POWER4BIO
REGIONS FOR BIOECONOMY

An overview of suitable regional policies to support bio-based business models

Deliverable 4.2

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Table 2: Document History

ABBREVIATIONS

AKIS: Agricultural Knowledge and Innovation Systems

ALSAG: Austrian landfill tax, known as the 'Altlastensanierungsbeitrag'

BAT: Best available technologies

BBE: Bio-based Economy

BBI JU: Bio-based Industries Joint Undertaking

BBI: biobased industries instrument for Europe

BERST: BioEconomy Regional Strategy Toolkit project

BIC: Bio-based Industries Consortium

bio-CNG: Bio Compressed Natural Gas

bioLNG: Bio Liquefied Natural Gas

CAP: Common Agriculture Policy

CEC countries: Central European Countries

CEPI: Confederation of European Paper Industries

CFP: Common Fisheries Policy

CHP: combined heat and power

CICs: Emission Certificates of Biofuel in Consumption

CO2: carbon dioxide

COM: Commission

COSME: EU programme for the Competitiveness of Small and Medium-Sized Enterprises

CSP: CAP Strategic Plans (CSP)

D.O.P. certificates: Designation of Origin

DEFRA: Department for Environment Food and Rural Affairs

DM: Dry matter content

EAFRD: European Agricultural Fund for Rural Development

EC: European Commission

ECBF: European Circular Bioeconomy Fund

ECCP: European Climate Change Programme

EEA: European Environment Agency

EMFF: European Maritime and Fisheries Fund

EP: European Parliament

EPBD: Energy Performance of Buildings Directive

EPR: extended producer responsibility

ERA-Nets: European Research Area Network

ERDF: European Regional Development Fund

ESIF: European Structural and Investment Funds

ESIF: European Structural and Investment Funds

ESR: Effort Sharing Regulation

ETC: emission trading system

ETS: Emission Trading System

EU EPBD: Energy Performance of Buildings Directive

EU: European Union

EUTR: European Timber Strategy

FIP: feed in premium

FIT: Feed in Tariff

FSC: Forest Stewardship Council

GAEC: Good Agricultural and Environmental Condition

GD: Green Deal

GDP: Gross domestic product

GHG: Greenhouse gas

GJ: Giga joule

GO: Guarantees of Origin

IAR: French Bioeconomy Cluster

IAS: Industry Applications Society

ICT: Information and Communication Technology

IED: Industrial Emissions Directive

ILUC: Indirect land use change

IPBES: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

IPCC: International Panel on Climate Change and Control

IPPC: Integrated Pollution Prevention and Control

JRC: Joint Research Centre

KETs: key enabling technologies

kWh: kilowatt-hour of energy

LCA: Life cycle assessment

LULUCF: land use, land use change and forestry

MSs: Member States

MW: Megawatt

N_2O: nitrous oxide

NACE: Statistical Classification of Economic Activities in the European Community

NECPs: National Energy and Climate Plans

NGO: Non-governmental organisation

NIR: National Inventory reports

NPK: Nitrogen, Phosphate, Potassium

NREAPs: National Renewable Action plans

ODE: sustainable energy storage

OECD: The Organisation for Economic Co-operation and Development

P2P public-public

PAYT: Pay As You Throw

PEFC: Programme for the Endorsement of Forest Certification

PFCs: perfluorocarbons

PPPs: public-private partnerships

PV: Photovoltaics

R&D: Research and Development

R&I: Research and Innovation

RDP: Rural Development Program

RED: Renewable Energy Directive

RIS 3: Regional Smart Specialisation Strategy

RSFF: Risk Sharing Finance Facility

S2BIOM: Delivery of sustainable supply of non-food biomass to support a “resource-efficient” Bioeconomy in Europe

SCIs: sites of Community importance

SDE+: Stimulation of Sustainable Energy Production - Stimulering Duurzame Energieproductie

SDGs: Sustainable Development Goals

SEA: strategic environmental assessment

SMART: Specific, Measurable, Achievable, Realistic, and Timely

SMEs: Small and Medium Sized Entreprises

SMR: Statutory Management Requirement

SPAs: Special Protection Areas

SWOT: Strengths, Weaknesses, Opportunities, and Threats

TACs: total allowable catches

TEN-E: Trans-European Networks – Energy Regulation

TEN-T: Trans-European Transport Network

TFEU: Treaty on the Functioning of the European Union

TJ: Tera joule

TOC: Total Organic Carbon

TRL: Technology readiness level

UN: United Nations

USA: United States of America

VAT: Value added tax

VPAs: Voluntary Partnership Agreements

WFD: Water Framework Directive

WP: Work package

WTO: World Trade Organisation

PROJECT PARTNERS

CIRCE: Fundación CIRCE Centro de Investigación de Recursos y Consumos Energéticos

DBFZ: DBFZ DEUTSCHES BIOMASSEFORSCHUNGSZENTRUM GEMEINNUETZIGE GMBH

WR: STICHTING WAGENINGEN RESEARCH

META: META GROUP SRL

AKI: AGRARGAZDASAGI KUTATO INTEZET

NAK: MAGYAR AGRAR-, ELELMISZERGAZDASAGI ES VIDEKFEJLESZTESI KAMARA

EPC: EPC Project Corporation Climate. Sustainability. Communications. mbH

DRAXIS: DRAXIS ENVIRONMENTAL S.A.

BZN: Bay Zoltán Nonprofit Ltd. for Applied Research

UNFU: Ukrainian National Forestry University

CAGPYDS (former CAPDER): Junta de Andalusia – Consejería de Agricultura, Pesca y Desarrollo Rural

MAE: Mazovia Energy Agency

USB: University of South Bohemia

CCB: Chemie Cluster Bayern GMBH

SPRING: Sustainable Processes and Resources for Innovation and National Growth

EWI: VLAAMS GEWEST (Government of Flanders)

SUA: Slovak University of Agriculture in Nitra

ECRN: European Chemical Regions Network (ECRN) e.V.

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PUBLISHABLE SUMMARY

This report presents the outcome of Task 4.2 in the POWER4BIO project. The aim of this this report is to give an overview of public policies and regulations for the bio-based economy (BBE) with special attention to policy integration over different scales (from EU, national to regional) and across different policy domains (environmental, sustainable development policy, energy, bioeconomy policy, etc.).

First it presents what type of policies can regulate and stimulate the development of a bioeconomy in a direction that is environmentally and economically sustainable. For this overview it is first explained how we can define the bioeconomy sector by presenting a bioeconomy system overview. This overview then provides an ordering mechanism to explain the different types of policies that can regulate and stimulate the bioeconomy in a region directly or indirectly.

Secondly, an overview of barriers to and opportunities for successful application of regional policies aimed at supporting or stimulating a bio-based economy (BBE) is presented. This information may be used by regional policy makers and other stakeholders for assessing the context in which they operate, particularly for the development of their bioeconomy strategies. It explains the strategy adopted to identify and analyse these conditions and then presents barriers and possible solutions and a range of opportunities.

Thirdly, an overview of the EU policy instruments that have been developed in the last decade directing, setting definitions and goals and supporting development of the bio-based economy in Europe. It emphasises that the bioeconomy development should lead to improved sustainability. Therefore, understanding how policies can regulate the development of a bioeconomy in a direction that is environmentally and economically sustainable is a key aspect to be taken into account. Much emphasis is also placed on what these EU policies imply in terms of actions for Member States and on understanding how EU policies and national and regional policies can and need to be integrated.

Fourtherly a long list of policies made as part of this study is compiled addressing the wide diversity of bio-based economy activities. From this list ten good policy examples were selected based on commonly agreed selection criteria. Policy factsheets were elaborated for the ten good policy examples and these are summarized in an integrative manner addressing issues such as type of instrument, main objective of the policy instruments, policy coherence, particularly links to EU policy instruments, impact of the policy instruments in time, money spent and objectives reached, arguments for categorizing the instruments as good policy examples, replicability options for the policy instruments in other regions, similarity to instruments in other EU regions, barriers and solutions encountered in the development and implementation of the policy instruments. The main aim of the detailed description and integrated analysis of the good policy examples is that it inspires policy development in other regions. The report therefore aims to provide knowledge on policy that can be used by different POWER4BIO regions partners that are working in Work Package 5 of the project on the BBE strategies and roadmaps for their own regions.

In the last chapter of the report the main conclusions and recommendations of this study are presented.

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1 INTRODUCTION

1.1 Aim and context

One of the aims of the POWER4BIO project is to give an overview of public policies and regulations for the bio-based economy (BBE) with special attention to policy integration over different scales (from EU, national to regional). The task should also deliver an overview of the main barriers and opportunities in policy development and implementation and to identify and present good policy practice examples bringing the bioeconomy development further in regions.

The information developed and presented in this report should directly support the realisation of a few main objectives of the POWER4BIO project which are:

1) To set up Regional Bioeconomy Hubs in the 5 CEE participant regions to lead the transition towards the bioeconomy in those regions.
2) To develop a portfolio of support policies and funding instruments suitable for local deployment in EU regions.
3) To develop and deliver an ambitious capacity building and training programme to increase the capacity and skills of regional/local authorities and other stakeholders in different aspects of the bioeconomy

This task 4.2 is therefore specifically designed to contribute to these three objectives in the following ways:

- Provide an overview of the general theoretical concepts of policy integration across different political levels (EU to regions - and the other way around) and across different policy domains (environmental, sustainable development policy, energy, bioeconomy policy, etc.) in the bio-based policy domain. This is illustrated by describing different policy types and classifications of policy measures in the Bio-based economy (BBE) domain at EU, national and regional level. This contributes directly to achieving objective 2 of POWER4BIO (see above).
- Identify and analyse the opportunities and barriers that apply to successful regional policies that bring further the bio-based economy. In chapter 4 the barriers and opportunities for good policy development and implementation in the Bio-based economy are discussed. In chapters 2, 5 and 6 examples of BBE policies are given. Particularly the examples discussed in Chapter 6 are meant to serve as good policy examples with strong options for replicability in other regions, particularly those in an early to intermediate stage of BBE development (relevant to reaching all 3 POWER4BIO objectives mentioned above).
- Before the good example policies were selected a long list was made of policies addressing the wide diversity of bio-based economy activities. From this list 10 good policy examples were select based on commonly agreed selection criteria. How these good examples policies are selected is presented in Chapter 5. In Annex V policy factsheets are presented of the 10 policy instruments and these are summarized in an integrative manner in Chapter 6 addressing the following issues:
    1) Type of instrument, detailed functioning of the policy instrument
    2) Main objective of the policy instruments
    3) Policy coherence, particularly links to EU policy instruments
    4) Impact of the policy instruments in time, money spent and impact
    5) Arguments for categorizing the instruments as good policy examples

6) Replicability options for the policy instruments in other countries of regions
7) Examples of similar instruments in other EU countries
8) Barriers and solutions encountered in the development and implementation of the policy instruments
9) References and links to obtain more information about the policy instruments

The main aim of the chapter 6 and the policy factsheets included in the Annex V is to describe selected good policy examples. These may inspire policy development ideas that can be used in the BBE strategies and roadmaps that are worked out by the different POWER4BIO regions as part of Workpackage 5 of the project.

1.2 Approach and data collection

Information used in this report was collected from different sources.

Firstly, all information on BBE policies was derived from former project in which the POWER4BIO partners participated, published reports and other published references derived from a literature review. The official websites of the EC were also an important source of information on EU policies and strategies developed in the BBE domain.

Secondly, information on existing policy instruments for the long list of policies and for the identification and description of the 10 good policy examples was derived from reports and databases on policies from project like S2BIOM[1] and BERST[2], but also with input from the region partners in the POWER4BIO project. With this input we developed a long list of 72 policy instruments regulating and stimulating the development of regional bioeconomies in Europe. Many policy instruments that played a major role in progressing the bioeconomy in the POWER4BIO regions were included in this long list. This information was derived through a workshop organised for the POWER4BIO regions on 20 January 2020 in Munich and followed up by several email exchanges with the region representatives in the P4B project between February- May 2020. This exchange process with the regions on their policies already in place, was very informative and helped a lot to focus the work presented in this report particularly to the information needs and the policy experience sharing between all partners in the project.

