoring, reporting and verification process depends on the source of finance
- A NAMA Registry will record information and facilitate the matching of action and support.

Until May 2011, 47 countries had submitted NAMAs to the UNFCCC[67]. Seven countries, including Peru[68], have submitted their own NAMAs in the Latin American and the Caribbean region. According to Peru's Second National Communication to the UNFCCC,

> *Peru is a Party to the United Nations Framework Convention on Climate Change (UNFCCC) since 1992 and to the Kyoto Protocol since 2002 and, therefore, it is aligned with the objective of the Convention to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference*[69].

Peru has proposed a series of three NAMAs, which include the following initiatives:[70]

- Reduction to zero of the net deforestation of primary or natural forests by year 2021;

[67] (Streck & Guimaraes, 2007, p. 4)
[68] (UNFCCC, 2012)
[69] (Ministerio del Medio Ambiente, 2010, p. 22)
[70] (UNFCCC, 2012)

- The modification of the current energy grid, so that renewable energy (nonconventional energy, hydropower and bio fuels) represents at least 33 per cent of the total energy use by 2020; and
- The design and implementation of measures which allow the reduction of emissions caused by the inappropriate management of solid waste.

The Second National Communication also elaborates on the need to tackle the energy inefficiencies associated with the transport sector and acknowledges that coordination of appropriate land use strategies will be an integral part of the strategies.

2.2 Urban responses to the regional competition

Competition for businesses and investment in cities is also an important factor in the success of urban development plans and policies. According to the latest report on city competitiveness produced by the Economist Intelligence Unit (EIU), "global trade and power is usually defined at a country level, cities are increasingly likely to be the focus of global business in the decade ahead"[71].

In the Latin American context, Lima is the third most populous city with an estimated eight to nine million inhabitants. According to the Peruvian National Institute of Statistics (INEI), the population of the city will reach 11.3 million people by 2025[72].

According to the EIU, it is ranked as the seventh most competitive city in the region behind Buenos Aires, Sao Paulo, Santiago, Mexico City, Rio de Janeiro and Panama City. Lima's worst scores in this ranking are: global appeal (10.2 out of 100); financial maturity (16.7 out of 100); environmental and natural hazards (37.5 out of 100); and economic strength (40.0 out of 100).On the other hand, the key comparative advantages shown by the EIU report is the strong social and cultural character as well as its human capital[73].

This analysis reveals the important challenges that Lima's institutions are facing from a strategic point of view, which can be summarised as the need to address environmental and policy-related problems whilst strengthening its human capital and cultural vibrancy.

Many competitive areas such as Tianjin[74] (China) and San Francisco (US) have responded to these challenges by creating districts with pioneering environmental aspirations, innovative identity and cohesive social strategies such as Tianjin eco-city and Treasure Island. These projects, usually classified under the umbrella of eco-cities, pursue an ambitious environmental agenda that also integrates strong economic and social principles. Further relevant examples of these initiatives are illustrated in the third chapter of this report.

[71] (Economist Intelligence Unit, 2012, p. 8)
[72] (INEI Instituto Nacional de Estadistica e Informatica, 2011)
[73] (Economist Intelligence Unit, 2012, p. 22)
[74] Tianjin is scored by the EIU report as the top 1 city in terms of its economic strength (Economist Intelligence Unit, 2012, p. 16)

2.3 Creating a response to the local needs

Along with external factors, successful urban development initiatives are based on locally appropriate solutions which address specific issues of a city. Following our observations in-situ; meetings held; and wider consultation with other Arup specialists, a summary of the relevant local determinants for a robust green zones initiative are provided below:

Urban Mobility

Currently Lima has high levels of congestion which, according to the stakeholders consulted, is due to the following:

- Although the rates of public transport usage in Lima are quite high, there is a lack of consistent policies and enforcement measures to regulate public transport operations.
- The new rapid transit lines - BRT (*Metropolitano de Lima*) and Metro (*Tren Electrico*) - are recent step changes in the provision of public transport. However, these lines are not connected between themselves, hence they do not operate as a network.
- Rapid transit networks are neither associated with any current planning instrument nor linked to land uses or any other strategies for recapturing investment through increased land values.

In this context, besides the major efforts by municipal and national authorities, higher levels of coordination among the agencies and systems are still required. Moreover, transport strategies should also be coordinated with other city-wide plans such as the location of specific land uses (mixed use zones, business nodes, etc); densities; and new development zones.

Smart location of land uses and densities

Several case studies reveal that cities with medium and high densities present lower levels of energy consumption associated with transport[75]. The strategic allocation of densities along public transport corridors can create more efficient and sustainable city operation.

Currently, in Lima there is no consistency between the alignment of the primary infrastructure of transport and the location of high density zones and mixed used areas. Lima rather follows traditional patterns of growth within many Latin American cities based on spines of desirable location that, as a result produce vast areas of disamenity and segregation in the rest of the city[76]. For example, Miraflores – San Isidro – La Molina

Identifying zones connected to existing and future transport infrastructure, and with potential for mixed use and medium density, will be essential for the creation of more sustainable patterns of growth.

---

[75] (Newman & Kenworthy, Sustainability and Cities: Overcoming Automobile Dependence, 1999)

[76] (Ford & Griffin, A model of Latin American city structure, 1980, p. 405) ; (Ford, 1999)

Governance and coordination

The roles of local and national governments are fundamental for the management and growth of contemporary megacities. In the case of Lima, we have identified a lack of coordination between the efforts of the metropolitan and national governments. This includes the following issues:

- Given that the current Lima plan is expired, there is no updated vision for the city. A new city plan would be instrumental in the coordination between city and national government. Moreover, the absence of a plan precludes the creation of a coordinated portfolio of projects and policy initiatives.
- At the local level, there is strong capacity to implement public projects. The Lima municipality is in charge of identifying, designing and implementing a diverse portfolio of infrastructure projects, from transport corridors to green spaces. The experience of the BRT (*Metropolitano de Lima)* demonstrates this capacity.
- Institutions within the national government do not have a clear scope for project implementation within Lima. They are usually seen as 'acting outside their competencies'. For example, the new metro line ('tren electrico') was built as per a design decided by the former president Alan Garcia, and implemented by an ad-hoc public agency -"*Autoridad Autónoma del Tren Eléctrico*"- via a private concession process.

Conflicts in the vision of the future of the city

Based on the information gathered in our interviews, there is a clear divergence of views on Lima's future growth. While many actors in the public and private sector support the densification of the city, others would rather focus solely on the generation of new development areas in the north and south of the city. Given these two positions are likely to respond to two different types of market demands associated with the different provision of infrastructure, we consider that these two approaches are valid and relevant for Lima's future development.

International case studies show that a usual response to city growth problem is the creation of new expansion areas and economic zones, for example, Panama-Pacifico in Panama City and Pudong in Shanghai. Alternatively, other cities focus their efforts on widespread regeneration and densification initiatives, such as 22@ in Barcelona. While both models are usually seen as opposites, in practical terms either of these initiatives is usually accompanied by the other as they respond to different market demands. For example,

- The inner-city densification of Punta Patilla in Panama City is occurring at the same time as the development of Panama-Pacifico's Special Economic Zone.
- In Shanghai, the inner city was densified through a series of redevelopments (for example, Xintiandi) at the same time as Pudong economic zone was developed.
- In parallel to the massive regeneration efforts in Barcelona, other expansion areas have been identified and developed on the outskirts of the city, such as Valle del Besos and Badalona.

Based on these examples, and the diversity of opportunities of urban development that can be implemented in Lima, we envisage that the identification of zones for future development should include wide range of contexts in Lima's metropolitan area.

Resource constraints and urban resilience

Contemporary cities are the predominant places for resource consumption and production of waste. For example, 78% of climate change emissions are related to consumption in major city regions[77]. According to the interviews carried out during our visit, Lima's future growth and consumption patterns are subject to major constraints associated with the semi-desert climate and geographic location. In particular, several of our interviewees highlighted lack of water as one of the main restrictions for future urban development in the following decades.

Recent investments in connecting the Peru's rich gas sources with Lima through a gas pipe have increased the availability of energy for the city. This has attracted the location of new industrial facilities in the southern access to the city. Other relevant investments in city infrastructure include new sewers for the north and south of the city and the creation of a sewage treatment plant in the Lurin area.

The above raise further questions on to what extent a metropolitan area like Lima can afford to rely on limited sources of water or a restricted number of energy sources. In this context, the creation of development zones that enjoy of more efficient technologies to reduce energy demands; water consumption; waste generation; and foul water, is a significant challenge for the city's future growth.

[77] (Nolmark, 2007, p. 11)

3 Case Studies

As a result of mainstreaming the sustainability agenda, there is worldwide interest in the development of large and medium scale urban projects that integrate sustainability principles. According to Simon Joss, a planning scholar at University of Westminster, the creation of eco-cities and eco-neighbourhoods responds to a phenomenon in which countries and cities are "competing to take a lead in developing and applying new socio-technological innovations and thus bringing about the next generation of sustainable towns and cities"[78].

Besides many theoretical and political questions raised by the notion of the eco-city, the focus of this report is to draw lessons on their successful implementation. These include the identification of innovative types of urban development as well as their financing instruments and technologies.

3.1 Tianjin eco-city, Tianjin, China

Tianjin eco-city is a major urban project jointly supported by the Chinese and Singaporean governments. Their role includes both the funding of the project as well as providing expertise for its planning and delivery.

Its developer, the Sino-Singapore Tianjin Eco-City Investment and Development (SSTEC) emphasises both, commercial viability and civic values, as fundamental principles of its sustainability objectives. SSTEC, as master developer and representative of the Chinese and Singaporean government, has been actively involved in identifying and selecting the possible investors and sub-developers for the infrastructure and real estate components of the project.

Basic Information

- Site: 3,000 hectares
- Expected number of residents: 352,000 residents
- The project includes residential (75%); mixed uses, commercial, industrial and social infrastructure

Site condition

In 2005, the 30 square kilometre site for the eco-city was a salt-pan area with no urban uses. Its designers proposed that the two defining criteria for the location were:

- Restricted access to water; and
- Strategic location near a city centre.

These two constraints are addressed in the design of the eco-city by exploring the opportunities of "construction under resource restrictions" and to "make use of advantages of transport"[79]

[78] (Joss, 2009, p. 240)
[79] (Yang & Dong, 2008, p. 32)

Enabling infrastructure

The design and implementation of the eco-city includes a strong governmental investment in infrastructure prior to the construction of residential and non residential buildings. This includes:

- Main roads (within the site)
- Highways (outside the site)
- Railways (including fast lines and urban services)
- Network of public spaces and waterfront areas (which include flooding defences)
- Water infrastructure

Policy links

The implementation of eco-cities in China is listed as one of the key initiatives in China's 2011 White Paper on climate change. The role of Singapore is not restricted to the provision of economic investment, but also to the provision of technical support with local officials and Singaporean design consultants.

The development of Tianjin eco-city is also utilised as an arena for testing new planning policies for the country, including:

- Industrial policy: creation of areas where the type of industries is regulated by their impact on the environment.
- Tax policies: tax policies are modified to direct the income generated by high-end industries towards public services. A new regime of property tax is employed.
- Housing policy: a minimum percentage of 20% of affordable and social housing is enforced across the development. The provision of new housing and employment is mandatory and applicable for all existing residents.
- Public services: a provision for public health and education facilities is mandatory within the eco-city.
- Transport policy: new regulations are put in place to guarantee limits to car ownership; parking charging; creation of not-for profit transport enterprises; and a funding framework.
- Environmental policy: policy framework created to improve emissions, promotion of clean industries, and the development of a water saving tax.