[1] https://www.s2biom.eu/en/

and https://s2biom.wenr.wur.nl/web/guest/home

[2] https://www.berst.eu/

At the workshop in Munich all regions in the POWER4BIO project were represented: Belgium (Flanders), Czech Republic (S.Bohemia), Germany (Bavaria, Central Germany), Hungary, Italy, Poland (Mazovia), Slovakia (Nitra), Spain (Andalusia), Ukraine (Lviv). For the selection of the 10 policy examples we mainly tapped upon the experiences of the more mature regions, since they have rich experiences with various policy instruments developed, implemented an evaluated over a longer period. For the compilation of the long list of policies, the development of the selection criteria for good example policies the input and valuable experience from all representatives of all P4B regions was obtained.

Thirdly, the selection criteria for good example policies were compiled with input from all region partners in POWER4BIO during this same January 2020 workshop in Munich. Before the meeting the region partners were asked to prepare for answering the following questions:

1) *Can you think of policies (in your region, country or in other EU countries) addressing (aspects of) bioeconomy that may serve as good example policies for other regions?*

2) *Why do you think this/these is/are a good policy example(s)?*

3) *What criteria are to be used to select the 10 good policy examples to be worked out in detail in POWER4BIO (task 4.2) so that they can serve as exemplar policies for other regions (including your own)?*

Fourthly, an extensive literature review was done to systematically collect information on the typical barriers and opportunities hampering and stimulating the BBE development in general and more specifically the policy development in this domain. The first step to understand and cluster the main barriers and opportunities for BBE development was taken with the POWER4BIO regions in the Munich workshop.

1.3 Reading guide

The report is divided in 7 chapters. Chapter 2 presents what type of policies can regulate and stimulate the development of a bioeconomy in a direction that is environmentally and economically sustainable. For this overview it is first explained how we can define the bioeconomy sector by presenting a bioeconomy system overview. This overview then provides an ordering mechanism to explain the different types of policies that can regulate and stimulate the bioeconomy in a region directly or indirectly. Directly means through influencing on the biomass delivery chain, and indirectly through supporting the different aspects of the enabling environment and the socio-economic and environmental drivers.

Chapter 3 provides an overview of the EU policy instruments that have been developed in the last decade directing, setting definitions and goals and supporting development of the bio-based economy in Europe. It emphasises that the bioeconomy development should lead to improved sustainability. Therefore, understanding how policies can regulate the development of a bioeconomy in a direction that is environmentally and economically sustainable is a key aspect to be taken into account. In this

chapter much emphasis is also placed on what these EU policies imply in terms of actions for MSs. The chapter particularly focusses on understanding how EU policies and national and regional policies can and need to be integrated.

Chapter 4 gives an overview of barriers to and opportunities for successful application of regional policies aimed at supporting or stimulating a bio-based economy (BBE). The outcomes may be used by regional policy makers and other stakeholders for assessing the context in which they operate, particularly for the development of their bioeconomy strategies. It explains the strategy adopted to identify and analyse these conditions and then presents barriers and possible solutions and a range of opportunities. The final section of the chapter summarizes the main recommendations and presents important conclusions from the analysis for policy development.

Chapter 5 presents and characterizes more than 70 policy examples that have been collected for this study and from which the 10 good policy examples have been selected which are described in chapter 6 and also systematically characterised in policy fact sheets in Annex III. The long list illustrates further the diversity of policies that influence the bioeconomy. The sub-selection of the 10 good policy examples from this list is meant to be instructive on the practice of relevant policy development in the bioeconomy field. The examples worked out in chapter 6 illustrate how diverse policies work in relation to types of policy instruments, sectors and biomass value chain and bioeconomy components addressed, similarity of policies in different regions and countries, integration of policies at different policy levels, impacts and evaluation and monitoring outcomes, characteristics that make them good policies and typical barriers and opportunities encountered when these policies were developed and implemented.

The last chapter presents the main conclusions and recommendations of this study.

2 OVERVIEW OF POLICY INSTRUMENTS FOR THE BIOECONOMY

2.1 Introduction

The Bioeconomy strategy of the European Commission was launched in 2012. It provided a framework to stimulate knowledge development, research and innovation on the conversion of renewable biological resources into products and energy (EC, 2012). The bioeconomy is defined as the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy. It includes agriculture, forestry, fisheries, food, and pulp and paper production, as well as parts of chemical, biotechnological and energy industries.

Shifting from non-renewable resources to biomaterial is an important innovation aspect of the circular economy agenda too. The bioeconomy and the circular economy are thus conceptually linked (EEA 2018).

The revision of the Bioeconomy Strategy in 2018 provides an opportunity to create a more coherent policy framework. In this Bioeconomy Strategy of the European Commision (EC, 2018) five objectives are formulated:

- Ensuring food security
- Managing natural resources sustainably
- Reducing dependence on non-renewable resources
- Mitigating and adapting to climate change
- Creating jobs and maintaining European competitiveness.

A recent report on the relationship between the economy and the bioeconomy (EEA, 2018) concludes that as pressures on ecosystems and biodiversity increase, it is essential to find a balance between different uses of biomass, as well as between its economic valorisation and preserving and enhancing ecosystem services, including soil quality, biodiversity, water quality and availability. It signals that there is a risk that sectoral approaches are incoherent and miss out on opportunities and synergies. It concludes that combined, such narrow sectoral approaches can contribute to overexploitation of biomass and further ecosystem degradation across the EU.

Exploiting biomass in a bioeconomy is not necessarily sustainable. Processed biomaterials are not always biodegradable and mixing them with fossile based materials can hamper recycling. In addition, exploitation of biomaterials may increase pressure on natural resources and dependence on use of non-biological materials with considerable environmental impact, such as agrochemicals. A further development of the bioeconomy has substantial impacts which can work out positively and negatively on the environment and the economy. The increasing global demand for food, feed, biomaterials and bioenergy resources could lead to exacerbating pressure on natural resources and demand/supply conflicts but could also create win-win opportunities. This requires coordinated action and the careful consideration of trade-offs in policies. Increased circular use of biomass resources is a strategy that would help to mitigate the environmental impacts of increasing demand for biomass by easing the competition between different biomass applications, reducing greenhouse gas emissions associated with material use and correcting geographical imbalances in nutrient flows.

As the bioeconomy development should lead to improved sustainability, the recently published sustainability vision of the European Commission's Joint Research Centre (JRC) is very relevant. This vision defines six important sustainability pillars: natural capital, ecosystem services and biodiversity, resource efficiency, sustainable urban living, climate change mitigation and adaptation and innovation for sustainability (JRC 2019).

To understand how policies can regulate the development of a bioeconomy in a direction that is environmentally and economically sustainable, particularly in relation to the six sustainability pillars mentioned above, a bioeconomy system overview is required. For this we used the food system framework developed by Berkum, et al. (2018) as a basis and extended it to cover the whole bio-based economy. The resulting framework is presented in Figure 2.1. Central in the system is a biomass delivery chain that starts with the biomass until end products and uses. The end uses also provide new biomass again and then the chains starts al over. Activities in the bioeconomy system also encompass the wider food and industrial environment and the 'enabling environment'. The different activities in the bioeconomy system have outcomes within the system in socio-economic and environmental and climate terms. These outcomes also influence on parts of the biomass delivery chain again.

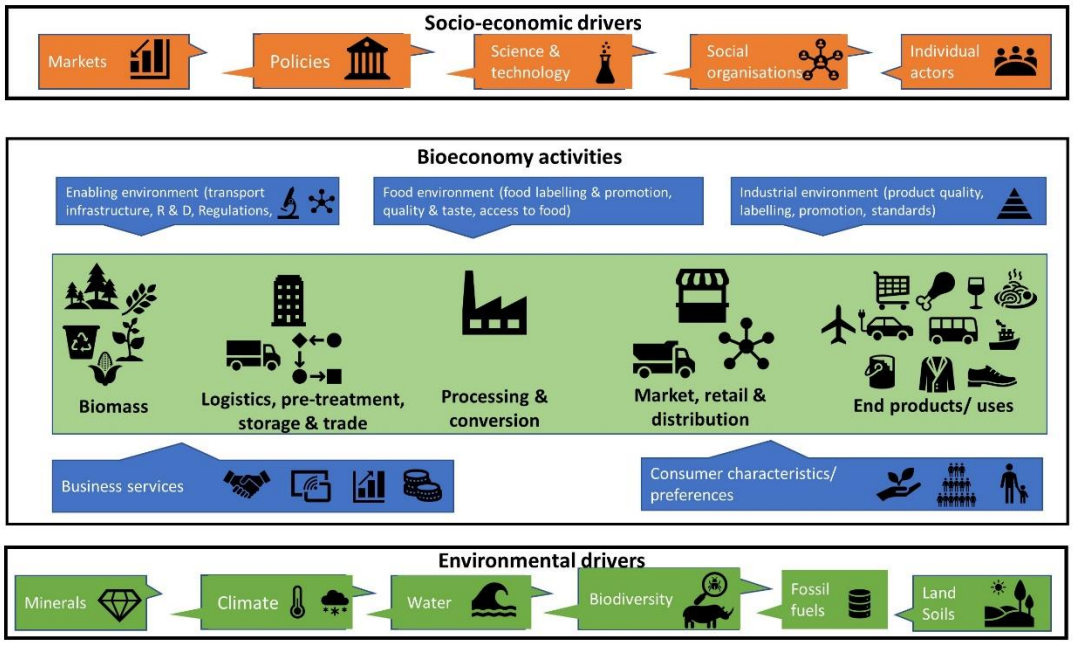


Figure 2.1 Bioeconomy system that can be regulated by policy instruments in different ways (Own elaborations taking the food system framework (Berkum et al., 2018) as a basis)

Central in the system is a biomass delivery chain that starts with the biomass production or harvesting, via logistics, pretreatment to conversions to distribution and then to end products and uses. These chains are all based on renewable biological resources and can include conversion into food, feed, bio-based products and bioenergy. It includes production processes taking place in agriculture, forestry, fisheries, food, and pulp and paper production, as well as parts of the chemical, biotechnological and energy industries.

Activities in the bioeconomy system encompass not only activities within the biomass value chain, but also the wider food and industrial environment and the 'enabling environment'. The wider food and industrial environment covers aspects such as food and product labelling and promotion, minimal quality requirements for food and products which can partly be arranged through different policy measures but also through voluntary certification and agreements between economic actors. As to the enabling environment it creates the conditions in which the system functions and covers factors such as transport, infrastructure, R&D and regulations (e.g. food safety and environmental regulations). A number of factors that influence activities at the consumer level are also a central part of the system. They cover the food and product environment and the characteristics of (individual) consumers, both of which determine the consumer's relationship to food and non-food bioproducts and how they manage the waste that comes from their consumption. The biomass delivery chains are displayed in the Figure 2.1 as linear but they are in fact to become more circular in that the end of life of bio-based products become reused as biomass resource in a new biomass delivery chain.

The different activities in the bioeconomy system have outcomes within the system in socio-economic, environmental and climate terms. These outcomes are feedback loops that occur between parts of the biomass delivery chain (production, processing, distribution and consumption), and from the socio-economic and environmental outcomes of bio-based product production and consumption (such as on food security and biodiversity impacts) back to that production and consumption.

Also the different feedback loops interact with one another. For example, certain socio-economic outcomes such as income can increase availability of food or other bio-based products, better end of life treatment and efficient food utilisation (e.g. reducing food waste). This interaction could have a positive environmental impact because it can lead to a lower demand for resources which may lower pressures on land, water, biodiversity and non-renewable resources. On the other hand, there are also trade-offs between environmental, socio-economic and food security outcomes which were for example referred to in the EEA (2018) report. For instance, the increasing global demand for food, feed, biomaterials and bioenergy resources may lead to exacerbating pressure on natural resources and demand/supply conflicts particularly between food and non-food uses.

The system framework in Figure 2.1 also shows that socio-economic and environmental conditions in turn affect the functioning of the bioeconomy system. Included in the socio-economic drivers are also the policies, but also markets, social organisations and science and technology. There are different kinds of policies for example, on land rights, food security, the environment, labour, trade or food and product safety. Normally policy seeks to guide the outcomes of the bio-based production system activities in a socially and environmentally desired direction, but outcomes are sometimes different to what is expected or policy measures do not align with the private interests of actors in the system.

An important component in the bioeconomy system is 'business services' (see Figure 2.1). These services are crucial to facilitate the development of bio-based businesses. They provide important support in terms of financing innovation and investments and informing business in their daily management as well as in their future planning. These business services are key players in the facilitation of good bio-based business models bringing the bio-based economy further. Policies can play an important role in facilitating the setting up of these business services, particularly in providing capital (soft loans) for new investments and near to market innovations, stimulating collaboration between sectors in new bio-based business opportunities and information sharing.

The relation of the bio-based system with the environment is strongly determined by the biophysical context that consists of five interacting components (see Figure 2.1):

1. The availability of land and minimal soil quality for agricultural and forestry activities and wider biomass production in natural and semi-natural environments. Intensive biomass production and harvesting methods can put pressure on soil ecosystem services.

2. The use of fossil fuels in production of agro-chemicals, fertilisers and use of machinery and equipment, refrigeration, storage, processing and transport for biomass production and harvesting for the conversion towards a bioproducts. Also the fossil feedstock used for the production of agrochemicals is based on nonrenewable resources and is very energy intensive. A side effect of using fossil feedstock and burning these fossil fuels is the emission of additional greenhouse gases in the long carbon cycle which contributes to climate change.

3. The use of minerals/microminerals, such as NPK and lime, to enrich soils and various metals such as steel, tin and bauxite for the manufacture of packaging, infrastructure and cookware. The growing scarcity of some minerals poses a challenge for biomass production such as in agriculture and forestry systems.

4. Ecosystem services including biodiversity (the variety of plant and animal life) facilitate the production of biomass in food, forestry and other land and aquatic systems. This also includes the provisioning service of biomass for food, firewood, as well as providing genetic diversity in animals and plants used for production of food and feed, soil quality, clean water resources and a diversity of plant and animal species that enable pollination. The expansion of the agricultural area, loss of semi-natural areas and forest areas and climate change pose a direct threat to biodiversity.

5. Water, as an important source of life. This involves not only the availability of water for irrigation in agriculture and for industrial processes, but also high-quality drinking water for cooking, and water for washing. Competition for clean water resources between human and natural systems should be avoided as both systems depend on each other.

The schematic overview in Figure 2.1 is presented and explained here to provide an overview in the following of the different ways the bioeconomy can be regulated by policy measures. These measures may impact directly on the different biomass chain components and on the enabling environment, the food and industrial environment, the business services and the consumer preferences and characteristics within the bio-based economy system. The policy measures may also have a more indirect impact on the bio-based economy system by regulating the relation between the bio-economy activities and the socio-economic and environmental drivers.

2.2 Overview of types of policy instruments addressing the biomass value chain

According to Jongeneel et al. (2010, based on DEFRA, 2005) market failure can be a reason for corrective government intervention. There are various types of what economist call market failure:

1. the presence of externalities –where a market transaction has a negative (or positive) impact on third parties who do not take part in the transaction (e.g. pollution, climate change

impacts, landscape quality loss). As a consequence the full costs and benefits of actions involving externalities are not reflected in market prices;
2. public goods – goods which owing to their nature are not typically provided by the private sector (e.g. access to clean air and water, biodiversity conservation, guarantees of food safety etc.). As a consequence of the non-rivalry and non-excludability of public goods the market will either fail to provide or underprovide these goods;
3. informational failures –problems with the amount of information or imbalances (asymmetric information) in its availability to different parties to a transaction (e.g information about the health status of animals). This will in general lead to inefficient outcomes;
4. failure of competition –imbalances in market power across the supply chain. Bio-based activities have to enter markets and compete with fossil based activities which have an enormous share of the existing energy and chemical markets, often lower tax advantages which can lead to unfair competition.

However, from an economic perspective, market failure is a necessary but not sufficient condition for justifying government interference. Not only markets but also governments can fail. The same factors that lead to the persistence of market failure (transaction costs, monitoring and enforcement costs) can adversely affect government intervention (DEFRA, 2005, 14). When screening government policies, one often finds inconsistencies, unforeseen adverse consequences of interventions (e.g. price support and environmental sustainability under the CAP), different policies creating opposite outcomes on different environmental parameters, policies failing to achieve the stated objectives, and even policies without clear objectives (non-SMART policies).

There are different ways in which governments can regulate, influence behaviour and alter incentives. Each of these instruments has its advantages and disadvantages, strengths and weaknesses. The different types of policy instruments can be summarized by building on Jongeneel et al., 2007 and the SOILCARE project (McNeill et al., 2018) in which different types of policy measures have been classified as follows:

1. direct regulation – a command and control approach using obligatory standards and licenses that require people/companies/market players to change their behaviour and punishes them if they are detected to be non-compliant;
2. economic instruments – includes all instruments changing price incentives (taxes, subsidies, feed-in tariffs), but also quantity constraints ((tradable) quota, tariff rate quota), and charges. These instruments give people incentives to voluntary (e.g. based on their own rational cost-benefit calculations) change their behaviour;
3. voluntary approaches – could be codes of good practice, self-regulation and other industry-led initiatives. Financial incentive schemes could be part of these instruments. These approaches typically encourage rather than force people or businesses to show the desired behaviour;
4. information and advice sharing systems – policies aimed at raising the awareness and facilitating changes in behaviour;
5. market-based signalling approaches – labelling, traceability, voluntary certification schemes and farm assurance schemes. These approaches are often related to informational problems (lack of information about product quality and food safety) hindering the proper functioning of markets;
6. other measures/instruments not in the categories above such as vision documents, road maps, strategies.

Examples of the direct regulation instruments in bioeconomy are quotas, mandates, product standards, targets and qualifying criteria for incentives, green procurement rules and permitting and zoning instruments.

Group 2, the economic incentives, could cover investment grants and subsidies, loans and loan guarantees, tradable certificates, feed-in tariffs or premiums, tax incentives/exemptions, user charges, and research and technology and innovation funds.

The last 4 groups together form, according to Pelkmans et al. (2016), the 'soft measures'. They are all based on voluntary principles such as voluntary standards and labelling, capacity building, education and platforms for collaboration or information sharing. They also include action plans, roadmaps and strategies which are elaborated by countries or regions.

In the next sections an overview is given of different types of policy measures having direct and indirect effects on the bioeconomy development.

2.3 Overview of policies targetting different sectors involved in the bioeconomy

To conclude this chapter, we give a general overview of policy instrument examples addressing different components in the bioeconomy delivery chain or the enabling food, industrial environments, business services and consumer preferences and behaviour. For these examples we have built strongly on the S2BIOM review of policies (Pelkmans et al., 2016).

First, examples of policy instruments addressing different componenents of the supply chain are presented in Table 2.1.

Table 2.1 Examples of policy instruments addressing different components of the supply chain (own elaboration taking S2BIOM policy examples (Pelkmans et al., 2016) as starting point)

Supply chain	Regulations	Economic instruments	Other 'soft instruments'
Biomass supply	Waste regulations in terms of waste management, waste separation, classification, landfill restrictions, recycling rules, end-of-waste criteria, waste hierarchy. Forest regulation: sustainable forestry rules Ecological zoning & restrictions (in relation to EU Natura2000 & Habitat Directive) in forests or to grow crops Requirements of good agricultural practice (in relation to EU-CAP) as precondition for financial support Restrictions on use of soil improvers on agricultural land (fertilizers, manure, compost, digestate, sludge (in relation to EU Nitrates Directive) Obligation to treat excess manure	Support of sustainable forestry management Support to smallholders grouping/collaboration Rural development support, e.g. for on-farm bioenergy, or energy crop premium (in relation to EU-CAP); R&D support for special crop and crop management development Support for establishment of forest roads Waste fees, return fees e.g. bottles RDP measure supporting agroforestry RDP measure for afforestation	Voluntary standards (FSC, PEFC) Forest harvesting guidelines Product labels at farm level (e.g. organic farming) Capacity building on good agricultural practices and specific farming techniques Guidelines and advisory support for avoiding waste, waste recycling, reuse (e.g. plastic bottles) Low ILUC certification

Supply chain	Regulations	Economic instruments	Other 'soft instruments'
	Rules for management of road sides and nature areas (e.g. by local communities) Food safety rules		
Logistics	Phytosanitary requirements	Support of infrastructure development such as forest roads, biomass hubs or yards	Setting up collection systems (separated streams) Creating standards for commodities
Conversion	Renewable energy mandates CHP mandates Requirement of Best Available Technologies (BAT) Zoning rules (industry park, …) Product norms & fuel standards Requirements/restrictions for the use of co-products & residues (e.g. for compost/digestate)	Subsidies / loans for conversion installations Producer tax incentives Taxes for fossil fuels in energy production Tradable certificates for biofuel/bioenergy producers Emission Trading Scheme CO2 tax R&D support for process development, demo and scale-up installations	Guidelines how to use standards
Distribution	Substitution mandates (quota) for fuel & energy distributors Grid connection requirements (electricity, natural gas grid, district heating) Obligations to develop alternative fuel infrastructure	Feed-in tariffs / feed-in premiums Support for grid development (e.g. district heating) Subsidies to develop alternative fuel infrastructure Trade import tariffs	Labelling / certificates of origin D.O.P. certificates
End use/markets	Obligations for renewable energy in buildings (relation to EU EPBD) Green public procurement	Promotion of clean and energy efficient vehicles Taxation - tax differential for energy products according to renewable and/or CO2 advantage User incentives (tax incentives biofuel vehicles, free parking, exemption of congestion charge / road tax, …)	Green procurement (private)

Bio-based economy environments that are part of the bioeconomy are also regulated by several policy instruments as presented in Table 2.2.

Table 2.2 Examples of policy instruments addressing different components of the supply chain (own elaboration taking S2BIOM policy examples (Pelkmans et al., 2016) as starting point)

BBE system componenent	Regulations	Economic instruments	Other 'soft instruments'
Enabling environment	Requirements for good agricultural practices, GAEC and Greening Regulation on organic production	Direct payments and Cross Compliance RDP agrienvironment and climate measures RDP measures supporting organic farming practices Research programmes/Support to R&D for sustainable innovations	RED I and II targets Bioeconomy action plans & roadmaps Environmental action plans Circular economy action plans and road maps Innovation action plans Public private partnerships
Food environment	Food quality requirements Food safety requirements	Research programmes/Support to R&D for sustainable food production	Voluntary standards Product labels Clustering, coorperation, networking facilitation
Industrial environment	Product quality requirements Product safety requirements Rules for fair competition	Research programmes/Support to R&D for innovations in industries	Voluntary standards Product labels Clustering & coorperation, networking facilitation
Business services		Soft loans Support knowledge/advice in adaptation processes towards more bio-based, circular, climate and/or energy efficiency in businesses/buildings/industial production processes	Information sharing
Consumer preferences & behaviour	Public procurements rules	Taxation - tax differential for energy products according to renewable and/or CO2 advantage (e.g. wind mills, PV, electric cars etc.) User incentives (tax incentives biofuel vehicles, free parking, exemption of congestion charge / road tax, …)	Private/public producrement Information sharing

Table 2.3 lists examples of policy instruments that address the relation between the bio-based economy and the environmental and socio-economic environment.

Table 2.3 Examples of policy instruments addressing the relation between the bio-based economy and the environmental and socio-economic environment (own elaboration taking S2BIOM policy examples (Pelkmans et al., 2016) as starting point)

Supply chain	Regulations	Economic instruments	Other 'soft instruments'
Environmental drivers	Emission legislation Habitat and Birds Directives Nitrate Directive Sewage sludge Directive		Climate agreements Sustainable Development goals

	Water Framework Directive		
Socio-economic drivers		Import tax Employment stimulation schemes European Development Fund	Sustainable Development goals Innovation action plans Public private partnerships

3 BARRIERS AND OPPORTUNITIES FOR BIOECONOMY POLICY DEVELOPMENT AND IMPLEMENTATION

3.1 Introduction

This chapter presents barriers to and opportunities for successful application of regional policies aimed at supporting or stimulating a bio-based economy (BBE). The outcomes may be used by regional policy makers and other stakeholders for assessing the context in which they operate, before and during policy development and implementation. First, it explains the strategy adopted to identify and analyse these conditions. Section 2 presents barriers and possible solutions and Section 3 a range of opportunities. The final paragraph summarizes the main recommendations and presents important conclusions from the analysis for policy development.