In planning terms, the development of Tianjin eco-city introduces a series of innovations in comparison with business as usual development. These include:

- Introduction of specific zones for cultural heritage.
- Differentiation of types of industrial use, such as first-class, light industrial and storage.
- Detailed zoning between four types of green spaces namely, community space; ecological areas; public greens; and green buffers.

Sources:

(SSTEC, 2010); (Yang & Dong, 2008)

3.2 Hammarby, Stockholm, Sweden

Hammarby is an initiative of Stockholm's city government which intended to showcase the unique opportunity of expanding the inner city while converting an old industrial and harbour area into a modern neighbourhood.

The overall environmental goal associated with this project is that the impact placed on the environment by emissions from Hammarby Sjöstad shall be 50 % lower than the corresponding level for newly constructed housing areas in 1990s.

The main partners of the project are: the city of Stockholm; environment and health committee of Stockholm; infrastructure and mobility departments; environmental protection agencies; private technical and economic partners (building companies, land owners); the Local Investment Programme Council; Stockholm Water Company; the Stockholm Waste Management Administration; Birka Energi; and the environmental information centre (GlashusEtt).

Basic Information / location

- Site area: 200 hectares
- Population at completion: 35,000 people, 25,000 of those will be residents
- Year of completion: 2015
- Total number of residential units: 11,000
- Type of uses: residential, commercial, social infrastructure and light industrial (associated with sustainable technologies on site)

Site condition

During the late half of the 20th century, a shantytown began to grow in the site, and the area eventually became a small-scale industrial area.

Constant threats of demolition meant the buildings in the area were of a temporary nature, largely consisting of a range of corrugated steel shacks. This condition of underutilisation lasted until 1998, when it was demolished to make way for Hammarby Sjöstad[80].

Enabling infrastructure

The development of Hammarby integrates a large number of innovations in its utilities and transport infrastructure. These include:

- Energy: renewable fuels, biogas products and reuse of waste heat coupled with efficient energy consumption in buildings.

[80] (City of Stockholm, 2011)

- Water & sewage: including new technologies for water saving and sewage treatment.
- Waste: the totality of its waste is processed, with material and energy recycling maximised wherever possible.
- Transportation: fast, attractive public transport combined with car pools and attractive cycle paths, in order to reduce private car usage.

The above technologies are integrated in a closed loop system called the 'Hammarby Model'. This model was jointly developed by the water, waste and energy companies of Stockholm.

Policy links

In Sweden, cities enjoy a large degree of legal and financial autonomy. Thus, Stockholm has a 660 million US dollars annual budget and has developed its own Local Investment Programme for ecological sustainability (LIP), investing 992 million US dollars in its programme. The Hammarby project is estimated to accumulate a total cost of 2.2 billion US dollars.

There is great emphasis placed on the importance of collaboration and synergistic thinking between diverse actors, each having responsibility for different segments of the closed-loop integrated Hammarby system. All these efforts are coordinated by the Stockholm city government.

Sources:

(ADEME, 2008); (City of Stockholm, 2011); (Poldermans, 2006); (SymbioCity, 2010)

3.3 Linha Verde, Curitiba, Brazil

Governance framework

According to Simon Joss, Curitiba has a long standing, international reputation as one of the world's first eco-cities[81]. The initiatives of Curitiba's metropolitan government to improve the urban conditions were initiated in the 1970s under the leadership of Mayor Jaime Lerner.

Linha Verde, as many other transport corridors in the city, constitutes a relevant example of urban retro-fit and densification that has been successfully managed by the local government. The scope for the interventions in Curitiba is based on the creation of public transport corridors partially funded by private investment triggered by strategic incentives provided within urban planning policy.

Basic Information / location

- Site area: 2,082 hectares
- Existing Population: 82,000 people 2010 census

[81] (Joss, 2009, p. 7)

- Population at completion: unknown
- Type of uses: mix of residential, non residential and social infrastructure uses. Overall, the large majority of the construction allowance created for the project is residential (73%) and a smaller amount for non residential uses (27%).

Site condition

The area of influence of the project includes three main areas with dissimilar characteristics.

- *Setor Norte* includes zones predominantly residential, industrial and services, with low and medium densities and a high percentage of vacant plots (27%).
- *Setor Central* includes low density mixed-use areas with a high percentage of vacant plots (27%).
- *Setor Sul* includes low density residential and commercial areas with important number of small industries.

Enabling infrastructure

The project encompasses the design and implementation of the following infrastructure:

- Rapid transit corridors, including roads, bus stops, crossings and alternative lanes for cars.
- Green spaces focusing on creation of leisure and pedestrian spaces.
- Roadways including cycle routes.
- Sewage and drainage system in the regeneration area.
- Social housing and social infrastructure, the latter includes "public facilities to serve the population and the municipal administration".

Policy links

The main innovation associated with the development of the infrastructure corridor is the creation of CEPACs, (*Certificados de Potencial Adicional de Construção*) which are tradable development rights issued by the municipality. These can be only utilised by developers within the area of influence of the project.

The resources obtained by the creation of CEPAC are reinvested in the urban interventions considered within the plan.

Sources:

(Joss, 2009); (Prefeitura de Curitiba, 2012)

3.4 Key findings

The creation of eco-cities or eco-districts is a practice that is occurring in both developed countries and in the global South. While their scales vary substantially according to the reality of each region, these projects are based on ambitious aspirations on environmental performance; deliverability; and quality of life. These objectives are stated at the outset of the project.

The general findings from the analysis in this chapter can be summarised as follows:

- The planning and implementation of eco-cities is usually driven by metropolitan governments (e.g. Curitiba Linha Verde, Brasil; Hammarby, Sweden) or, alternatively, dedicated governmental agencies (e.g. Tianjin eco-city, China; Masdar, UAE). Although there are many attempts to trigger the development of eco-cities by purely private investment, these are limited to small scale initiatives (e.g. BedZED, London, UK) as they don't require major infrastructure development.
- The creation of a green development zone does not propose a "standard" set of policy modifications. Instead, these are usually set on an ad-hoc basis and target the generation of incentives for private sector investment.
- The implementation of eco-cities integrates key strategies of urban systems thinking, such as a water cycle management plan; integrated waste management planning; energy; green spaces; etc. Moreover, public transport systems play a key role in the reduction of car use as well as in the integration of these projects with the wider urban context.
- Residential land uses form the majority of the areas built in eco-city projects. In general they represent 2/3 to 3/4 of the developable areas.

A summary of specific findings related to the project are provided in the following table:

	Tianjin eco city, Tianjin, China	Hammarby, Stockholm, Sweden	Linha Verde, Curitiba, Brazil
Start / completion	• 2008 - 2023	• 1997 - 2012	• 2011 - unknown
Area	• 3,000 hectares	• 200 hectares	• 2,082 hectares
Stated objective	"A thriving city which is socially harmonious, environmentally-friendly and resource-efficient – a model for sustainable development". This vision is underpinned by the concepts of "Three Harmonies"(social harmony, economic vibrancy, environmental sustainability) and "Three Abilities" (practicable, replicable and scalable)"	"The impact placed on the environment by emissions from Hammarby Sjöstad shall be a massive 50 % lower than the corresponding level for newly constructed housing areas dating from the early 1990s in Stockholm"	"To promote urban structural changes, social improvements and environmental enhancement, in the catchment area, using funds from the sale of Certificates of Additional Construction Potential – CEPACs"
Trigger elements	• The project was proposed by then Singapore's Minister Goh Chok Tong to the Chinese Premier Wen Jiabao in April 2007, against the backdrop of rapid urbanisation and increasing global attention on the importance of sustainable development. • On 18 November 2007, Singapore Prime Minister and Chinese Premier signed a Framework Agreement for Singapore and China to jointly develop Sino-Singapore Tianjin Eco-city	• Increase in housing demands as a consequence of economic boom in 1992 • Failure in the bid for Olympics • Creation of a contingency plan to create a new vision of the site based on environmental objectives	• Political initiative of Mayor Luciano Ducci. His proposal pursues to establish a further connection of the two sides of the city. • The Prefeitura released launched bonds on the Sao Paulo Stock Exchange for investment in the development corridor.
Key stakeholders	• Chinese government (Vice Premier level) • Government of Singapore (Deputy Prime Minister level) • Tianjin city government	• City of Stockholm • Local investment programme council • Stockholm Water Company	• Prefeitura de Curitiba (Municipality) • Banco do Brasil • Construction Industry Chamber of

		• Stockholm Waste Management Administration • Birka Energi (energy operator)	Parana • Parana Housing Union • Engineering Institute of Paraná • Commercial Association of Paraná • Parana Architects and Town Planner Union
Key Financing Sources	• Governments of China and Singapore are financing the construction of major infrastructure (highways, access roads, railways, waterways, city parks, flooding defences) • Private developers finance all infrastructure within their development plots, including minor roads and utilities, public spaces and buildings.	• The City of Stockholm joined forces with 25 construction companies to build the 200 hectares district, with the latter contributing 80% of the total cost. Other funding comes from two government agencies - the Swedish Rail Administration (rail transport) and the Swedish Road Administration (routing of the Southern Link ring road)	• The city of Curitiba financed the feasibility studies with its own internal funding. • The implementation of the infrastructure and public facilties is financed through bonds sold inthe Sao Paulo Stock Exchange
Published KPIs	• These were generated based on national standards in China and Singapore, and the higher of the two standards was adopted, wherever feasible. International best practices and local conditions in Tianjin were also taken into account. • There are 22 quantitative and 4 qualitative KPIs. • KPIs associated with initial stages will be enforced by 2013 • KPIs applicable to the whole project will be enforced by 2013 • A complete list is provided in Appendix A	• Overall objective: emissions shall be 50 % lower than 1990s business as usual (newly constructed housing in Stockholm) • Energy consumption: 60kWh/m2/year • Water use: 50% reduced compared to new inner city projects • Waste generation: reduction of 20% • Public transport: 80% of the travel to and from work would be by public transport, bicycle or by foot by 2005; 90% by 2015	• Minimum price for CEPACs in first auction: 200 BRL (110 US$) • Creation of potential 4.47 million square metres of additional construction

4 Principles for Green Zones in Lima

4.1 Vision

Opportunity

Lima-Callao, as other metropolitan agglomerations in Latin America, has major environmental problems related to the lack of coordinated approaches to urban systems such as mobility, infrastructure, public transport, land uses and energy sources.

In this context, the Green Zones initiative proposes to introduce a substantial change in the development of Peruvian cities by creating zones of exemplar sustainable development. These will demonstrate the benefits of an integrated approach to planning in which national and city governments, the private sector, and the local communities join their efforts in the creation of more sustainable environments able to reduce their impact in the ecosystem.

Key elements

A sustainable and resilient environment is also a more attractive place to live. The Green Zones in Lima will be pieces of city that will demonstrate how to live, work, play and learn, producing innovation that benefits people, the environment and the economy.

The 5 key elements of the Green Zones are:

Innovation – a creative approach to city making: The integration of sustainable aspirations, innovative business models, and a coordinated governmental action will facilitate the creation of urban environments where citizens will enjoy a better quality of life. A consented, transparent and understandable delivery model will guarantee the participation of a wide range of social actors.

Efficiency - Integration of urban systems: The design and implementation of the Green Zones will respond to a coordinated approach to investment in infrastructures and buildings. As a result of the integrated action of public and private actors, these projects will be able to go through design and implementation stages in a shorter period of time. Moreover, given that the thinking of the infrastructure contained in the project will be approached holistically, new opportunities for the creation efficiencies of scale and resources will be created.