In this chapter, we consider barriers as impediments that are experienced in the process of driving the bioeconomy development, including factors that hamper the development and success of policy instruments supporting the bioeconomy development.

We use the term opportunities for developments and circumstances that facilitate development and implementation of policy instruments, the exploitation of which accelerates the transition towards bioeconomy.

The first activity to determine important barriers was conducted in a POWER4BIO meeting prior to the workshop on Bavarian Bioeconomy, held in Munich on January 20, 2020, to which all regional partners were invited (see Chapter 1.2). After discussing successful policy examples and reasons for their effectiveness, participants in small groups shared their knowledge and experiences on the barriers and facilitating conditions or opportunities, in their regions.

In these discussions, participants often took a broader view and described the experience they had with barriers and opportunities for bioeconomy development in general, not only affecting *policies* for bioeconomy. Although in practice there is indeed an overlap, in sections 4.2 and 4.3 they are separated to support understanding of the context and mechanisms successful policies need to address.

After aggregating the contributions of the participants into groups, five main categories of barriers emerged, and four categories of opportunities. Participants felt it was more difficult to come up with opportunities than with barriers.

Categories of barriers or obstacles (the order indicates how often these were mentioned, from high to low)

- Lack of societal awareness and engagement; no market
- Lack of policy coherence (with a subcategory related to waste)
- Policies without financial instruments
- Lack of vision and strategy
- Lack of expertise and (technical) knowledge

Categories of opportunities (the order indicates how often these were mentioned, from high to low)

- Organisation for collaboration (for instance create clusters and technology platforms)
- Financial instruments available
- Societal opportunities (for instance citizens' concerns about the environment)
- Policy changes (for instance regarding waste management)

The next activity consisted of a literature review. We analysed more than 20 recent scientific and professional papers, books and official reports on barriers and opportunities for policies in Europe. The references to these publications are included at the end of this chapter. From these, we derived over 60 relevant descriptions, including a brief description of the barrier or opportunity; the socio-economic driver(s) or activity(ies) to which it is related; whether the issue is related to a specific region and if so, which region and maturity level; whether the issue is related to a specific sector; in case of a barrier, which solutions are mentioned; the evidence for the issue (case study, analysis etc.); and the source. The full table is included as Annex II.

The categories developed earlier were reorganized to better accommodate the barriers and opportunities identified from literature. Within the categories, further groups or themes were identified, that are elaborated on in sections 4.2 and 4.3.

For the barriers, solutions are given if they were mentioned in literature.

For barriers for the bioeconomy development, the following categories are applied:

- Biomass availability
- Technical infrastructure in place
- Finance and market mechanisms
- Public acceptance and consumer awareness
- Collaboration
- Research and education

For barriers for bioeconomy policies, the following categories are applied:

- Policy goals
- Time frame
- Policy implementation

For opportunities for the bioeconomy development, the following categories are applied:

- Biomass supply - availability of biomass feedstock, residues
- Conversion and distribution of biomass, end-use markets
- Information on bioeconomy
- Existing business opportunities
- Potential in research and education

For opportunities for bioeconomy policies, the following categories are applied:

- General support on behalf of existing policy framework
- Synergies with other policy trends – systemic approach across sectors
- Collaboration between different types of stakeholders
- Existing funding

The final section presents a summary of the key barriers and opportunities and uses the collected information to answer the following questions:

1. What are the key barriers for the bio-based economy and in the development of policies for the bio-based economy development at national/regional levels?
2. What are the key opportunities/factors that support the bio-based economy and that make development of policies for BBE development at national/regional level successful?
3. What are typical barriers related to the integration of policies at different scales, particularly those initiated at EU level that need further translation into national/regional policy instruments?
4. What typical barriers are to be avoided/addressed by regions, particularly with respect to their bioeconomy development phase?

3.2 Barriers for policy development and implementation at national and regional scales

4.2.1 Barriers for bioeconomy development

In this section, we present the barriers that national and regional policymakers face when they aim to drive the development towards a bio-based economy. A barrier is considered as an impediment that is experienced in the process of driving the bioeconomy development. These barriers can be classified based on the following aspects presented in the first column of the Table 4.1. The table will be further explained in detail below.

Table 4.1 Summary overview of general barriers that are impediments for the development of the BBE found in literature.

BBE aspect	Experienced barrier	Specific issue	Source
Biomass availability	Biomass is not available	Biomass is difficult to mobilise	Pelkmans et al., 2016; OECD, 2018; Hodgson et al., 2016
		The quality of the biomass supply is too low, compared to demand of the quality	Gyalai-Korpos et al., 2018; CEPI, 2012; Pelkmans et al., 2016
		The biomass is not sustainably harvested	OECD, 2018; Pelkmans et al., 2016
Infrastructure	Insufficient technical infrastructure	Lack of required infrastructure	Pelkmans et al., 2016; Spatial Foresight et al., 2017
		Centralized systems that are not beneficial for countryside	Spatial Foresight et al., 2017

BBE aspect	Experienced barrier	Specific issue	Source
Finance and market mechanisms	No access to finance	Difficulties to mobilize resources	Hodgson et al., 2016
		High financial risks of BBE development– affecting models to become commercially	Philp, 2018; Pelkmans et al., 2016
	Lack of supporting market mechanisms	Price competition with petrochemical market and other fossil fuelbased industries	Philp, 2018;
		Lack of incentive for consumers/producers to shift toward bio-based economy	Philp, 2018
		Lack of commercial frameworks – lack of green public procurement	NNFCC, 2018
Public acceptance and consumer awareness	Lack of societal awareness and engagement, resulting in limited market uptake of bio-based products	Lack of public acceptance/societal awareness; resistance to change; not sufficient legitimacy of bio-based alternatives	Pelkmans et al., 2016; Hodgson et al., 2016
		Lack of consumer confidence	Diakosavvas et al., 2019
		No framework to assess the quality of products	Diakosavvas et al., 2019; Pelkmans et al., 2016
Collaboration, research and education	Lack of collaboration	Lack of connection between government and value chain actors	Hodgson et al., 2016
	Poor research valorisation	Inadequate diffusion and transparency of research	Kitney, 2019; Diakosavvas et al., 2019
		Lack of commercial adoption of research and patents	Wozniak et al., 2016
	Lack of expertise and technical knowledge	Lack of education and skills	OECD, 2018
		Lack of knowledge exchange	OECD, 2018

Biomass availability. The sustainable mobilisation of sufficient and good quality biomass is essential to build the bio-based economy. Biomass is the main resource in this type of economy. While it is claimed that there is sufficient biomass available in Europe to reach the 2030 goal of bio-based economy, there are difficulties to mobilize the required biomass (Pelkmans et al., 2016; OECD, 2018). European regions have indicated in the Biohorizons survey that difficulties in mobilising biomass is one of the main barriers that hamper bio-based supply chain development (Hodgson et al., 2016).

Mobilisation of biomass is affected by the lack of willingness of farmers and foresters to supply biomass, for instance due to the food vs. fuel debate and land use change conflicts (Gyalai-Korpos et al., 2018). A survey among Czech farmers has indicated that the majority of farmers has the opinion that straw should remain on the land and should not be harvested for other purposes (Dettenhofer, 2020). This is quite surprising, because in a biomass assessment study (Dees et al., 2017) it was assessed that more than 50% of the straw could be removed in most regions in the Czech Republic while keeping soil carbon at a constant level. Biomass from agricultural products may be only seasonally available (CEPI, 2012). Furthermore, biomass is a typically disperse resource (opposed to fossil fuels) and sometimes coming from remote and difficult to reach areas. These issues relate to logistics i.e. the easiness in mobilising biomass (Pelkmans et al., 2016). Policy solutions to improve the biomass mobilisation are for instance paying farmers (via subsidies) for biomass production, or R&D to improve crop characteristics such as seasonality and also other characteristics leading to sustainable intensification i.e. high biomass yields per area and/or stronger build-up of below and above ground biomass. Regions can also limit mobilisation issues by building a bio-based economy strategy based on the biomass potential that is the most available in the regions, as was done by the Danube region (Gyalai-Korpos et al., 2018).

Another issue is the variability of biomass quality. Most biomass has low quality. But for higher quality material, there is more demand, also by other markets, which results in higher competition (Pelkmans et al., 2016). R&D may help here to develop biomass conversion routes that can handle lower quality biomass and mixed biomass sources with larger variation in biomass characteristics.

When harvesting biomass for bio-based production, the issue of sustainability is relevant. Sustainability is one of the arguments why bio-based economy should be preferred over fossil fuel-based economy. However, the increase of biomass demand may entail the risk of unsustainable exploitation and environmental degradation (OECD, 2018). To overcome this barrier, the policy option is to oblige companies to provide information on sustainability performance criteria to the management of forests and agriculture that are transparent and can be checked (Pelkmans et al., 2016).

Infrastructure. The processing of biomass into bio-based products as well as the logistics of biomass and bio-based products differs from fossil-based products. To be able to shift towards a bioeconomy, specialised infrastructure should be in place. To harvest biomass from for instance forests, roads, tracks and other infrastructure to access the forests, are needed. The use of biofuel like high ethanol blends or biomethane requires dedicated infrastructure like fuelling stations (Pelkmans et al., 2016). Biomass conversion also requires specialised facilities and processing plants, as for instance biofuel from algae (Spatial Foresight et al., 2017). It is a barrier when this required infrastructure is not in place. The study of Spatial Foresight et al. (2017) has also highlighted the mismatch of infrastructure with the regional characteristics. The case of Lapland has indicated that many existing frameworks supported centralised systems for bio-based production, while Lapland should benefit more from decentralised systems. Regional circumstances can therefore be a barrier for certain bio-based perspectives since the infrastructure does not fit with it. A solution could be the introduction of biomass yards

or hubs to collect biomass via shared facilities. Another solution is the use of small decentralised biomass conversion units to produce locally used biomass.

Finance and market mechanisms. Research and development and also the implementation of infrastructure and market development require funding. In the Biohorizons survey, experts in bio-based research, industry and governance have indicated that lack of access to finance is a barrier in the bioeconomy development (Hodgson et al., 2016). Not many investors are willing to invest in the bioeconomy, due to high financial risks. Many innovations are in a pilot phase and they may fail to scale, which make it high risk investments. Furthermore, the initial investment costs are quite high, as for instance building biorefineries (Philp ,2018). Governments can use tools to reduce financial risks as for instance providing guarantees or low-interest loans (Pelkmans et al., 2016). A joint initiative of the European Investment Bank and the European Commission – Innovfin – enables access to risk finance for R&I projects (see Box 4.1) (Philp, 2018). Other examples are a loan-programme for bioeconomy, which has been implemented in Ukraine, or the Flanders Future Tech Fund to finance the risks of technological innovations.

Box 4.1 Decreasing financial risks by InnovFin – the European Circular Bioeconomy Fund (ECBF)

InnovFin – EU finance for innovators is a joint initiative of the European Investment Bank Group and the European Commission (as part of the H2020 programme) to provide a wide range of financial instruments to cover some of the financial risks that are associated with research and development projects. In this way, InnovFin aims to facilitate and accelerate access to finance for innovative business and other innovative entities. InnovFin is built on the basis of the Risk Sharing Finance Facility (RSFF). InnovFin Energy Demo Projects is especially targeted to energy projects, while InnovFin Thematic Investment Platforms aim to catalyse third-party financing for thematic areas as for instance the circular bioeconomy. This platform was launched in 2019 after the results of a study on access to finance conditions for investments in bio-based industries. This platform aims to provide access to finance in the form of debt or quasi-equity to innovate bioeconomy projects.

Developing a bio-based economy is also hampered by lack of supporting market mechanisms. It requires a shift in the whole value chain, from producers to consumers. This shift is not easy to make, given the current market mechanisms. One aspect is the fierce price competition from the petrochemistry, affecting the willingness of producers and consumers to shift towards bio-based economy (Philp, 2018). Products from fossil fuels are still often cheaper compared to bio-based products. Bioeconomy production should be partly driven by consumer demand. Manufactures wait until there is clear market demand before commercialising technologies. Governments, like for instance that of Denmark, may play a role in increasing demand via public procurement policy but regions have indicated that lack of public procurement policy is a barrier in the bioeconomy development. Demand side policy is needed to overcome this barrier (NNFCC, 2018).

Lack of awareness and public acceptance. In bioregions, a lack of awareness of the benefits of bioeconomy, compared to the fossil-based economy is hampering the development. However, the acceptance by the public is crucial to make sure bio-based products are taken up by the market (Pelkmans et al., 2016). Several studies have indicated public, media and policy makers are not well informed about possibilities and opportunities of biomass, bioenergy and bio-based economy, resulting in the lack of willingness to buy bio-based products. This is one of the big barriers in bioeconomy development. The food vs fuel debate as well as the debate on carbon accounting principles have contributed to an overall poor public image of biofuels and bioenergy in some regions (Pelkmans, 2016). The public's resistance to change is another barrier related to consumer awareness and is a barrier that requires policy measures to overcome (Hodgson et al., 2016). Many products are still in a development stage and quality is not yet at the quality level of fossil-based products (Pelkmans et al., 2016). The lack of confidence of consumers in the product is also hampering the market uptake of bio-based products (Diakosavvas et al., 2019). Policy instruments to overcome the barrier of lack of consumer awareness and limited market uptake are public campaigns, provision of information on sustainability performance, quality control, public procurement, quality assurance and product standards (Diakosavvas et al., 2019; Pelkmans et al., 2016). However, to make sure sustainability performance is correctly communicated, there is need for uniform systems to verify the sustainability. Policy that is based on broad societal debate that includes overall visions and implementation pathways has also been offered as a solution to overcome this barrier (Meyer et al. ,2017).

Collaboration, research and education. Bioeconomy development also requires collaboration, research and education. We have observed barriers related to lack of collaboration. As was stated in Hodgson et al., (2016), the development of the bioeconomy "involves a deeply interconnected series of actors and value chains operating at international, national, regional, and sectoral levels as well as different spatial scales all developing in parallel". This requires close collaboration between governments that promote enabling policies and the private sector that expresses specific needs for support. Many bioregions struggle with a lack of connection between the government and the value chain actors, resulting in poor policies (Hodgson et al., 2016).

A region that wants to grow towards a bioeconomy is dependent on research, innovation and education. Research and innovation are required to design a bioeconomy that fits to the regional potentials. The lack of research and innovation potential largely affects bioeconomy development. In regions where research is taking place, there may be barriers with regard to difficulties in reproducing the research. This is mainly the case when working with complex biological systems (Kitney, 2019). Not all bioeconomy research is made transparent and there are difficulties in diffusing the research results to the private sector (Diakosavvas et al., 2019). There is also the barrier related to the commercial adoption of research, for instance by limited number of patents available in some countries and regions (Wozniak et al. 2016). A solution would be public private partnerships where finances are joined and information is shared, like in the Bavarian Cluster Initiative.

To make the bioeconomy work, new skills and capacities are needed. Studies have indicated that the lack of skilled employees is affecting bioeconomy development (OECD, 2018). Training and capacity building programmes are ways to overcome this barrier. Another barrier is that existing knowledge is not exchanged very well, resulting in inefficiency to innovate and produce (OECD, 2018).

4.2.2 Barriers in policy, affecting bio-based economy development

It is observed that many regions have policy instruments that drive bio-based economy development but that are not labelled as such. These policy instruments can be found in energy policy, nature policy, and rural development policy. This is for instance also indicated by Wozniak et al., 2018 for the case of Poland, where no single strategic document was dedicated to the bioeconomy, but bioeconomy issues were incorporated in three integrated strategies. This barrier means that policies and policy support do exist, but that they are fragmented, suffer from a lack of coherence and an insufficient overview by the actors that want to develop the bioeconomy.

The literature has revealed that although some bioregions have designed policies to support the bio-based economy development, they still experience barriers which are mainly related to inefficient and ineffective policy frameworks and policy instruments. We can learn from these experiences to promote and design better policy instruments. The barriers are related to:

- Policy goals
- Time frame
- Policy implementation

The experienced barriers are elaborated in the following section.

Table 4.2 Summary overview of barriers for effective policy frameworks and policy instruments, found in literature.

BBE aspect	Experienced barrier	Specific issue	Source
Policy goals	Vague goals and no operationalisation	No straightforward implementation of policies/short on detail on how to implement	Winkel et al., 2018
		Lack of targeting policy measures	Interview POWER4BIO regions
Time frame	The time frame of the policy is uncertain	Uncertain policy framework/lack of continuity (hampers investor confidence in bioeconomy etc.)	OECD, 2018; Pelkmans et al., 2016; Gyalai-Korpos et al., 2018
Policy implementation	Lack of policy coherence	Too many different policies/policy instruments	Aggestam et al., 2017; Pelkmans et al., 2016
		Conflicting goals between policies	Diakosavvas et al. ,2019; Aggestam et al., 2017
		Action at multiple scales increases complexity	OECD, 2018
		Diverse interests and political positions of stakeholders	Viaggi et al., 2018

BBE aspect	Experienced barrier	Specific issue	Source
	Lack of incentives	Lack of economic incentives for transition to BBE	Spatial Foresight, 2017
	Perverse policy effects	Fossil fuel consumption subsidies	OECD, 2018; Philp, 2018
		The way environmental damage is part of prices (not)	OECD, 2018
		Waste regulation that hampers re-use of residues into new products	POWER4BIOregions
	Lack of standards, regulation	Lack of standards in enabling biotechnology	Kitney et al., 2019
		Lack of sustainability framework	
	Market	Adverse impact on competitiveness on other sectors due to pressure for price increase	Toppinen et al., 2018

Policy goals. The literature study revealed that several bioregions do have policies to support bioeconomy development, but these documents lack details on how to implement the strategy (Winkel et al., 2018). This was for instance elaborated with regard to European forest policy in Winkel et al. (2018). The result is that the strategy is interpreted in different, sometimes even conflicting ways and there are many difficulties to implement the strategy, due to the lack of guidance. In addition, policies seem to miss clear ways to measure and evaluate progress in meeting policy targets. The policy documents are described in a strategic but qualitative way and rarely include indicators to monitor the progress of the bioeconomy development (workshop POWER4BIO in Munich, January 2020).

Time frame. Many of the existing policy documents do not mention a clear and specific time frame and they are not stable and change quickly (OECD, 2018). This affects the willingness to invest by private and public actors, who are looking for continuity (Gyalai-Korpos et al., 2018). Policy continuity is needed to build up investor confidence and to catalyse investments (Ting et al., 2018). A long-term vision is necessary. The timeframe for a strategic policy vision should be 20 years or more, while a policy framework should be up to 10 to 20 years (Pelkmans et al., 2016).

Policy implementation. Regions in progress to bioeconomy development are also affected by lack of policy coherence. Some regions do not yet have a bioeconomy strategy, but the policy instruments for bioeconomy development are part of different policies like agriculture, energy, nature, innovation policies. This fragmentation of policy instruments is affecting the bioeconomy progress, because there are instruments in many different policies, which are not labelled as bioeconomy instruments. This affects the transparency of policy instruments (Aggestam et al., 2017). It is important that there is consistency between the policy fields (Pelkmans et al., 2016). It may also happen that different policies have conflicting goals for instance with regard to land use in relation to food production or the production of

renewable raw materials for energy and bio-based products (Diakosavvas et al., 2019). There are also goals in EU regulation and priorities that conflict with national goals and among member states when being transposed, implemented and enforced by member states (Aggestam et al., 2017). EU policies like the Common Agricultural Policy leave responsibility to the member states to transpose policies into national regulation, which results in differences in terms of the level playing field for actors in the bioeconomy. The bioeconomy development also requires action at multiple scales, from the local scale to the global scale. This results in complexity, also at the level of policy implementation (OECD, 2018). The implementation of policy also depends on the different interests and political positions of stakeholders (Viaggi et al., 2018).

Another issue with existing policies is the lack of economic incentives that drive bioeconomy development (Spatial Foresight, 2017). These incentives are needed to encourage business and consumers to act differently. Pricing carbon emissions and environmental damage would be a very strong incentive (OECD, 2018). Current policies also favour the use of fossil fuels. These perverse effects of policies have to be avoided; more specifically, carbon taxation and fossil fuel subsidy policies (Philp, 2018). Another effect of waste regulation is that it hampers re-use of residues into new products, and therefore largely affects bioeconomy development (as interviews with representatives of the regions involved in the POWER4BIO project mentioned). The latter also creates differences in what is seen as waste in different EU regions.

The bioeconomy development is also affected by the lack of standards and regulation, for instance with regard to biotechnology. These standards play an important role in guaranteeing the continuity and quality of bio-based products. Standards will play an important role in accelerating the transition (Kitney et al., 2019). There is also a lack of framework to secure the sustainability of the bioeconomy. And last but not least, some policies specifically support a sector in a direct way, therefore affecting price and the market mechanisms (Toppinen et al., 2018).

4.2 Opportunities for policy development and implementation at national and regional scales

4.3.1 Opportunities for bioeconomy development

National and regional policymakers are faced with certain opportunities, the exploitation of which accelerates the transition towards bioeconomy. To create and facilitate the development of a bio-based economy efficiently there are different opportunities to choose from. These opportunities can be classified based on the aspects in the left column of Table 4.3. The table will be explained in detail in the following.

Table 4.3: Opportunities influencing the BBE development

Aspect	Opportunity	Specific opportunity connected with literature review	Source

Availability of biomass feedstock/ residuals – Biomass supply	Quantity of industry byproducts and residues	Industry residues have the advantage of being available at a central location, i.e. at the industry site.*	Pelkmans et al., 2016
	Bio-based economy links to different policy fields	Biomass and developments in the bio-based economy link to different policy fields	Pelkmans et al., 2016
Conversion and distribution of biomass, end-use markets	Conversion into real commodities	Commodities are tradable	Pelkmans et al.,2016
	Demand side measure	Demand side measures are often directed towards production and distribution especially in the case of bioenergy and biofuels.	Pelkmans et al.,2016
Information on bioeconomy	Policy decisions taken based on available data	Data on bioeconomy and biomass	Ronzon et al., 2017 and 2018 (JRC Bioeconomics dataset)
Business opportunity	New business opportunity for farmers	Farmers become more resilient and can adapt better to climate change, which is especially beneficial for the socio-economic development of rural areas.	Carus, 2017.
Research and education		High potential of researchers and scientific discoveries	Schieb et al., 2015; Lainez et al., 2018, Woźniak and Twardowski, 2016.
	Innovation opportunity	Potential to commercialize research	
		Potential for innovations	Carus, 2017.

Note: * Matching good policy examples are: Pay as you Throw (PAYT) schemes in BE, NL, LU; Austrian landfill tax and appointing waste advisors

Biomass supply. The mobilisation of biomass is an important key for further deployment of the bio-based economy. Assessments have proven that there is a huge biomass potential – unutilised potential - in agriculture, forestry and industry. By focusing on industry by-products and residues it can be stated that they have certain advantages we can rely upon. These advantages are on the one hand, that most of them have been already valorised, and on the other hand that they are already available at a central location. Besides industry by-products and residues, opportunities provided by the post-consumers waste should be mentioned. The policy's task is to promote resource efficient application of them. Policy options vary however country by country as they are at different stages in waste management. Countries with high landfill shares should at first shift from landfill to mixed waste treatment, while in countries with more developed waste management systems separate collection of waste stream types and further processing them into products should be aimed at. According to the findings of the S2BIOM project (Pelkmans et al., 2016) the key policy suggestions for the waste sector are in terms of regulations and soft measures as follows:

"Regulations:

- Refine terms and conditions in the EU Waste Framework Directive and respective legislation in Member States and account for all potential uses of organic wastes;
- Set up waste treatment systems as alternative for landfill;

- Set up separate collection systems of waste streams to increase the availability of organic waste fractions (source separation);
- Introduce regulations for recycling of waste wood by the wood industry.