Accountability - Creation of measurable outcomes: By integrating the capacity to measure the environmental impacts of the design and its implementation and operation, the Green Zones will provide robust and quantitative information that demonstrates how issues such as energy demand in buildings, impact of transport and carbon emissions can be improved.

Behavioural Change - Enabling new urban living: By creating projects that are socially and economically attractive, the Green Zones will allow for the convergence of the aspirations of governmental and private actors.

Complementarily, integrating the community from the outset will enable people to understand and act on choices about their consumer goods, transport and energy - among others – so that we can accelerate the rate at which their carbon and ecological footprint can be reduced over time.

Implementing, learning and replicating: The prompt implementation of a pilot project will enable to learn lessons on improving incentives to private investment, public policy and coordination mechanisms. These lessons should then be integrated into follow up projects and relevant regulation.

The result

Green zones will be **vibrant medium to high density city quarters** characterised by innovation in the design of places where people can live, work and play. Their vibrancy will attract dynamic businesses and diverse communities that will incorporate sustainable principles in their day-to-day choices.

We imagine a network of **active public spaces** that are full of life. These will incorporate sustainable infrastructures that will benefit the environmental performance and resilience of the community.

We propose the implementation of **flexible buildings** that can integrate mixed uses from the early stages. These will prioritise the integration of strategies to reduce consumption of energy and water, as well as minimising the generation of waste.

Efficient and sustainable **transport choices** will be available for the travel of citizens within, into and out of the green zones. These will integrate innovative strategies such as new fuel options (for example, electric cars, hydrogen BRT buses, etc); reduction in the need for travel due to availability of housing, jobs and leisure options; and the prioritisation of the use of efficient modes of transport (such as public transport) and non-motorised modes such as walking and cycling.

People living, working and playing in the green zones will be aware of the impact that their choices have on the environment. Through an active process of accounting and engagement, the Green Zones will **influence people's behaviour** towards a more sustainable lifestyle.

4.2 Environmental advantages

Among the many environmental advantages that the creation of green zones in Lima will produce, we envisage the following:

Measurable Outcomes

Green zones will produce measurable outcomes that can be monitored at planning and design stages and their results will be seen within the first year. Operational

emissions can be compared to business as usual development (or compared to an existing area in Lima) from year one. For example,

- Green Zones can be exemplar cases of the integration of ambitious sustainability objectives into the planning and design process of city districts. In Finland, SITRA Jätkäsaari Climate Neutral district has become a globally acknowledged example of city planning where carbon neutrality principles are integrated from the outset. It is envisaged that this approach will allow Jätkäsaari to achieve carbon neutrality in 2020 and a 35% decrease in overall carbon emissions vs. Business as Usual in the long term, (2032-2037)[82]

- Co-location of both commercial and residential space in dense areas has the potential to eliminate or shorten motorised journeys to work, thus maximising time for residents, and lessening fuel use. In 1999, a research on 32 cities by Newman & Kenworthy demonstrated that the fuel consumption per capita in medium and high density cities -such as Vienna (140 people per hectare) or Singapore (175 people per hectare) - is 25% lower than in low density metropolitan areas such as Melbourne (20 people per hectare) and New York City (30 people per hectare across its five boroughs)[83].

- Designing buildings according to a consistent sustainable approach focused in resource efficiency can lead to important reductions of the energy demands. For example in Beddington Zero Energy Development (BedZED), occupancy monitoring shows that average electricity consumption is 45% lower than in the surrounding area, and heating 81% less[84].

- By providing a multiplicity of choices for more efficient and sustainable modes of transport, commuting choices can be influenced. In Hammarby, Sweden, daily commute by public transport, bicycle or by foot has reached 70% of the trips. Surveys show that in London's BedZed the introduction of innovative ideas such as 'car clubs' triggered a 65% reduction in private car mileage[85]. According to the Government of Singapore, the design of Tianjin eco-city is targeting at a 90% of trips within the Eco-city, which should be in the form of green trips by 2020[86].

Non-measurable outcomes

Other important environmental advantages of this approach include:

- Denser development concentrates growth in specific areas and reduces development pressure on undeveloped or ecologically sensitive land

- Green zones can demonstrate how Lima can be operated more efficiently, drawing in strategic improvements to the current infrastructure as well as on cooperation between metropolitan and national governments

[82] (Arup, 2009, p. 31)
[83] (Newman & Kenworthy, 1999)
[84] (Guardian, 2011)
[85] (Guardian, 2011)
[86] (Government of Singapore, 2012)

- Exemplar initiatives such as the Green Zones will illustrate how the various levels of government can collaboratively implement initiatives that have direct impact on people's quality of life.
- A new integrated planning policy can be tested through pilot projects. Following a performance-based approach, green zones have the potential to be pilot projects for an improved and more coordinated planning policy that combines enhancements at both the national and local levels.

4.3 Economic advantages

Economic sustainability is generally defined as economic growth that positively impacts both quality of life and the environment. In the context of development, we believe that there is a strong link between economic sustainability, social and environmental performance, and value creation. Value creation is the financial attractor that has the potential to persuade developers and governmental agencies to reprioritise the drivers within the development business.

From a financial point of view, values or revenue generated in the long-term must not just equal but exceed those in the short-term inclusive of discounting. This is a challenge and one that must be tested within each prospective development as drivers will differ with the local market.

In this context, we envisage the following economic advantages will benefit the society as a whole:

- The creation of a local green economy can boost the demand for the location of inhabitants and business in a certain area. Surveys in Curitiba show that the integration of ambitious long term environmental policies and creative business models has resulted in a "99% of inhabitants that want to live in the city"[87]. In comparison, 70% of Sao Paulo's residents want to live in Curitiba.
- The implementation of innovative approaches to urban development allows the creation of a strong urban identity able to attract new investment and jobs. For example, Curitiba's average income per person has gone from less than the Brazilian average in the 1970's to 66% greater than the Brazilian average in the last decade[88].
- The creation of green zones and active role of private investors in urban development offers an opportunity to rethink the pricing and investments models on infrastructure. In this context it is essential to establish workable pricing models and jointly ensure that both financial and social targets are being met. Potentially, a partnership approach could result in public sector savings, increased spend and risk taking from the private sector, and the formation of new business models/revenue streams.
- The definition of a delimited Green Zone will concentrate development into a smaller quarter thereby reducing the areas requiring utility services in a business as usual context. It also offers the opportunity to have private companies fully or partially finance the costs of infrastructure, thereby reducing demand on government and public/private risk sharing.

[87] (O'Hare, 2009)
[88] (O'Hare, 2009)

The economic benefits that will directly benefit the developers or long-term land owner include[89]:

- Creation of employment and retail areas can act as an attractor for residential sales
- Diversity in commercial, retail and industrial space offers diversification opportunities and different revenue streams
- Leasing of space offers an opportunity to gain through increasing capital values over time and extend the revenue generation period beyond the typical sales period of strictly residential development;
- Proximity to quality social infrastructure (namely schools and high quality public facilities) and well maintained green spaces can increase land values
- Potential to attract enough employers and residents to make public transport economically viable.

4.4 Proposed Sites

Lima's Planning Metropolitan Institute, IMP, has proposed the location of seven sites for green zones within the city. These respond to the following criteria:

- A reference area of 500 hectares.
- The current use of the site should consider low and medium density occupation inside or outside the urban boundaries of the city.
- Areas should have a potential for rapid mass transportation servicing, associated to either the BRT (*Metropolitano de Lima*) or metro (*tren electrico*).
- Located in areas of low to medium income population.
- Private real estate investment potential.

Based on the information and opinions gathered in our visit, we have summarised key constraints and opportunities for each of the sites. They are as follows:

Name	Area	Existing population	Opportunities	Constraints
Chacracerro-Comas	530 ha	11,017	• Direct access from Panamericana Norte increases opportunities to utilise existing road infrastructure to gain access to the site • Likely to be connected to	• Distance from city centre increases cost of mass transit public transport systems • Risk of flooding • Irregular settlements

[89] (Arup, 2008, p. 195)

			mass transit systems • Existing agricultural use	• High number of land owners requires substantial work with existing communities
Carapongo-Lurigancho	720 ha	14,118	• Direct access from Carretera Central increases opportunities to utilise existing road infrastructure to gain access to the site • Existing agricultural use • Several surrounding existing communities may benefit from the facilities provided by this development •	• Access points are scarce • Flooding risk from Rimac river • Land is subdivided, hence its development requires substantial work with existing communities • Existing informal settlements • Existing informal rubbish dumps
Pucusana	750 ha	620	• Direct access from Panamericana Sur increases opportunities to utilise existing road infrastructure to gain access to the site • Low levels of subdivision of land • Future availability of employment associated with the surrounding industrial areas	• Substantial distance from city centre increases cost of mass transit public transport systems • Existing industrial use in close proximity • Possible risk of flash floods
Villa El Salvador	581 ha	5,340	• Direct access from Panamericana Sur increases opportunities to utilise existing road infrastructure to gain access to the site • Potentially create a positive impact for a large number of inhabitants in the surrounding area	• Land is subdivided • Unorganised mix of agricultural and industrial land uses is present in the same area
Chuquitanta	843 ha	55,819	• Potential for low income upgrade of settlement	• Low access to urban infrastructure • Informal settlement is utilising the site, demanding substantial

				efforts in work and negotiations with existing communities • Existing population is substantial
Manchay Bajo	532.57ha	3,422	• Potential for residential real estate investment • Scenic character of its surroundings	• Distance from city centre increases cost of mass transit public transport systems • Accessibility is restricted by geographic location • Land is subdivided • Restricted potential for mass transit system
Manchay Alto	1,170 ha	49,500	• Accessibility is restricted	• Distance from city centre decreases the potential for integration of mass transit public transport systems • High population • Substantial level of development • Land is subdivided

Among the sites with potential for development identified by the interviewees, we can include:

Name	**Area**	**Existing population**	**Pros**	**Cons**
Aeropuerto Las Palmas	300 ha (approx)	0	• A single land owner (Peruvian Air force) • Surrounded by substantial population that could be benefited from the new accessibility and social infrastructure delivered by the project • Potential connection to extension of Paseo de la Republica • Likely connection to BRT system • High potential for real estate investment	• The implementation will require the identification of an alternative location for the Air Force facilities currently located on the site

Pampas de Lurin y San Bartolo	23,500 ha[90]	115,000	• Accessible from Panamericana Sur and potentially from a future extension of Pachacutec road. • Strong interest from national government • High interest from private sector • Potential to create a new image for the city • Its environmental conditions require high levels of innovation in the provision of urban infrastructure	• Distance from city centre increases cost of mass transit public transport systems • The development of this major site requires a coordinated effort of the city and national governments • There are perceived levels of speculation in the real estate market • Its development will require substantial investment in urban infrastructure • Water provision for the area is difficult • In order to ensure the development of medium density districts, this large size of the site requires a phasing plan that integrates development in the short, medium and long term. This will discourage land speculation and saturation of property market • Requires substantial work with existing communities

Following this analysis, our recommendation for further feasibility studies (please refer to section 5) includes the following groups:

Sites with high development potential, requiring focus on understanding of existing ownership conditions

- Aeropuerto Las Palmas
- Pampas de Lurin y San Bartolo
- Villa El Salvador
- Chacracerro Comas

Sites with development potential under a delivery model that integrates extensive work with existing communities on/surrounding the site

- Carapongo Lurigancho
- Manchay Alto

[90] (Florez, 2010)

- Chuquitanta

Sites with lower development potential associated with a Green Zone vision

- Manchay Bajo
- Pucusana

5 Delivery mechanisms

5.1 Key variables for site development

Principles

The manner in which this initiative is implemented is critical to its success, thus great attention needs to be given to this stage. Strong and permanent backing from National and Metropolitan governments is fundamental, as investment programmes will surely run over more than one presidential or mayoral period due to the scale of the identified sites. In this context we would like to note that the delivery mechanism should be:

- Competitive, open, transparent and accountable
- Responsive to the dynamics of the local market
- Designed to balance risks and rewards for major stakeholders
- Integrated, including all components of urban development
- Based on governance structure that transcends national or municipal governments
- Monitored according to a set of performance indicators that allow control and continuous revision of quality
- Inclusive of economic, social and environmental objectives and indicators as well as quality of life indicators

Key Considerations

There are different considerations in establishing an appropriate governance and delivery mechanism for the Lima Green Zone. Key points to consider are:

- **Objectives**: What is the delivery mechanism intending to accomplish?
- **Needs**: Why is there a need for a mechanism that is different or separate from existing channels? What are the challenges, barriers and risks that need to be addressed?
- **Institutional capacity**: What is the capacity of the local institutions to deliver a project of this complexity? Who will be in charge of providing a strong local leadership with adequate powers?
- **Legal framework**: What delivery mechanisms are allowed in the local context? Can land be transferred to the private sector? How complex is land ownership?
- **Investment needs**: How significant is the scale of investment needed? Can the government provide any funding to support this initiative?
- **Private sector interest**: What is the investment climate? Would there be strong private sector interest? What are their concerns and preferences?

- **Financing mechanisms**: What are the existing or potential financing mechanisms that could be utilised? Could the green zone enjoy special tax status?

5.2 Key variables for a delivery model

Possible Delivery Approaches

Outlined below are 5 delivery approaches that have been used in other cities around the world. Regardless of the delivery mechanism utilised, a strong governance system needs to be established to drive this process in collaboration with stakeholders and to ensure it has political longevity. This could mean establishing a dedicated Green Zone Development Corporation or a special Agency for Green Zone Development. These organizations could then enter into agreements with private sector partners and coordinate planning policies and incentives for development of the district.

Traditional planning model

Under a traditional planning model, the national government or Lima's city government can establish a planning framework that determines:

- In which areas green zones can be developed
- The planning policies and design guidelines that developers must follow when developing sites in these areas
- Incentives available to developers (for example, fast-track planning granted to green projects)
- Fees or contributions required from private developers to cover the costs for connecting to infrastructure

This approach is straight forward in terms of the planning stage, but will probably leave some important gaps in the provision of an integrated city district, as investments can be piecemeal (for example, it does not address how major infrastructure for green zones will be delivered in a coordinated manner).

Public Private Partnership (PPP) - Concession model

Under this model, the government would grant a private developer (or a consortia of developers) a concession to design, build and maintain the green zone for a specified period (e.g., 100 years). The government would retain ownership of land, serving as the "freeholder", while the developer partner would have a "leasehold" over the development and use of land. The partner could then enter into separate agreements with other partners for development of specific parcels.

The concessionaire would be selected through a competitive, transparent process whereby different bidders would submit their ideas for developing the site based on a specified land use and other requirements. The evaluation and selection process could involve a quantitative component focused on the concession payment offered and a qualitative component focused on the quality of the proposed development from an urban design perspective. Depending on the

nature of investment required, the government may still need to fund major infrastructure development.

The outcome of this process will result in the selection of a Public Private Partnership agreement that includes all development conditions, including agreed incentives, policies, permitting, investment programme for both parties and KPI's.

The agreement between the concessionaire and the government would specify:

- Terms and requirements for the concession, including design guidelines and standards that must be complied with across design, construction and operation
- Financing available from the government
- Annual rental payment due to the government and/or revenue-sharing scheme

This model is fairly uncommon for district-wide, mixed-use developments. It tends to be used when either: (a) there is a legal constraint regarding transfer of ownership to private developers; or (b) the development has a single land use, such as a hospital or industrial estate, which can be developed through a PPP or PFI model. It places a significant risk to developers as they will not have ownership of the land, which impacts marketability to homebuyers, and will have to take full responsibility for commercial risks while the district is being developed.

An example of a project being developed through a concession is the Porto Alegre waterfront development in Brazil.

An alternative to this model would be to have the government become the master developer responsible for developing all the horizontal components. The government could then find a concessionaire(s) to develop specific parcels. This means the developers would be taking on less risk and therefore pay a higher concession fee to the government. However, it requires the government to have the funds needed for the horizontal development.

PPP - Exclusive Development Rights

Under this model, the government would enter into a partnership with a private developer (or a consortia of developers), providing the exclusive right to develop the green zone. Unlike a concession whereby the government continues to own the land, the rights for development would include partial or full transfer of land to the private sector partner.

Selection of the partner consortia would be through a competitive process similar to that for a concession. The partner would serve as the master developer, responsible for developing the infrastructure, utilities and open space, and could then either develop parcels of land themselves or sell parcels for development to other developers.

An example of a project being developed through this way is the redevelopment of the Stapleton Airport in Denver, Colorado and Treasure Island in San Francisco, California.

As with a concession, an alternative approach would be to have the government become the master developer responsible for developing all the horizontal

components. The government could then grant a private partner the right to develop specific parcels.

Urban Development Corporation

Urban Development Corporations (UDCs) are not-for-profit corporations established as limited life bodies with responsibility and power to develop or regenerate a designated geographic area. They are used to bring land and buildings back into effective, productive use; attract new industry and commerce; improve the urban environment; and ensure that housing and social facilities are available to encourage people to live and work in the area.

UDCs have significant planning powers and access to considerable resources – including the ability to acquire, hold, manage, reclaim and dispose of land and other property. They can also directly deliver services and programmes in the regeneration area and enter into partnerships with private developers. Although they require significant seed funding, typically the funds raised from redevelopment are ring-fenced to be spent within the project area.

Key advantages are that they embeds powers, authority, responsibility and funding for delivering regeneration into one organization that has strong independence from the government and can make decisions swiftly. However, such organizations may need legislative approval and significant oversight, as well as start-up capital.

An example of a project developed through this way is the regeneration of the London docklands by the London Docklands Development Corporation.

Local Asset-Backed Vehicle

LABVs are special purpose vehicles that allow public sector bodies to use their assets (usually land and buildings) to attract long-term investment from the private sector for regeneration through a 50/50 ownership structure. They are designed to bring together a range of public and private sector partners in order to pool finance, planning powers, land and expertise and to ensure an acceptable balance of risk and return for all partners.

Private sector partners invest cash and/or equity, with the LABV providing returns, a share of which is reinvested in infrastructure or regeneration within the area.

An example of a project developed through this way is the British Waterways partnership with AMEC and Igloo Regeneration Fund to regenerate a 2000 mile waterway network in collaboration with local authorities and private land owners.

Recommendations

We recommend pursuing a PPP to provide Exclusive Development Rights to a private partner(s), as this model gives the most flexibility, is well-understood in the marketplace, and would likely not involve significant legislative changes to be implemented. To understand how this model could apply in practice to Lima, and how the governance structure should be developed to lead this effort, we recommend conducting a workshop with key stakeholders to discuss options and agree on the best approach. We also recommend soft market testing with real

estate developers to understand their preferences and concerns about how the PPP would be structured.

5.3 Key variables for carbon measurement

Delivering on green performance

A fundamental aspect of the planning and design of green zones will be the development of a robust framework of measurable outcomes. Among these, the assessment of carbon emissions constitutes an internationally recognised agenda. A performance-based approach focused on carbon also enables the creation of links to international financing mechanisms.

In this context, and in parallel to the definition of planning, policy, governance and consultation frameworks, the design of the green zone will require a constant focus on identifying and quantifying the costs, risks and opportunities associated with carbon emissions related to the construction and operations of the green zone.

This method will require expertise in developing, prioritising and delivering practical cost and carbon reduction measures tailored to the development processes.

In order to achieve the above, we recommend the inclusion of the following tasks:

- Define the mechanisms and protocols used to measure and monitor greenhouse gas emissions (GHG) (see next section), as well as how to measure other green or sustainable metrics that are to be considered (eg, water use).
- Establish a target for carbon reduction
- Undertake the planning and design needed to achieve low carbon targets. Establish strategies, actions, and targets for each sector.
- Quantify the business case for a low carbon strategy. This should be carried out in parallel to the development of specific development strategies for the Green Zone through an iterative process. It includes cost benefit analysis; market review; scenario analysis.
- Drive the delivery of real and sustained carbon reductions. This task will require the involvement of all the main project stakeholders. It is recommended that a dedicated team will be responsible for the following: implement, sustain, and engage users and report progress; define overall objectives and targets; create a roadmap for delivery; carry out monitoring of delivery; and provide training.

GHG Accounting

Accounting for GHG emissions was first defined by the Greenhouse Gas Protocol in 2001. The GHG Protocol identified emissions sources at 3 levels: Scope 1 (direct combustion of energy); Scope 2 (electricity purchased); Scope 3 (indirect emissions from consumption of goods and services). However, the GHG Protocol is focused on accounting for carbon at a corporate not city or regional level.

City Protocols

Currently there is no one protocol being adopted by cities. According to the Carbon Disclosure Project (CDP) Cities 2011 report, "efforts to measure GHG emissions from city government operations in a harmonised way have not yet caught on widely."[91]

At present the most commonly adopted protocols are:

- ICLEI IEAP- Local Governments for Sustainability International Local Government Greenhouse Gas Emissions Analysis Protocol[92];
- the UN/World Bank's International Standard for Determining Greenhouse Gas Emissions for Cities[93]; and
- For new community developments, the Climate Positive Development Program (CPDP) Framework established by the Clinton Foundation, in collaboration with the C40 Cities and the US Green Building Council

According to the CDP, cities are using these existing methodologies and combining them with their own proprietary approach. This situation should soon change, however, since the C40 Cities Group and ICLEI, supported by the UN and the World Bank, announced in 2011 that the two organisations will work together to establish a global standard for accounting and reporting on community-scale GHG emissions that can be used across multiple platforms. This will enable comparability in baseline GHG measurements among different cities and regions.

Key Issues in GHG Accounting

For the Lima Green Zone, key issues that will need to be further reviewed are:

- What emissions should be included? How much of Scope 3 emissions should be included, for example, carbon embodied in construction materials or in food consumed by the community?
- What is the boundary for measuring emissions?
- What emissions can be either controlled or influenced by the project?
- Can any emissions reduction generate tradable verified emissions reductions? If so, what project methodologies need to be used to calculate these?

Initial Recommendations

We recommend measuring GHG emissions using the CPDP Framework. The CPDP is a voluntary initiative that encourages developers of new districts or communities to meet a "climate positive" emissions target of net-negative on-site, operational GHG emissions. This climate positive outcome can be achieved by reducing emissions on-site as much as is feasible and then offsetting emissions in the surrounding community by for example, undertaking retrofit projects or creating green areas to serve as carbon sinks.

The program is designed specifically for new developments, and a carbon accounting tool is currently being developed. If the Lima Green Zone establishes

[91] CDP Cities 2011 Report (p.14)
[92] http://www.iclei.org/index.php?id=ghgprotocol
[93] http://www.unep.org/urban_environment/PDFs/InternationalStd-GHG.pdf

a net zero emissions target, it could submit itself as one of a select number of CPDP projects around the world[94].