Soft measures:

- Capacity building and guidelines on best practices for waste treatment;
- Measures to promote re-use and stimulate industrial symbiosis;
- Provide clear definitions of 'end-of-waste' criteria (i.e. when certain waste ceases to be waste and obtains a status of a product or a secondary raw material)." (Pelkmans et al.,2016)

Conversion and distribution of biomass. Commodities have the advantage of being fully tradable, complying with storage facilities, furthermore with shipping and conversion processes. Thus, certain materials e.g. lignocellulosic materials should be turned into real commodities and low-quality materials should be converted into intermediate products (such as pellets or pyrolysis oil). As a result, contracting is easier, markets open faster and more options to finance become available (Pelkmans et al., 2016). In connection with production and distribution of bio-based materials we could consider the application of demand side measures as opportunities, especially in the case of bioenergy and biofuels. The support systems for bioelectricity and -heat include feed-in tariffs/premiums, renewable energy mandates in connection with green power certificates, CHP support systems and fossil fuel taxation e.g. CO2 taxes in heat production (Pelkmans et al., 2016).

From the logistics point of view an opportunity to provide sustainable supply of solid biofuels could be the implementation of agro-industry logistic centres in the agro-industry, i.e. to create biomass hubs. The main advantage would be that biomass feedstocks could be pre-treated and stored in the agro-industry facilities also in the idle periods. During those periods biomass feedstocks (mainly from agricultural residues) could be handled and pre-treated to produce quality solid biomass (e.g. https://www.sucellog.eu/).

Information on bioeconomy. The BBE development requires specific information and data on different aspects of the bioeconomy. Over the last few years severe progress has been made towards gathering and interpreting data. In 2018 Ronzon and his colleagues published an article in which they made a state of play assessment by using data compiled in the JRC Bioeconomics dataset. The assessment is considered a complex task as, according to the official statistical classification of economic activities of the European Community (NACE rev. 2.), the economic activities are not divided into bio-based or non-bio-based activities. Thus, certain sectors include both. In case of these so-called 'hybrid' sectors it is a major requirement to measure the extent to which a given hybrid sector is bio-based. The methodology to quantify the sectoral bio-based shares was, however, developed by Ronzon and his colleagues in 2017 (Ronzon et al., 2017). As a result of the application of the methodology in the study key socio-economic indicators were analysed. The EU member states were clustered based on those indicators and a heat map of the sectoral contribution to bioeconomy jobs and value added was created. (Ronzon et al., 2018)

The collaboration of research, education, and industrial sectors is an essential element in moving forward from the biomass-use bioeconomy towards the advanced bio-based economy. The bioecon-

omy is a strategic area for the EU, focusing on the business-led initiatives and public-private-partnerships with innovation from both public and private actors. However, the cooperation level between actors shows a very diverse picture in Europe, especially between Central and Eastern European and Western European countries.

In the Champagne region of France, where the biorefinery sector has a long-standing tradition, the market players from different sectors such as industrial, research and innovation, academic research and also experimental equipment and demonstration have been collaborating since the middle of the 20th century. The sector is unique in that it is an "ecosystem," in which exchange and interaction have boosted the production of the firms present on the platform. Research is at the heart of the biorefinery's structure, which provides fertile ground for mutualisation and synergy (Schieb et al., 2015). (See also Box 4.2)

According to M. Lainez et al. (2018), Spain has also a huge potential in generating know-how in the area of the bioeconomy due to the collaboration of public research bodies and universities, or public and private technological centres and companies. Contrary to the situation in France, research projects on food and agriculture were the most prevalent, but fundamental areas of biology and biochemical science and technology were also quite well represented in the Seventh Framework Programme, H2020 and different funded programs by the Spanish Public Administration. In general, the funded research projects that were led by companies are always supported by applied research activities carried out at universities or research centres.

In the case of Poland, Woźniak and Twardowski (2016) stated that the innovation capacity and great research capabilities in Poland are mainly focused on the primary sectors such as agriculture, food/feed production, and energy production from biomass, biogas, and biofuels. The technologically advanced sectors such as biotechnology, pharmaceutical industry or biomaterial industry are less representative in Polish bioeconomy. This is because the close collaboration among the different private and public partners is much less common compared to Western Europe. The majority of research and industrial activities are supported by the state because of the lack of participation in different EU funded programs. A barrier to this, already discussed in section 4.2, is the conversion of academic ideas to consumer products illustrated by a low number of national and especially international patent applications. This is because the knowledge of intellectual property law is still very limited within Polish academia. To assist in overcoming these obstacles, bioeconomy clusters and hubs should be developed in Poland to boost the industrial application of know-how.

Due to the close cooperation between the public and private sectors and adaptation of the new research outcomes, new innovative business opportunities open up for market players such as farmers. Michael Carus (2017) says that "the sustainably bio-based economy can offer opportunities to farmers since a more diverse production of crops for food, feed, and industrial markets can provide more security and stability. Through the local production of feedstocks for bioenergy and bio-based products, farmers become more resilient and can adapt better to climate change, which is especially beneficial for the socio-economic development of rural areas". Finally, it contributes to bringing new business opportunities, investments, and employment to rural areas. Furthermore, it facilitates to foster regional development and support small to medium enterprises.

4.2.2 Opportunities for policy development and implementation

Many regions in Europe have a low level of bioeconomy maturity and further development of bioeconomy related research and innovation activities is necessary. To improve the situation a streamlined and integrated EU strategy and policy framework is required through which EU and regional policy makers and politicians provide willingly coordinated support from EU level to national and local level in strategic planning and communication, among others raise awareness or ensure consequent allocation of resources. At the level of government, coordination among different policy areas (e.g. research and innovation, agriculture, environment) is needed to promote the bioeconomy. Nowadays even if the term 'bioeconomy' is not used, a mix of support policies and programmes for different aspects of the bioeconomy i.e. specific programmes or instruments exist within sectoral policies (e.g. research and innovation, economic/industry development, agriculture, environment).

Certain countries/regions have already established relevant governance mechanisms such as: strategies (e.g. on bioeconomy, on food innovation or the research and innovation strategy for smart specialisation (RIS3) , framework programs for the transition to a green/circular economy), strategic councils, integrated pilot projects to prepare an ad-hoc governance, as well as supportive platforms and communities (web-based, but also real groups). It means that these countries/regions:

- combine supply and demand side policy instruments to achieve goals of the bioeconomy;
- create policies that trigger the industry to innovate continuously and emphasize competition, technology neutrality;
- align principles of different policies;
- are able to prioritise thematic areas or value chains/cycles and
- can take adequate decisions on investments in infrastructure or on cluster support;
- point out how synergies among existing funds (ESIF, H2020, ERA-Nets, COSME, LIFE+ etc.) can be exploited;
- and promote communication of good practices and project results.

The aspects of **opportunities for policy development and implementation** are diverse. These can be classified using aspects in Table 4.4 (left column) based on evidence gained from literature review.

Table 4.4 Opportunities for policy development in BBE

Aspect	Opportunity	Specific opportunity connected with literature review	Source
Support of existing policy frameworks	Government being neutral towards technologies	Government that remains neutral concerning choices of technologies provides more stable framework.	Schieb et al., 2015
	EU level policy	National and regional bioeconomy strategies are required in each Member State.	Dupont-Inglis and Borg, 2018
	Raising awareness in society	Action plan helps to bring BBE to different groups of society.	José et al., 2018
	Existing support options	There are many policy options to support engineering biology as part of BBE.	Kitney et al., 2019
Synergies with other policy	Policy changes	Sustainable intensification of farming practices together with support of the bioeconomy.	Gyalai-Korpos et al., 2018

trends - systemic approaches across sectors - win-win situation		BBE can be a way to deal with climate change.	Carus, M., 2017
		"The Directorate-General for Research and Innovation is in the process of developing a new research and innovation policy framework for food and nutrition security (FOOD 2030) with a view to structure, scale-up and boost research and innovation to future-proof our nutrition and food systems. FOOD 2030 will be tightly coupled with the R&I pillar of the Bioeconomy Strategy."	Bell et al., 2018
		"Removing fossil fuel subsidies and pricing the environmental damage of those industries would put a completely different complexion on their economics and would make arguments against green bioindustries much less convincing."	OECD, 2018
		The Communique´ of the Global Bioeconomy Summit emphasizes the need to align the principles of a sustainable bioeconomy with the principles of a circular economy, which "would involve systemic approaches across sectors (i.e. nexus thinking), particularly innovation policy measures that aim at optimizing Bioeconomy value networks and minimizing waste and losses" (Bioeconomy Summit 2015, p. 5).	Lewandowski, 2018
	Financial instruments	Greenhouse gas emissions reduction trading system – it is a way to raise the required finance	OECD, 2018
		Policies can transform trade-offs into synergies	
		BBE policies brings together agriculture, environmental and energy policies	Diakosavvas & Frezal, 2019,
Collaboration	Organized collaboration	Existing BBE networks and platforms	Schieb et al, 2015
		Active involvement of private sector in PPS – shared technology platforms	Schieb et al, 2015
Existing funding	Financial instruments	Combine funding at EU and national level	BBI JU, 2018
		EU funding for innovation and scaling/boosting research	

General support on behalf of existing policy framework includes the need to provide a stable regulatory framework while remaining neutral concerning choices of technologies and promoting competition both with existing technologies and other sectors. The industrial bioeconomy needs to be compensated for the benefits (disregarded externalities) and massive direct and indirect subsidies (tax relief**,** favourable tax regimes) awarded to established sectors (see box 4.2).

Box 4.2. General support on behalf of existing policy framework

There is an excellent example for neutral policy framework in the biorefinery sector in the Champagne region of France. As a result of 70 years of initiatives the Bazancourt-Pomacle biorefinery became the first operational integrated biorefinery with varied industrial facilities and production, an innovation platform and the operation of a genuine knowledge economy. The geographical proximity of different stakeholders contributed to the economies of scale or diversification and thus improved their competitiveness. Procurement and production depending on upstream and downstream markets are optimised by the biorefinery. Furthermore, economic optimisation is accompanied by environmental optimisation regarding e.g. waste management or energy consumption (Schieb et al., 2015).

At EU level the general policy framework – namely the EU's bioeconomy strategy - has been already established. The goals of the bioeconomy strategy could, however, be achieved only by tackling existing policy fragmentation, engaging the civil society to a greater extent and putting in place the national and regional strategies (Dupont-Inglis and Borg, 2018). In some countries EU level policy and strategy development have been already translated into policies at national and regional level and the bottom-up initiatives meet top-down guidance - legislation and support.

The EU's bioeconomy strategy is supported for example by certain EU level directives - e.g. Renewable Energy Directive (RED) that mandates levels of renewable energy use within the European Union or the directive on the landfill of waste aiming to reduce environmental pressures from landfill, particularly methane emissions and leachates – or specific instruments such as the bio-based industries instrument for Europe (BIV/BBI). The latter was launched in 2014. The BBI supports industrial research and innovation. Its strategy is industry driven and therefore result- and market-oriented. It is based on a robust framework that brings clarity for activities and investments; long-term stability and predictability; a joint approach, across sectors and across nations; joint financial commitment and a jointly defined programme; and leveraging of further investments. The BBI is aimed at levelling the fragmentation and building bridges between the sectors (OECD, 2018).