The CPDP recommends the following in terms of GHG emissions measurement:

- **Emissions from construction**: The program encourages but does not require these to be measured. It suggests developer partners measure energy, waste, transportation, embodied carbon in materials, and land use change related to construction activities.
- **Operational Emissions**: The program requires GHG to be measured from:
  - (i) On-site thermal energy and electrical use, including emissions from energy consumed in buildings, project infrastructure, and water usage;
  - (ii) Solid waste and wastewater, including liquid and solid waste produced on-site, regardless of whether they are treated on-site or off-site;
  - (iii) Transportation, including a percentage of the total emissions associated with vehicular trips that start or end within the community.

In addition to these emissions, Arup could undertake GHG emissions calculations related to consumption of food.

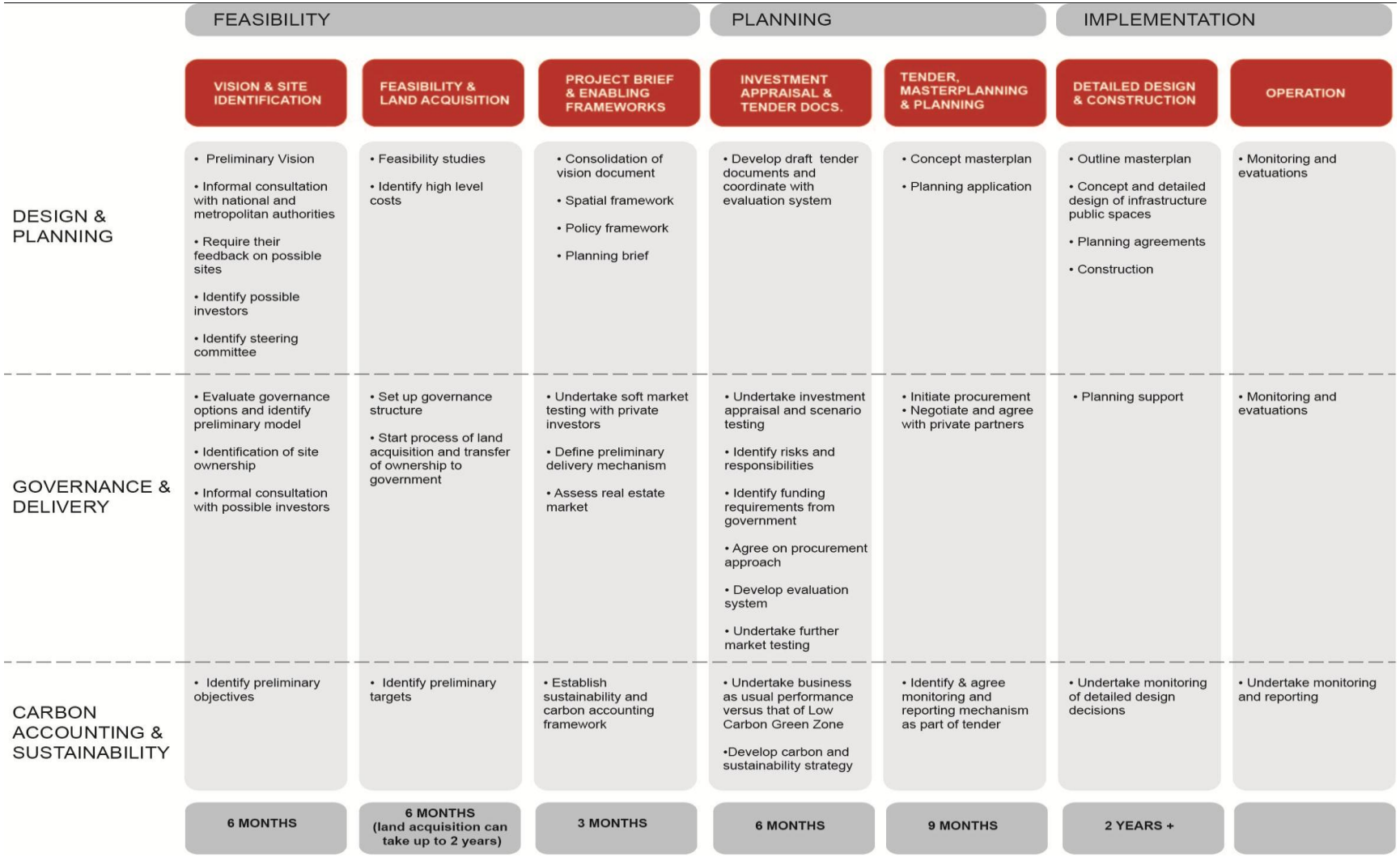
5.4 A delivery route map

As an overview, we envisage preliminarily that the following high level stages would be involved in the procurement process:

- Vision and Site Identification (6 months)
- Feasibility and land acquisition (6 months, land acquisition can extend to 1-2 years)
- Project brief and enabling frameworks (3 months)
- Investment appraisal and tender documents (6 months)
- Tendering process, Masterplan & Planning (9 months)
- Detailed design and Construction (2 years plus)
- Operation

A brief description of the tasks associated to these stages is included in the following route map

[94] http://www.clintonfoundation.org/what-we-do/clinton-climate-initiative/c40-cci-cities/climate-positive-development-program


FEASIBILITY
PLANNING
IMPLEMENTATION
VISION & SITE IDENTIFICATION
FEASIBILITY & LAND ACQUISITION
PROJECT BRIEF & ENABLING FRAMEWORKS
INVESTMENT APPRAISAL & TENDER DOCS.
TENDER, MASTERPLANNING & PLANNING
DETAILED DESIGN & CONSTRUCTION
OPERATION
DESIGN & PLANNING
• Preliminary Vision
• Informal consultation with national and metropolitan authorities
• Require their feedback on possible sites
• Identify possible investors
• Identify steering committee
• Feasibility studies
• Identify high level costs
• Consolidation of vision document
• Spatial framework
• Policy framework
• Planning brief
• Develop draft tender documents and coordinate with evaluation system
• Concept masterplan
• Planning application
• Outline masterplan
• Concept and detailed design of infrastructure public spaces
• Planning agreements
• Construction
• Monitoring and evatuations
GOVERNANCE & DELIVERY
• Evaluate governance options and identify preliminary model
• Identification of site ownership
• Informal consultation with possible investors
• Set up governance structure
• Start process of land acquisition and transfer of ownership to government
• Undertake soft market testing with private investors
• Define preliminary delivery mechanism
• Assess real estate market
• Undertake investment appraisal and scenario testing
• Identify risks and responsibilities
• Identify funding requirements from government
• Agree on procurement approach
• Develop evaluation system
• Undertake further market testing
• Initiate procurement
• Negotiate and agree with private partners
• Planning support
• Monitoring and evatuations
CARBON ACCOUNTING & SUSTAINABILITY
• Identify preliminary objectives
• Identify preliminary targets
• Establish sustainability and carbon accounting framework
• Undertake business as usual performance versus that of Low Carbon Green Zone
•Develop carbon and sustainability strategy
• Identify & agree monitoring and reporting mechanism as part of tender
• Undertake monitoring of detailed design decisions
• Undertake monitoring and reporting
6 MONTHS
6 MONTHS (land acquisition can take up to 2 years)
3 MONTHS
6 MONTHS
9 MONTHS
2 YEARS +

Instruments in place

We envisage that the various levels of government will assume an active role in the creation of the following incentives / instruments for investment:

- An infrastructure subsidy would be created for capital expenditure on urban infrastructure for each district. This excludes energy power plants, waste water and water treatment plants.
- Transport corridor and associated low carbon mobility would be a demonstration on its own. This initiative could be addressed in coordination with the development of the districts.
- Government (or dedicated agency) should finance the feasibility studies for the project. This should include external funding associated to low carbon programmes, such as the NAMAs.
- Match funding from technology providers for ICT infrastructure could be sought from companies such as Siemens.

Conclusions and next steps

The creation of low carbon development zones in Lima is an idea with enormous potential. Its innovative agenda combines new patterns of urban development with cutting edge environmental agendas. Moreover it offers an interesting opportunity to address strategically current problems of the city as well as the aspirations of social and political agendas at national, regional and global level.

However, the potential of the green zones can only be achieved by addressing two critical issues: the lack of a governance and delivery framework to coordinate the actions of local and national governments (including innovative incentives for investment) as well as the definition of preliminary project-specific objectives associated with carbon accounting and sustainability.

In order to proceed with the above, a clear identification of sites and their current ownership is needed. This report proposes a group of sites with high development potential for the Green Zones. This includes:

- Aeropuerto Las Palmas
- Pampas de Lurin y San Bartolo
- Villa El Salvador
- Chacracerro Comas

Consistently with previous discussions on the project, we suggest that the delivery of the project is likely to be most efficient by using a public private partnership (PPP). Our further studies indicate that this PPP should be implemented under the Exclusive Development Rights modality, as this model gives the most flexibility, is well-understood in the marketplace, and would likely not involve significant legislative changes to be implemented.

In order to provide a consistent approach to that the reduction of carbon emissions in the Green Zones initiative, we propose to follow the principles set by internationally recognised GHG accounting methods. In this context, we suggest to utilise CPDP Framework as this has

been designed specifically for new developments, and a carbon accounting tool is currently being developed.

Based on the above principles, the following next steps are recommended:

Design and Planning Tasks

- Establish a formal process of communication between the planning, environmental and economic authorities at the national and local levels. While there is an acknowledgement that the green zones project can contribute to develop a future vision for Lima, further discussions are required to address issues at the strategic and practical level.
- Undertake an informal round of consultations with national and metropolitan authorities so that there is initial support on the prioritisation of sites and the preferred delivery model. This could take the shape of an initial workshop in which the relevant stakeholders (e.g. Lima municipality, IMP, Ministry of Housing, British Embassy) will discuss their views on the project.
- Identify private investors with interest in the development of the sites identified and validated by the relevant stakeholders. Although this report provides a high level review of the constraints and opportunities of each site, this should be complemented with a further round of discussions with real estate investors and an understanding of their views on the development potential for the sites. This information can be compiled by an independent planning consultant.
- Identify a steering committee, which formally or informally will act as a decision maker in the initial stages of the project, i.e. first year.

Governance and Delivery

- Based on our recommendation for a delivery model, an Exclusive Development Rights PPP, it is recommended to understand how this model could apply in practice to Lima, and how the governance structure should be developed to lead this effort. We recommend conducting a workshop with key stakeholders to discuss options and agree on the best approach.
- Undertake a preliminary soft market testing with real estate developers to understand their preferences and concerns about how the PPP would be structured.
- Analyse the ownership condition for each of the sites prioritised by the relevant stakeholders. This legal/planning study should rely in local knowledge and should identify the number of owners associated with each of the proposed sites. This should also take into account the legality of existing settlements in the sites.

Carbon accounting and sustainability

- Identify preliminary carbon accounting and sustainability objectives. We suggest this task takes the shape of an initial literature review study (2 weeks) together with an initial sustainability workshop. The objective of this workshop should be limited to the identification of possible funding for the carbon accounting aspects of the project and the objectives associated with it. The definition of the objectives should not be limited to carbon accounting; hence it should include other social, economic and environmental variables.
- Identify possible sources of funding for the project as well as a summary of possible incentives already available in the national and international contexts

We envisage that the tasks described above could be completed in a period of six months. Subsequent tasks will include:

- Tendering and undertaking of feasibility studies for: land uses, accessibility, enabling works, and utility infrastructure
- Identification of high level costs, which should only include a rough order of magnitude, based on the feasibility studies in progress.
- Setting up a governance structure, this should define the duties and rights for each of the major stakeholders, as well as for representatives of local communities.
- Proceed with legal studies to support the land acquisition process. At the end of the first year, these studies should identify a feasible process of transferring/selling the land from its current situation to the agreements associated with an Exclusive Development Rights PPP.
- Identify the preliminary targets associated with a carbon accounting and sustainability framework. This should capture the diversity of aspirations proposed by the various stakeholders, such as developers, politicians, and existing communities.