A supportive policy framework is also able to bring bio-based economy to society for example by means of trainings or educational programs. The policy framework can however be very broad and the tools to be used have a vast array as well (See chapter 2 and 3). Choices need to be made within countries and regions. Spain's choice for example is as follows: In the country following the launch of the 2016 Action Plan for implementing the Spanish strategy on bioeconomy more than 250 people (coming from different areas of society) were trained in the concept of bioeconomy and its funding opportunities (Lainez et al., 2018). If we define a closer focus on policy framework and choose for example engineering biology as an integral part of the bioeconomy, we can state that there are many policy options to support it. Success stories in engineering biology can be accelerated through policy (Kitney et al., 2019)

Synergies with other policy trends, i.e. creating a win-win situation for different policy fields call for policy changes. Policy changes are required at all different levels, at global, EU, national and regional level. At global level the alignment of principles of sustainable bioeconomy with principles of circular

economy would involve systemic approaches across sectors leading to optimised value networks and minimised losses and waste. Policy instruments used for the abovementioned purpose might be either direct or indirect tools. Direct instruments are tariffs and subsidies on different (bio-based) products either domestically produced or traded. Indirect instruments include environmental taxes (carbon tax) or voluntary agreements (Lewandowski, 2018). Among others at EU level the link between bio-based economy and climate change or the need to put more emphasis on research and development is clear. As for the former statement the bio-based economy can significantly contribute to climate change mitigation. Sustainable sourcing and smart use of biomass can lead to the production of alternative versions of traditional fossil-based products or completely new goods. This way positive contribution to savings in GHG emissions, toxicity, waste reduction, and a long-term shift away from finite resources can be provided by means of new business opportunities, investment or support to medium enterprises (Carus, M., 2017). Another very important topic from the point of view of bioindustries is subsidising young technologies of any sort for climate change mitigation and removing fossil fuel subsidies. According to the OECD carbon price and carbon tax could work well if taken up by a wide number of countries at the same time (e.g. this is proposed in the Green Deal for EU-27). This may be an instrument to remove the huge fossil fuel subsidies (OECD, 2018) and create a fairer level playing field for renewable energies.

As for initiatives supporting technological development, the Directorate-General for Research and Innovation of the European Commission developed a new research and innovation policy framework for food and nutrition security i.e. FOOD 2030 that is tightly coupled with the R&I pillar of the Bioeconomy Strategy (Bell et al., 2018) The Farm to Fork strategy for Sustainable food, that is a key component of the European Green Deal needs to be mentioned here as well. This strategy will contribute to achieving a circular economy, too and it will provide new opportunities for all operators in the food value chain.

At the global level, the greenhouse gas emissions trading system has an important role to raise the required investments to finance the public contributions of projects, although the effectiveness of ETS system has until now been limited. The GD therefore announces an adaptation of the ETS and also a new carbon pricing instrument (see Chapter 3).

Pricing carbon emissions through a carbon tax/carbon price should be a powerful incentive to invest in cleaner technologies and adopt greener industrial processes (OECD, 2018). According to Diakosavvas and Frezal (2019) development of the bioeconomy is complex from a policy perspective, due to its broad scope. In principle, developing a bioeconomy strategy is a first step to establish policy coherence and coordination at the national level. Coherence needs to be sought in particular across agriculture, food, rural development, environment, forestry, energy, research and innovation, waste and climate change policies that are perceived as vital to foster the development of the bioeconomy of the agriculture and food system.

Organised collaboration is active involvement of the private sector through public-private partnerships. It brings the industry together with research institutions and enables the circulation of human capital and knowledge such as changing jobs or employers on the same site, collaboration on the same projects, informal and formal interaction between members of a community (Schieb et al., 2015). Several European countries (Greece, Spain, Germany, Belgium) reported that the existence of networks, platforms, associations, and clusters supports the bio-based industrial sector and encourages/facilitates the involvement of national stakeholders in the EU-funded programs. Woźniak and Twardowski

(2016) also mentioned the importance of the bioeconomy networks in case of Poland where these networks are not well represented.

4.3 Summary and conclusions

This chapter presents the results of a stakeholder workshop and literature study into barriers and opportunities for policy development and implementation, to support the bio-based economy. In practice, these barriers and opportunities are closely linked to barriers and opportunities for the bio-based economy itself. We therefore include descriptions and explanations on both categories.

This chapter aims to answer the following questions:

1. What are the key barriers for the bio-based economy and in the development of policies for the bio-based economy development at national/regional levels?
2. What are the key opportunities/factors that support the bio-based economy and that make development of policies for BBE development at national/regional level successful?
3. What are typical barriers related to the integration of policies at different scales, particularly those initiated at EU level that need further translation into national/regional policy instruments?
4. What typical barriers are to be avoided/addressed by regions, particularly with respect to their bioeconomy development phase?

The key barriers for the bio-based economy and the development of policies for the bio-based economy development at national/regional levels that are identified and described in this chapter, are included in Table 4.5.

Table 4.5 Key barriers for the BBE development and for effective policy frameworks and policy instruments

Key barriers	Category	Description
BBE development		
	Biomass availability	The sustainable mobilisation of sufficient and good quality biomass is essential to build the bio-based economy. Obstacles are a.o. low cooperation of farmers and foresters, seasonal availability, provenance (and logistics), quality and sustainability.
	Lack of public acceptance and awareness	Acceptance by the public is crucial to make sure bio-based products are taken up by the market. Problems are public's resistance to change, lack of consumer knowledge and confidence, and product quality.
	Lack of supporting market mechanisms	Developing a bio-based economy requires a shift in the whole value chain, from producers to consumers. This shift

Key barriers	Category	Description
		is not easy to make, given the current market mechanisms, for instance the price competition from the petrochemistry.
	BBE policy	
	Vague goals and no operationalisation	Policies often miss clear goals and ways to measure and evaluate progress in meeting policy targets. The policy documents are described in a strategic but qualitative way and rarely include indicators to monitor the progress of the bioeconomy development.
	Timeframe of policy is uncertain	Long term vision and policy continuity are needed to build up investor confidence and to catalyse investments.

The key opportunities/factors that support the bio-based economy and that make development of policies for BBE development at national/regional level successful that are identified and described in this chapter, are included in Table 4.6.

Table 4.6. Key opportunities for the BBE development and for policy development in BBE

Key opportunities	Category	Description
	BBE development	
	Biomass supply	The mobilisation of biomass is an important key for further deployment of the bio-based economy. There is generally a large unutilized biomass potential in agriculture, forestry and industry. The advantage of industry by-products and residues is that they are already available at a central location.
	Conversion and distribution of biomass	Commodities have the advantage of being fully tradable, complying with storage facilities, with shipping and conversion processes. As a result, contracting is easier, markets open faster and more options to finance become available.
	Established governance mechanisms	Are able to support supply and demand side policy instruments, create policies for innovation, align principles of

Key opportunities	Category	Description
		different policies, prioritise thematic areas or values chains/cycles, take decisions on investments.
		BBE policy
	General support on behalf of existing policy framework	Provides a stable regulatory framework while remaining neutral concerning choices of technologies and promoting competition both with existing technologies and other sectors. A supportive policy framework is also able to bring bio-based economy to society.
	General policy framework-EU level	EU's bioeconomy strategy - has been already established. The goals of the bioeconomy strategy can be achieved only by tackling existing policy fragmentation, engaging the civil society to a greater extent and putting in place the national and regional strategies. At EU level the link between bio-based economy and climate change or the need to put more emphasis on research and development is clear.
	Synergies with other policy trends, i.e. creating a win-win situation for different policy fields	At global level the alignment of principles of sustainable bioeconomy with principles of circular economy would involve systemic approaches across sectors leading to optimized value networks and minimized losses and waste.
	Close cooperation and adaptation of the new research outcomes, new innovative business opportunities, in (existing) BBE networks and platforms.	Bioeconomy networks in Central and Eastern Europe are important to support the bio-based industrial sector and encourage/facilitate the involvement of national stakeholders in the EU-funded programs.

The third question this chapter aims to answer, concerns barriers related to the integration of policies at different scales, particularly those initiated at EU level that need further translation into national/regional policy instruments.

At EU level the general policy framework – namely the EU's bioeconomy strategy (see chapter 3) - has been already established. The goals of the bioeconomy strategy can, however, be achieved only by tackling existing policy fragmentation, engaging the civil society to a greater extent and putting in place the national and regional strategies (Dupont-Inglis and Borg, 2018). The lack of policy coherence, or difficulty in aligning policies, includes several issues, discussed in section 4.2: too many different policies/policy instruments, conflicting goals between policies, complexity as a result of action at multiple scales, and diverse interests and political positions of stakeholders. In some countries EU level

policy and strategy development have been successfully translated into policies at national and regional level and the bottom-up initiatives meet top-down guidance - legislation and support.

The bioeconomy development requires action at multiple scales, from the local scale to the global scale. However, there are goals in EU regulation and priorities that conflict with national goals and among member states when being transposed, implemented and enforced by member states (Aggestam et al., 2017). EU policies like the Common Agricultural Policy leave responsibility to the member states to transpose policies into national regulation, which results in differences in terms of the level playing field for actors in the bioeconomy: the implementation of policy also depends on the different interests and political positions of stakeholders (Viaggi et al., 2018).

The bioeconomy development in the EU is also affected by the lack of standards and regulations, for instance with regard to biotechnology. These standards play an important role in guaranteeing the continuity and quality of bio-based products. Standards will play an important role in accelerating the transition (Kitney et al., 2019). There is also a lack of framework to secure the sustainability of the bioeconomy and this framework is implemented differently between EU countries.

The EU's bioeconomy strategy is supported by certain EU level directives (see chapter 3) or specific instruments such as the bio-based industries instrument for Europe (BIV/BBI). However, not all countries seem to benefit equally from participation in different EU funded programs.

Finally, we tried to identify which barriers are to be addressed by regions, particularly with respect to their bioeconomy development phase. Although the literature analysis of the barriers did not clearly indicate a distinction between the three bioeconomy development phases, and we may expect that barriers return in the different phases, we may be able to attach barriers to specific phases based on the analysis of the chapter 5 results.

Poor infrastructure is a barrier that may specifically hamper in the initial stage. Lack of supporting market mechanisms is a probable important obstacle in the medium phase of development. Regions in high stage of maturity development especially deal with barriers related to demand, stakeholder perception and investment.

Literature shows that many barriers hamper all phases of development:

- Absence of bioeconomy strategy
- Lack of transparency and policy coherence
- Fragmentation of policy instruments
- Biomass availability
- Need for research and innovation that are required to design a bioeconomy that fits to the regional potentials
- Public awareness and stakeholder acceptance, and lack of demand-side policy.

Public awareness and stakeholder acceptance, and lack of demand-side policy, therefore affect BBE development of regions in all maturity stages of development. The importance of demand-side policy has been recognized by the European Commission and considered as one of the main action areas (Directorate-General for Research and Innovation, 2018)

Other important barriers are first, investment barriers, that are seen as actively preventing business development, primarily because the sector is perceived as high risk by investors. The more mature a

bioeconomy becomes, the higher the investments, since high value bio-based products are being produced. Secondly, regulatory barriers, related to the lack of efficient and transparent standards and international agreed sustainability criteria and certification systems are still experienced by regions in high maturity phase.

In Chapter 6 the typical barriers are discussed in relation to the 10 selected policy examples.

4 EU POLICY INSTRUMENTS FOR BIOECONOMY DEVELOPMENT AND LINK TO WIDER SUSTAINABILITY AMBITIONS

4.1 Introduction

From chapter 2 it became clear that the bioeconomy is a wide concept that can be influenced directly and indirectly through policies impacting on different aspects of the bioecoomy. In this chapter we provide an overview of EU wide policies driving the development of the bioeconomy directly and indirectly. Many of the regulations, roadmaps and action plans presented here are the basis for further policy development at national and regional level. Several of the EC regulations require national implementation/transposition policies while other EC ambitions require national roadmap or strategy development or formulation of policy targets to be reached within a certain time. In the following an overviw is given of all EC policy instrumnts directly or indirectly aimed at further development of the bioeconomy in the EU and how their vertical policy integration from EU, to national and regional policy instruments is expected to be.

In the recently launched Green Deal (December 2019) and Circular Economy action plan (March, 2020) the most recent policy ambitions and new instruments expected to be developed in the near future that will have important impacts on the development of the bio-based economy (BBE) in Europe are presented. However, these are still in development and build strongly on the already diverse suit of existing EU policy instruments from the last decades. All these existing instruments have influenced the BBE in the EU sofar and have (had) an important impact on how national and regional policies were developed influencing directly or indirectly on bio-based economy development. In the following sections these instruments are explained. The chapter finished with a summary of all the EU policy instruments of importance in driving BBE developments and policy implementation at national and reional level.