Bibliography

ADEME. (2008). *Guidebook of Sustainable Neighbourhoods in Europe.* Paris: ADEME & Energie Cities.

Arup. (2008). *Wanzhuang Eco-City: Development Strategy Masterplan Report.* Shanghai: Arup.

Arup. (2009). *c_life: city as living factory of ecology.* London: Arup.

City of Stockholm. (2011, May 18). *Environmental goals*. Retrieved March 20, 2012, from Environmental web portal to Hammarby Sjöstad: http://www.hammarbysjostad.se/glashusett/

CONAM. (2006). *Hacia una Política Energética y Ambiental sostenible en el Perú.* Lima: CONAM.

ECLAC. (2010). *Foreign Direct Investment in Latin America and the Caribbean.* Santiago, Chile: United Nations.

ECLAC. (2011). *Foreign Investment in Latin American and the Caribbean.* Chile.

Ecofys, E. a. (2011). *Annual Status Report on Nationally Appropriate Mitigation Actions (NAMAs).*

Economist Intelligence Unit. (2012). *Hot spots: Benchmarking global city competitiveness.* London: Economist Intelligence Unit.

Filipe Fraga, D. R. (2011). *Car Fleet renewal schemes: Environmental and Safey Impacts.* Holland: International Transport Forum.

Florez, R. (2010). *UNA VISIÓN DE LIMA AL 2035.* Lima: URVIA.

Ford, L. (1999, January). Latin American City Models Revisited. *Geographical Review, 89*(1), 129-131.

Ford, L., & Griffin, E. (1980, October). A model of Latin American city structure. *Geographical Review, 70*(4), 397-422.

Government of Singapore. (2012). *KPIs*. Retrieved April 13, 2012, from Tianjin eco-city: A model for sustainable development: http://www.tianjinecocity.gov.sg/bg_kpis.htm

Guardian, T. (2011, November 2). *Sustainable Business Partner Zone*. Retrieved April 12, 2012, from The Guardian: http://www.guardian.co.uk/sustainable-business/pooran-desai-interview-green-buildings

IDB, A. S. (2010). *NAMAs in the Transport Sector Case Studies from Brazil, Indonesia, Mexico and the People's Republic of China.* Philippines: ADB and IDB.

IMP. (2011). *La Viabilidad y el Trasnporte Urbano Metropolitanos en la Situación Actual.* Lima: IMP.

INEI Instituto Nacional de Estadistica e Informatica. (2011). *Indicadores Demograficos*. Retrieved April 12, 2012, from Presidencia del Consejo de Ministros Instituto Nacional de Estadistica e

Informatica: http://www.inei.gob.pe/perucifrasHTM/inf-dem/cuadro.asp?cod=9176&name=d15_02&ext=jpg

Iturregui, P. (2012, February 20). Letter of appointment. Miraflores, Lima, Peru: British Embassy in Lima.

Joss, S. (2009). Eco-cities — a global survey 2009. *WIT Transactions on Ecology and The Environment, 129*, 239-250.

Maria Paz Cigaran, T. P. (2011). *Priotización y Formulación de Medidas Nacionalmente Apropiadas de Mitigación en el Marco de los Lineamientos Nacionales de Mitigación.* Lima: MINAM.

MINAM. (2010). *Segunda Communicación Nacional del Perú a la Convención en el Marco de la Naciones Unidas sobre Cambio Climático.* Lima: Ministerio del Medio Ambiente.

MINEM. (2009). *Plan Referencial del uso Eficicente de la Energía 2009-2018.* Lima: MINEM.

MINEM. (2011). *Balance Nacional de Energia 2010.* Lima: MINEM.

Ministerio del Medio Ambiente. (2010). *Segunda comunicacion Nacional del Peru a la Convencion marco de las Naciones Unidas sobre Cambio Climatico.* Lima: Fondo Editorial del MINAM.

Newman, P., & Kenworthy, J. (1999). *Sustainability and Cities: Overcoming Automobile Dependence.* Washington D.C.: Island Press.

Newman, P., & Kenworthy, J. R. (1999). *Sustainability and Cities: Overcoming Automobile Dependence.* Washington DC: Island Press.

Nolmark, H. (2007). *Re-thinking Sustainable Urban Development in an Era of Globalisation, Resource Constraints and Climate Change: The Mistra Difference.* Stockholm: Node.

O'Hare, M. (2009). *A city for people, not for cars*. Retrieved April 12, 2012, from Cities for people: http://www.citiesforpeople.net/cities/curitiba.html

Poldermans, C. (2006). *Sustainable Urban Development: The Case of Hammarby Sjostad.* Stockholm: Kulturgeografiska Institutionen Stockholms Universitet.

Prefeitura de Curitiba. (2012, January 02). *Operação Urbana Linha Verde*. Retrieved March 20, 2012, from Prefeitura municipal de Curitiba: http://www.curitiba.pr.gov.br/conteudo/cepac-apresentacao/575

Richard Webb, G. F. (2010). *Perú en números 2010.* Lima: Instituto Cuanto .

SSTEC. (2010, June). *Celebrating Eco.* Tianjin: Sino-Singapore Tianjin Eco-City Investement and Development Co. Ltd (SSTEC).

Streck, C., & Guimaraes, L. (2007). *Nationally Appropriate Mitigation Actions in Developing Countries: Emerging opportunities for private sector engagement.* Washington DC: Climate Focus.

SwissContact. (2010). *Aproximación Programática para Futuros Mercados de Carbono en Argentina, Colombia y Perú.* Lima: Swisscontact.

SymbioCity. (2010). *Hammarby Sjöstad, Stockholm: Making an entire sustainable urban district*. Retrieved April 11, 2012, from SymbioCity Sustainability by Sweden: http://www.symbiocity.org/en/Cases/Hammarby-Sjostad/

The World Bank. (2010). *Cities and climate change: an urgent agenda.* Washington DC: The World Bank.

UNFCCC. (2012). *Appendix II - Nationally appropriate mitigation actions of developing country Parties **.* Retrieved March 22, 2012, from United Nations Framework Convention on Climate Change: http://unfccc.int/meetings/cop_15/copenhagen_accord/items/5265.php

Yang, B., & Dong, K. (2008). Theories and Practices of Eco-city Planning:A Case Study on Tianjin Sino-Singapore Eco-city. *China City Planning Review, 17*(4), 32-39.

Appendix A: Tianjin eco-city KPIs

KPIs

The planning and development of the Eco-city is guided by a comprehensive set of Key Performance Indicators (KPIs) covering its ecological, economic and social development. The KPIs were jointly formulated by experts from Singapore and China and endorsed by the Ministerial-level Eco-city Joint Working Committee. In formulating the KPIs, due consideration was given to the national standards in China and Singapore, and the higher of the two standards was adopted, wherever feasible. Prevailing best international practices and the local conditions in Tianjin were also taken into account.

There are 22 quantitative and 4 qualitative KPIs. The start-up area and the entire Eco-city are targeted for completion by end-2013 and 2020 respectively. It is for this reason that reference is made to these years in the KPIs.

Quantitative KPIs

Good Natural Environment

Ambient Air Quality

The air quality in the Eco-city should meet at least China's National Ambient Air Quality Grade II Standard for at least 310 days. The SO2 and NOx content in the ambient air should

not exceed the limits stipulated for China's National Ambient Air Quality Grade 1 standard for at least 155 days.

Quality of water bodies within the Eco-city
Water bodies in the Eco-city should meet Grade IV of China's latest national standards by 2020.

Quality of Water from Taps
Water from all taps should be potable.

Carbon Emission Per Unit GDP
Description: The carbon emission per unit GDP in the Eco-city should not exceed 150 tonne-C per US$1 million.

Net Loss of Natural Wetlands
Description: There should be no net loss of natural wetlands in the Eco-city.

Healthy Balance in the Man-made Environment

Proportion of Green Buildings
Description: All buildings in the Eco-city should meet green building standards.

Native Vegetation Index
Description: At least 70% of the plant varieties in the Eco-city should be native plants/vegetation.

Per Capita Public Green Space
Description: The public green space should be at least 12 square metres per person by 2013.

Good Lifestyle Habits

Per Capita Daily Water Consumption
Description: The daily water consumption per day each person should not exceed 120 litres by 2013.

Per Capita Daily Domestic Waste Generation
Description: The amount of domestic waste generated by each person should not exceed 0.8 kg by 2013.

Proportion of Green Trips
Description: At least 90% of trips within the Eco-city should be in the form of green trips by 2020. Green trips refer to non-motorised transport, i.e. cycling and walking, as well as trips on public transport.

Overall Recycling Rate
Description: At least 60% of total waste should be recycled by 2013.

Access to Free Recreational and Sports Amenities
Description: All residential areas in the Eco-city should have access to free recreational and sports amenities within a walking distance of 500m by 2013.

Waste Treatment
Description: All hazardous and domestic waste in the Eco-city should be rendered non-toxic through treatment.

Barrier-Free Accessibility
Description: The Eco-city should have 100% barrier-free access.

Services Network Coverage
Description: The entire Eco-city will have access to key infrastructure services, such as recycled water, gas, broadband, electricity and heating by 2013.

Proportion of Affordable Public Housing
Description: At least 20% of housing in the Eco-city will be in the form of subsidised public housing by 2013.

Developing a Dynamic and Efficient Economy

Usage of Renewable Energy
Description: The proportion of energy utilised in the Eco-city which will be in the form of renewable energy, such as solar and geothermal energy, should be at least 20% by 2020.

Usage of Water from Non-Traditional Sources
Description: At least 50% of the Eco-city's water supply will be from non-traditional sources such as desalination and recycled water by 2020.

Proportion of R&D Scientists and Engineers in the Eco-city Workforce
Description: There should be at least 50 R&D scientists and engineers per 10,000 workforce in the Eco-city by 2020.

Employment-Housing Equilibrium Index
Description: At least 50% of the employable residents in the Eco-city should be employed in the Eco-city by 2013.

Qualitative KPIs

Maintain a safe and healthy ecology through green consumption and low-carbon operations.

Adopt innovative policies that will promote regional collaboration and improve the environment of the surrounding regions.

Give prominence to the river estuarine culture to preserve history and cultural heritage, and manifest its uniqueness.

Complement the development of recycling industries and promote the orderly development of the surrounding regions.

Appendix VII Impacto Ambiental de una Zona de Actividad Logística (ZAL)

CASO DE UNA MEGAZAL EN LA ISLA SAN LORENZO (ZALISAL)

(Autor: Dr. Alberto Ruibal Handabaka, Consultor y Profesor de Postgrado en Logística Comercial Global, Ginebra 25.03.2012)

EQUILIBRIO ENTRE IMPACTO AMBIENTAL Y DESARROLLO INTEGRAL

Dentro de la prospectiva del portafolio de mega proyectos logísticos en la costa Pacífica de Suramérica (iniciativas privadas y programas oficiales de conocimiento público en los países), está ***potenciar los atributos que tiene la Isla San Lorenzo para devenir en una mega plataforma logística (PLALOG) plurimodal***[95]. Se ha contemplado el establecimiento de una ***megazona de actividad logística (MEGAZAL), con la implantación de centros de consolidación y transferencia de carga (CECOTRACA).*** Argumentos de variada índole se han esgrimido para tener pendiente llevar adelante este emprendimiento que ***viabilizaría el pleno usufructo de las ventajas comparativas que posee la Isla San Lorenzo y sentar las bases para propiciar los beneficios de las ventajas competitivas que se obtendrían***.

Uno de dichos argumentos es el ***impacto ambiental que ocasionaría la ZALISAL***, pero hasta el presente, ***no se ha realizado ningún estudio a profundidad que lo analice***. Particularmente, en lo que concierne a la ***emisión de gases de efecto invernadero por el uso de combustibles fósiles en el funcionamiento de la ZAL***. Sin embargo, se pueden hacer algunas apreciaciones empíricas orientadas hacia alcanzar un eco-objetivo basado en una ***política de "desarrollo integral socio-ambiental*** sustentable. Este, ***aspiraría a lograr un equilibrio del emprendimiento de la ZALISAL, entre el impacto ambiental que ocasione y el aporte que otorgue*** al hinterland de la Macro Región Central del Perú, a todo el país, al Ecuador, este del Brasil, oeste de Bolivia y norte de Chile. La política mencionada, tendría como ***eco-objetivo el minimizar el impacto ambiental de la ZALISAL, mitigando y atenuando los efectos perniciosos de la contaminación y maximizando los beneficios del usufructo de la ZALISAL.***

La ZALISAL estaría concordante y sería el ***componente centro-pivote, del dúo de los otros mega puertos (calado profundo natural de 40m permite acoderamiento de navíos hasta de 350.000 TPM y orientación norte proteja contra mareas y permite operar grúas pórtico con tasa de izamiento de 35 TEU/h) que tiene el Perú (Bayóvar y San Juan), conformando con la isla San Lorenzo (geolocalización estratégica) una tríada única en la costa pacífica suramericana***. Y, que ***distribuiría los beneficios socio-ecológicos de tres megazal***, ***a cada una de las tres macro regiones del reordenamiento futuro de territorio del país,*** Macro Región Septentrional (Bayóvar), Central (ZALISAL) y Meridional (San Juan).

VISIÓN GEOLOGÍSTICA COMERCIAL GLOBAL DE LA ZAL EN LA ISLA SAN LORENZO

La isla, por su geolocalización estratégica en el litoral oeste del Pacífico en Suramérica y casi al centro oeste en el Perú, tiene y ha de tener la posibilidad de que ***converjan ejes viarios plurimodales de transporte ferroviario, autoviario, océanoviario y aeroviario***, Así funcionará

[95] Lugar geoestratégicamente localizado al que convergen numerosas vía y modos de transporte (plurimodal) en que se transfieran pasajeros y carga intermodalmente (PLALOG) desde terminales de transporte y centros de consolidación de carga (CECOTRACA). Ello le dan los atributos para implantar una zona de actividad logística (ZAL), en las que se realicen o no, transformaciones (ZAL activas o pasivas) a los productos para darles mayor valor agregado, y comerciarlos en las áreas adyacentes y aledañas del hinterland de influencia. Según su dimensión de operaciones, una PLALOG y ZAL, puedes ser mega, macro o meso. Ambas Son generadoras de empleo.

como un ***nodo tetramodal de interfase para la transferencia intermodal de los flujos de bienes y personas provenientes del hinterland de influencia*** (ver Mapa 1). Este lo conformarán ***cuatro flujos de pasajeros y carga generados por el intercambio comercial y turístico con el entorno adyacente y aledaño.*** Ya el Callao es actualmente desde la década pasada y podría ser la ZALISAL, una plataforma logística ***como nodo aéreo y marítimo para la transferencia de pasajeros y carga, norte-sur-este y viceversa***.

- ***Comercio nacional***
  - ***Intra-macro región central e inter-macro regiones;*** Central-septentrional-meridional y viceversa.
  - ***Comercio internacional*** (ver Mapa 2)
  - ***Intra-suramericano:*** Perú con el resto de Suramérica.
  - ***Inter-suramericano:*** Perú con los mercados de ultramar.
  - ***Tránsito comercial:*** Transbordo de pasajeros y carga de origen./destino extra-ZALISAL

ATRIBUTOS LOGÍSTICOS DE LA ISLA SAN LORENZO

Cinco son las principales ventajas comparativas.

- ***Geolocalización estratégica:*** El Callao tiene una equidistancia portuaria norte-sur en el litoral de Meso, Centro y Suramérica.
  - ***México-Chile:*** Entre los puertos de Manzanillo en México (2.539 mn) y Punta Arenas en Chile (2.604 mn) en el Estrecho de Magallanes.
  - ***Panamá-Chile:*** Entre los puertos de Balboa en Panamá (1.343 mn), entrada-salida en el Pacífico del Canal de Panamá y Valparaíso /San Antonio en Chile (1.315 mn).

- ***Hinterland productivo de influencia:*** Tiene un radio de influencia que cubre un área total de 1.107.500 km2, que involucra el hinterland nacional del Perú (área adyacente) y el hinterland internacional (área aledaña).
  - ***Nacional:*** Es el área adyacente que abarca los Departamentos de la Macro Región Central, Ucayali, Huánuco, Pasco, Junín, Huancavelica, e Ica; con 224.000 km2.
  - ***Internacional:*** Es el área aledaña que abarca a cuatro países de Suramérica, con 883.000 km2.
    - ✓ ***Ecuador:*** Abarca las Provincias de El Oro, Guayas y Manabí; con 42.000 km2.
    - ✓ ***Brasil:*** Abarca os Estados de Acre y Amazonas (norcentro); con 410.000 km2.
    - ✓ ***Bolivia:*** Abarca los Departamentos de Pando, La Paz y Oruro, con 251.000 km2.
    - ✓ ***Chile:*** Abarca las Regiones XV-Arica-Parinacota, II-Tarapacá y III-Antofagasta; con180.000 km2.

- ***Flujo potencial de carga marítima y aérea:*** Tipo de carga general contenedorizada y al granel.
  - ***Productos de exportación e importación:*** Provenientes del hinterland adyacente (nacional) y aledaño (internacional).
  - ***Productos de transbordo exportación e importación:*** En tránsito al /del mercado internacional, provenientes y /o destinado al hinterland aledaño (internacional).

- ***Origen y destino de carga transbordada:*** Proveniente del Norte, Meso, Centroamérica, Caribe y Suramérica.
  - ***Marítimo-Terrestre:*** Desde /hasta puertos y ciudades del hinterland aledaño.
    - ✓ ***Ecuador:*** Manta, Guayaquil y Puerto Bolívar (marítima y terrestre).
    - ✓ ***Brasil:*** Cruzeiro do Sur (río Juruá) (marítima y terrestre).
    - ✓ ***Bolivia:*** Riberalta (río Madre de Dios), Cobija, La Paz y Oruro (fluvio-terrestre).
    - ✓ ***Chile:*** Arica, Iquique y Antofagasta (marítima y terrestre).

- ***Aérea:*** Desde /hasta aeropuertos de toda América
  - ✓ ***Norte-Meso-Centroamérica y Caribe:*** México-Guatemala-San Salvador-San José-Panamá-Habana-Santo Domingo.
  - ✓ ***Suramérica:*** Caracas-Bogotá-Quito-Guayaquil-Brasilia-São Paulo-Río de Janeiro-Porto Alegre-La Paz-Santa Cruz-Asunción-Santiago-Montevideo-Buenos Aires.

- ***Conectividad pluriviaria:*** Nodo logístico pluriviario de convergencia tetramodal.
  - ***Ferroviaria:*** Ferrovías Andinas S.A., Callao-Lima-La Oroya-Cerro de Pasco /Huancayo-Huancavelica. Futura ferrovía andina que recorrerá la sierra.
  - ***Autoviaria***
    - ✓ ***Carretera Panamericana:*** Aguas Verdes (Ecuador)-Concordia (Chile)-Desaguadero (Bolivia).
    - ✓ ***Carretera Central:*** Callao-Lima-La Oroya-Cerro de Pasco-Huánuco-Pucallpa.
  - ***Océanoviaria***
    - ✓ ***Cuenca del Pacífico:*** Norte-Meso-Centro-Suramérica-Australasia.
    - ✓ ***Cuenca del Atlántico:*** Norte-Suramérica-Caribe-Golfo de México-Europa-África, vía Canal de Panamá-Estrecho de Magallanes-Pasaje del Drake.
  - ***Aeroviaria:*** Norte-Meso-Centro-Suramérica-Europa-Asia.

Impacto ambiental actual del puerto y aeropuerto

El puerto del Callao y el aeropuerto Jorge Chávez, con sus ***instalaciones y equipamiento actual causan una notoria contaminación física, química y acústica que produce un fuerte impacto ambiental*** en los núcleos poblacionales de las áreas circundantes a ambos terminales de transporte.

- ***Puerto:*** El recinto portuario está circundado por una área urbana cuya población es ***afectada por la contaminación de las emisiones y emanaciones, residuos y vertidos que dejan los camiones*** que transitan con carga y contenedores y sobre todo por las ***partículas altamente nocivas de los minerales transportados en vagones ferroviarios*** lo que ***impedirá la obtención de la certificación de la ISO-14000*** y a ello se aúna las vibraciones que produce la operación portuaria.
- ***Aeropuerto:*** Con el ascenso y descenso de las aeronaves en la sola pista existente y las maniobras en las pistas auxiliares, hay una ***contaminación acústica cercana a los 100 dB*** y con la construcción de la segunda pista ya programada, ***estará cercana a los 150 dB***. La ***OMS recomienda un máximo de 65 dB*** y sobre investigaciones realizadas, se afirma que con 55 dB el 10% de la población es afectada, pero con 85 dB toda la población es afectada.

Prospectiva ambiental de la Isla San Lorenzo

- ***Geocaracteristicas:*** Orientación norte-sur paralela al litoral continental, calado natural del flanco oeste 20m, área 16.5 km2 (8 km x 2 km x 210 msnm), distancia del continente 5 km a ser atravesada por una unión pluriviaria (ferro-auto-ductoviaria) por puente o túnel hasta el ápice del cono de Lima Metropolitana al este.
- ***Infraestructura requerida:*** Edificaciones de la ZAL, los CECOTRACA, y los terminales de transporte. ***Portuario*** (muelles, rampas, grúas móviles y pórtico, vehículos, almacenes, patios para contenedores y cubiertos para minerales, silos, tanques), ***aeroportuario*** (2 pistas de 4 km c/u, equipamiento para manipuleo de carga, rampas de carga y mangas de pasajeros, ayudas de aeronavegación), ***autoportuario y ferroportuario*** (plataformas, muelles de recepción y transbordo intermodal de carga equipo de manipuleo, patio de contenedores).
- ***Probabilidades de impacto ambiental:*** Hay varias fuentes que causarían contaminación en la fase de construcción y funcionamiento de la ZALISAL ***a la fauna acuática, piscícola de cardúmenes de peces y terrestre de lobos marinos*** que habitan en la isla. Igualmente con el

uso de combustibles fósiles por los vehículos que operen en la ZAL y en los terminales de los cuatro modos de transporte

Mitigar y atenuar la contaminación y el impacto ambiental

La mayoría de los ***vehículos que transportan la carga de entrada y salida a los terminales de carga de las ZAL***, puerto, aeropuerto, estación de ferrocarril y terminal de camiones, ***usan como combustible hidrocarburos en una sustancial proporción***. Y, el ***manipuleo de la carga en las operaciones de cargue y descargue al terminal respectivo y las transferencias intermodales*** ferro-auto-portuarias, ferro-aeroportuarias y auto-ferroportuarias, ***son causantes de contaminación e impacto ambiental***. El cuadro siguiente nos presenta la contaminación que producen los vehículos de cada modo de transporte.

Como contrapartida ambientalista, hay una ***amplia gama de medidas a implantarse y ponerse en vigencia para morigerar al máximo los efectos nocivos que se cause por el funcionamiento*** de la ZAL y los terminales de transporte. Ello estará en función de llevar a cabo un ***eco-gerenciamiento en su manejo y gestión orientado a***

- ***Normativa internacional***

  - ***Reglamentación del transporte aéreo:*** Verificación de que las aerolíneas comerciales apliquen la Resolución A33-7 de la OACI (octubre 2011) sobre contaminación acústica en aeropuertos y aeronaves. Y, de las Normas de la OACI e IATA sobre el transporte de mercancía peligrosa.
  - ***Reglamentación del transporte marítimo:*** Verificación de que las navieras apliquen el Código IMDG de la OMI, sobre el transporte de mercancía peligrosa.
  - ***Reglamentación de la ONU:*** Verificación de que se aplique para la ZAL, los terminales de y los vehículos de transporte ferroviario y autoviario, las 9 categorías de productos peligrosos.
  - ***Signos pictóricos de la ISO:*** Verificación de que toda las unidades de carga (general y contenedorizada) tenga la rotulación de estos signos para su manipuleo.

Mitigación del Impacto Ambiental de una ZAL en la Isla San Lorenzo (ZALISAL)

Numerosos son los efectos de atenuar y disminuir la variada contaminación, entre otros, por el menor uso de combustibles fósiles y emisión de gases de efecto invernadero.

- ***Concentración de la transferencia de carga:*** Intermodalmente (ferro-auto-océano-aeroviario) en los CECOTRACA (“cross docking”), reemplazando a los individuales, la estación ferroviaria, terminal de camiones, puerto y aeropuerto. Este sería el caso actual de los trenes de Ferrovías Andinas S.A. al centro del Perú y la Carretera Panamericana, para acceder al puerto del Callao y al aeropuerto Jorge Chávez.
- ***Conglomerado de vehículos de transporte terrestre:*** Las vías de acceso actuales al recito portuario del Callao muestra una considerable congestión del tránsito, así como el traslado de ida y vuelta de contenedores llenos y vacíos a los almacenes extra portuarios por no haber actualmente espacio en el recinto portuario. La ZALISAL dispondrá de un acceso directo (túnel o puente) y de suficiente área para el de almacenamiento de contenedores.
- ***Puerto pivote en costa pacífica suramericana:*** Puertos alimentadores de Ecuador (Guayaquil y Manta) y de Chile (Arica, Iquique y Antofagasta) transbordarían su carga (exportación e importación) en la ZALISAL (“ocean hub”), disminuyendo la frecuencia los viajes de estos 5 puertos a los mercados de ultramar, que serán atendidos por los servicios directos desde la ZALIZAL.

- ***Aeropuerto nodo del centro-oeste suramericano:*** Los aviones (cargueros y pasajeros) de fuselaje ancho (A-380, An-126, B-747 /777 /878), solo servirán mega aeropuertos como el de la ZALISAL, disminuyendo las frecuencias individuales de los vuelos desde los países suramericanos. J. Chávez ya es un "air hub".
- ***Rutas directas a la Cuenca del Pacífico:*** Las expediciones de exportación e importación destinadas y provenientes de los mercados de Australasia, Centro y Norteamérica, han de realizarse con menos frecuencias por la dimensión de los navíos que acoderen en la ZALISAL, disminuyendo los viajes individuales desde los 5 puertos de Ecuador y Chile.
- ***Manipuleo de carga peligrosa:*** El importante volumen que representa la carga de concentrados de minerales, han de ser manipulados y embarcados fuera del recinto portuario actual rodeado de la zona urbana del Callao que actualmente es contaminada con partículas que afectan las vías respiratorias. Esto permitiría la certificación de la ISO.14000.
- ***Pasividad sonora:*** Se eliminaría la contaminación acústica actual de las aeronaves que sirven al aeropuerto Jorge Chávez (100 dB y 150 dB con una y dos pistas) que afectan los núcleos urbanos del entorno y a la fauna aviaria. La ZALIZAL estaría a 5 km de la Punta y de 8 a 10 km de los conos norte-sur-este de Lima.

Impacto ambiental en el área adyacente y aledána al puerto del Callao y al aeropuerto Jorge Chávez

- Vehículos de transporte autoviario: Los camiones que transportan carga general y contenedores hacia al /o desde el puerto de Callao, tienen como combustible petroleo diesel o gasolina. Ellos atraviesan el área urbana de Lima Metropolitana y del Callao, por las avenidas periféricas y /o calles. Los automóviles de los funcionarios de aduana, ENAPU, DWP, agentes aduanaros y agentes navieros, usan mayoritariamente gasolina (plomo tetraetílico). En ambos casos se producen efectos contaminantes por la emisión y emenación de gases, vertido de residuos de combustible y lubricantes, y vibraciones de tráfico con impacto acústico. Estos vehículos son provenientes y destinados, en los tres conos, norte, sur y este, que conforma el triángulo de la metrópoli Lima-Callao.
- Material rodante de transporte ferroviario: Los trenes, locomotoras y vagones, que trasnportan carga general y particuoarmente concentrados de minerales, producen efectos contaminates por el vertido de residuos de los concentrados desde los vagones tolva y otros, y particularmente partículas en suspención altamente tóxicas (concentrados de plomo y zinc). Las vibraciones del rodaje del tren producen un impacto acústico importante a las áreas urbanas que atraviesa, muchas de ellas adyacentes a la ferrovía y que son zonas de núcleos poblacionales de bajos recursos económicos. El recorrido de la ferrovía cruza de este a oeste afectando los distritos de Chosica, Chaclacayo, Vitarte, Rimac, Lima Cercado, Carmen de la Legua y Callao. Las locomotoras de la empresa que opera, Ferrovías Andinas S.A. han sido recorvertidas de diesel a gas natural, habien reducido sutancialmente el tipo de emisions y emanaciones por combustión de los motores.
- Aeronaves de transporte aéreo: Algunas aerolíneas nacionales emplean tipos de aviones de gran impacto acústico (B-373, 100 dB; A-340, 97 dB). La OMS recomienda un máximo de 65 dB. El radio de operación para la aproximación, en el aterrizaje y para alcanzar altura despues del decolaje abarca las zonas urbanas desde el distrito de Ventanilla al norte, hasta el distrito de San MIguel, San Isidro y Miraflores al sur. Toda la bahía de la Punta al Callao, recibe las micro partículas líquidas y sólidas del vertido de la combustión de las turbinas, tubohélices y hélices según el tipo de aeronave. La ubicación actual del aerpoerto es además peligrosa por el riesgo que representa los aterrizajes y decolages para los habitantes de las áreas urbanas circundantes.
- Navios de transporte oceánico: Los barcos al acoderar en los muelles, usualmente producen un vertido de combustible y emisiones y emanaciones de la combustión del sus motores. Estando el recito portuario encastrado en el área urbana del Callao, los habitantes son afectados por la contaminación odorífera y acústica de las operciones portuarias.

Bibliography

CONAM. (2006). *Hacia una Política Energética y Ambiental sostenible en el Perú.* Lima: CONAM.

ECLAC. (2010). *Foreign Direct Investment in Latin America and the Caribbean.* Santiago, Chile: United Nations.

ECLAC. (2011). *Foreign Investment in Latin American and the Caribbean.* Chile.

Ecofys, E. a. (2011). *Annual Status Report on Nationally Appropriate Mitigation Actions (NAMAs).*

Economist Intelligence Unit. (2012). *Hot spots: Benchmarking global city competitiveness.* London: Economist Intelligence Unit.

Florez, R. (2010). *UNA VISIÓN DE LIMA AL 2035.* Lima: URVIA.

IDB, A. S. (2010). *NAMAs in the Transport Sector Case Studies from Brazil, Indonesia, Mexico and the People's Republic of China.* Philippines: ADB and IDB.

IMP. (2011). *La Viabilidad y el Trasnporte Urbano Metropolitanos en la Situación Actual.* Lima: IMP.

INEI Instituto Nacional de Estadistica e Informatica. (2011). *Indicadores Demograficos*. Recuperado el 12 de April de 2012, de Presidencia del Consejo de Ministros Instituto Nacional de Estadistica e Informatica: http://www.inei.gob.pe/perucifrasHTM/inf-dem/cuadro.asp?cod=9176&name=d15_02&ext=jpg

Joss, S. (2009). Eco-cities — a global survey 2009. *WIT Transactions on Ecology and The Environment, 129*, 239-250.

Maria Paz Cigaran, T. P. (2011). *Priotización y Formulación de Medidas Nacionalmente Apropiadas de Mitigación en el Marco de los Lineamientos Nacionales de Mitigación.* Lima: MINAM.

MINAM. (2010). *Segunda Communicación Nacional del Perú a la Convención en el Marco de la Naciones Unidas sobre Cambio Climático.* Lima: Ministerio del Medio Ambiente.

MINEM. (2009). *Plan Referencial del uso Eficicente de la Energía 2009-2018.* Lima: MINEM.

MINEM. (2011). *Balance Nacional de Energia 2010.* Lima: MINEM.

Ministerio del Medio Ambiente. (2010). *Segunda comunicacion Nacional del Peru a la Convencion marco de las Naciones Unidas sobre Cambio Climatico.* Lima: Fondo Editorial del MINAM.

Prefeitura de Curitiba. (02 de January de 2012). *Operação Urbana Linha Verde*. Recuperado el 20 de March de 2012, de Prefeitura municipal de Curitiba: http://www.curitiba.pr.gov.br/conteudo/cepac-apresentacao/575

Richard Webb, G. F. (2010). *Perú en números 2010.* Lima: Instituto Cuanto .

SSTEC. (June de 2010). *Celebrating Eco.* Tianjin: Sino-Singapore Tianjin Eco-City Investement and Development Co. Ltd (SSTEC).

Streck, C., & Guimaraes, L. (2007). *Nationally Appropriate Mitigation Actions in Developing Countries: Emerging opportunities for private sector engagement.* Washington DC: Climate Focus.

SwissContact. (2010). *Aproximación Programática para Futuros Mercados de Carbono en Argentina, Colombia y Perú.* Lima: Swisscontact.

SymbioCity. (2010). *Hammarby Sjöstad, Stockholm: Making an entire sustainable urban district*. Recuperado el 11 de April de 2012, de SymbioCity Sustainability by Sweden: http://www.symbiocity.org/en/Cases/Hammarby-Sjostad/

The World Bank. (2010). *Cities and climate change: an urgent agenda.* Washington DC: The World Bank.

UNFCCC. (2012). *Appendix II - Nationally appropriate mitigation actions of developing country Parties **.* Recuperado el 22 de March de 2012, de United Nations Framework Convention on Climate Change: http://unfccc.int/meetings/cop_15/copenhagen_accord/items/5265.php

Yang, B., & Dong, K. (2008). Theories and Practices of Eco-city Planning:A Case Study on Tianjin Sino-Singapore Eco-city. *China City Planning Review, 17*(4), 32-39.