4.2 EU bioeconomy en circularity policy and instruments

According to McCormick and Kautto (2013) the foundations for the EU policy interest for the bioeconomy already developed in the beginning of the 1990s which became clear from the presentation of the **EU White Paper** (1993). In it the need for non-physical, knowledge-based investments, and the role of biotechnology in innovation and growth was highlighted. This was followed by the Lisbon Agenda in 2000 that called for 'global leadership in the knowledge-based economy to secure competitiveness and economic growth' and life sciences and biotechnology were seen as most promissing to reach these objectives.

In 2012 the bioeconomy was fully embraced by the EC and seen as one of the main motors to drive and let the EU economy grow as the EC published a combined strategy and action plan 'Innovating for Sustainable Growth: A Bioeconomy for Europe' which was called in short the **Bioeconomy Action plan** 2012. The three aims of the strategy were to improve the knowledge-base for the bioeconomy, encourage innovation to increase natural resource productivity in a sustainable manner, and assist the development of production systems that mitigate and adapt to the impacts of climate change. In the

2012 bioeconomy Strategy the bioeconomy is defined as '*the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy. It includes agriculture, forestry, fisheries, food, and pulp and paper production, as well as parts of [the] chemical, biotechnological and energy industries'*.

To reach these, the strategy particularly emphasises the need for creating synergies and complementarities in policies, initiatives and sectors making up the bioeconomy. The main resulting actions included 1) investments in research, innovation and skills; 2) reinforced policy interaction and stakeholder engagement; and enhancement of markets and competitiveness in bioeconomy sectors.

This central bioeconomy perspective in EU policy was further widened in 2013 in the 7th environment action plan (EC 2013) in which circularity was incorporated in the main vision of the EU: '*In 2050, we live well, within the planet's ecological limits. Our prosperity and healthy environment stem from an innovative, circular economy where nothing is wasted and where natural resources are managed sustainably, and biodiversity is protected, valued and restored in ways that enhance our society's resilience. Our low-carbon growth has long been decoupled from resource use, setting the pace for a safe and sustainable global society*'. In 2015, the EC launched the **Circular Economy Package** (EC, 2015a), in which circularity was defined along the same lines.

With this Circular Economy Package the basis was created for the current EC ambitions regarding bioeconomy and circular economy which have been elaborated in three very recent strategies: the 2018 update of the Bioeconomy Strategy, the Green Deal and the New Circular Economy Action plan 'For a Cleaner and more competetive Europe' only published in March 2020.

The **2018 update of the Bioeconomy Strategy** (EC, 2018) aims to accelerate the development of the European bioeconomy particularly to maximise its contribution towards the Paris Agreement, the 2030 Agenda and the Sustainable Development Goals (SDGs). The update also aligns more to new European policy priorities. Sutainainability and circularity are now integrated with the bioeconomy objectives. Central in the Bioeconomy Strategy and Action Plan (EC, 2018) is the need to reconcile the competition of different sectors (food, feed and industrial uses) for biomass. In the action plan 14 measures to be launched in 2019 are proposed, based on three key priorities:

- Strengthen and scale up the bio-based sectors, unlock investments and markets
- Deploy local bioeconomies rapidly across the whole of Europe
- Understand the ecological boundaries of the bioeconomy

As to actions at national level, the Bioeconomy Strategy (2018) does not require MSs to develop any strategies or plans although it is very much recommended. In practice many EU countries have or are in the process of developing their bioeconomy (or bioeconomy-related) strategies. Also at regional the elaboration of research and innovation strategies for SMART specialisation is encouraged as this should lead to an integrated approach towards smart growth in all regions. In this report two good policy examples are presented (see Chapter 6) of such SMARTspecialisation clusters for Bavaria and for the Piemonte Bioeconomy Technological Platform. There are five European Structural and Investment Funds (ESIF) which support such regional smart specialisation initiatives.

The **Green Deal (GD)** is a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use. The communication was presented in December 2019 by the newly appointed European Commission. The GD

is therefore the strategy providing the key ambitons en instruments to reach these in the fields of climate neutrality, circular economy, increased economic growth and strong research and innovation leadership by European institutions and industries in these fields. It is foreseen that all EU actions and policies will have to contribute to the European Green Deal objectives. For a detailed overview of the GD ambitions, actions and streamlining with existing policy instruments read Annex II of this report.

Soon after the GD publication the **Circular Economy Action Plan** (COM(2020) 98 Final) was published in March 2020. This plan is taking the GD ambitions further and specifies how the trasition to further circularity in the EU economy should be brought about as an instrument to reach further climate-neutrality. It states that the climate-neutrality target by 2050 without transitioning to a fully circular economy because half of total greenhouse gas emissions come from resource extraction and processing. It therefore announces initiatives for the entire life cycle of products, from design and manufacturing to consumption, repair, reuse, recycling, and bringing resources back into the economy. It introduces legislative and non-legislative measures and targets areas where action at the EU level brings added value. The aim of the Circular Economy Action Plan is to reduce the EU's consumption footprint and double the EU's circular material use rate in the coming decade, while boosting economic growth. Measures in the Circular Economy Action plan cover measures for products, on design, for consumers and public buyers. For further details please read the summary of this Action Plan presented in Annex III of this report.

From the former we can conclude that no specific EU bioeconomy legislation exists. However, sectorial legislation, which in many cases is considerably older than the current bioeconomy concept presented by the EC, has major impacts in the field. Is is also in the ambitions in the GD and the Circular Economy strategy to elaborate on existing sectorial instruments and adpat these further to the ambitions for an accelerated BBE and circularity development, reaching more climate neutrality and overall sustainability in all sectors of the EU sectors.

Given the wide deifinition of the bioeconomy and the integration of bioeconomy and circularity makes that developing it further calls for wide policy integration in all field of EU policy. In the revision of the Bioeconomy Strategy in 2018 it is therefore no surprise that it calls for a more coherent policy framework with objectives for food security, managing natural resources sustainably, reducing dependence on non-renewable resources, mitigating and adapting to climate change, strong knowledge and innovation development in bioeconomy and circularity and boosting economic growth, creating jobs and maintaining European competitiveness. In the following the main EU policy instruments in these fields developed in last decades are discussed.

4.3 Climate and energy

4.3.1 Climate policy instruments

The first EC Community strategy to limit GHG emissions and improve energy efficiency was from 1991 in which initiatives in the field of renewable energy and energy demand management were presented. This followed in 2000 by the European Climate Change Programme (ECCP) in which environmentally and cost-effective policies and measures were worked out that coud be taken at European level to cut greenhouse gas emissions to ensure that the EU meets its target for reducing emissions under the

Kyoto Protocol. This was done by the appointment of different EU wide working groups that identified options for reducing emissions based on cost-effectiveness and potential co-benefits on other policy areas. These options were further translated in EU wide actions described in the EU's Sixth Environmental Action Programme (2002-2012) and Sustainable Development Strategy. One of the first instruments that resulted from these was the the 2003 European Union (EU) **Energy Tax Directive**, which requires to set minimum rates for the taxation of energy products in EU member states.

The second European Climate Change Programme was launched in 2005. Again, working groups were established to work out cost-effective options for reducing greenhouse gas emissions in synergy with the EU's Lisbon Strategy for increasing economic growth and job creation. Working groups covered fields like transport, energy supply, energy demand, non-CO_2 GHG gases, agriculture, aviation, CO_2 and cars, CO_2 and shipping, carbon capture and storage such as sinks in agricultural soils and forest, and adaptation to climate change. Based on these recommendations a climate and energy package 2020 was agreed. In 2007 EU leaders decided on the targets for 2020 which were enacted in legislation in 2009 committing to 20% GHG emission reductions (from 1990 levels), 20% of EU energy consumption from renewables and 20% improvement in energy efficiency.

A further update of the targets for 2030 followed in December 2018 with **The Regulation on the governance of the energy union and climate action** ((EU)2018/1999). It entered into force on 24 December 2018 as part of the Clean energy for all Europeans package. The goals of the regulation are:

- to implement strategies and measures which ensure that the objectives of the energy union, in particular the EU's 2030 energy and climate targets, and the long-term EU greenhouse gas emissions commitments are consistent with the Paris agreement
- to stimulate cooperation between MSs in achieving the objectives and targets of the energy union
- to promote long-term certainty and predictability for investors and foster jobs, growth and social cohesion
- to reduce administrative burdens. This was done by integrating and streamlining most of the current energy and climate planning and reporting requirements of EU countries, as well as the Commission's monitoring obligations
- to ensure consistent reporting by the EU and its Member States under the UN Framework Convention on Climate Change and the Paris agreement, replacing the existing monitoring and reporting system from 2021 onwards

Form the above described framework three main policy instruments have emerged which will make the GHG emission reduction be translated in concrete action also on MS and/or regional level. These are the **EU wide Emission Trading System** (ETS), covering 45% of the GHG emissions, the **Effort sharing Regulation** setting annual emission reductions for the sectors not covered by the ETS, covering the other 55% of EU emissions. Lastly, is the instrument of **Land Use and Land Use Change and Forestry (LULUCF)** monitoring.

This **EU emission trading system (ETS)** was set up in 2005. It is to cut GHG emissions from large-scale facilities in the power and industry sectors, as well as the aviation sector. These sectors cover around 45% of the EU's greenhouse gas emissions. Within the overall EU-wide cap set in ETS, companies receive or buy emission allowances, which they can also trade. Each allowance gives the holder the right to emit one tonne of carbon dioxide (CO2), or the equivalent amount of nitrous oxide (N2O) and perfluorocarbons (PFCs). Emission caps in the ETS become smaller every new phase: with a 21% cut in emissions covered by the EU ETS by 2020 and 43% by 2030.

Sofar, in 2020, emissions from sectors covered by the ETS system will be 21% lower than in 2005 and this means that the EU is on track to surpass this target, althouh this does not apply to every EU country target. In 2030, emissions from sectors covered by the EU ETS will be cut by 43% from 2005 levels, as part of the EU's current 2030 climate and energy framework. Under the European Green Deal, the Commission presented an impact-assessed plan to increase the EU's greenhouse gas emission reduction target in a responsible way, including for the EU ETS.

The other regulation, the **Effort Sharing Regulation,** sets national emission reduction targets for 2020 and, since 2018, also for 2030 for all Member States, ranging from 0% to -40% from 2005 levels and requires many actions by MSs in the form of developing national action plans, reporting on emissions and particularly introducing new policies and measures to reduce emissions such is reducing transport needs and promoting public transport, decreasing fossil fuels in transport, support schemes for retrofitting buildings, promote more efficient heating and cooling systems based more on renewable energy, more climate-friendly farming practices etc.. EU countries have taken on binding annual targets until 2020 and now also until 2030 for cutting emissions in these sectors (compared to 2005).

The targets differ according to national wealth: in 2020 from a 20% cut (reference to 1990) for the richest countries to a maximum 20% increase for the least wealthy and for 2030 a cut of at least 40%. So, the actions by MSs are very concrete and are closely monitored and reviewed by the EC. First MSs had to submit their draft National Energy and Climate Plans (NECPs) for the period 2021-2030 by 31 December 2018. These also include the national targets for the REDII (see underneath). These NECPs were analysed already by the EC and country-specific recommendations were published in June 2019. Taking these recommendations into account, Member States were then required to submit their final NECPs by 31 December 2019. In addition, each MS must submit a progress report every two years. Finally, EU MSs also need to submit by the start of 2020 national long-term strategies looking forward to 2050.

Regulation on the inclusion of greenhouse gas emissions and removals from **land use, land use change and forestry (LULUCF)**. This instrument ensures that emission reductions are also contributed to by the land use sector. The first EU LULUCF rules were agreed in 2013 with the Decision No 529/2013/EU, European Commission which was applicable until 2020. On 14 May 2018 the new updated Regulation (EU) 2018/841 for LULUCF was approved which entered into force in July of 2018, setting the targets and rules up to 2030. It sets binding commitment for MSs to ensure that accounted emissions from land use are entirely compensated by an equivalent removal of CO_2 from the atmosphere, the so-called "no debit" rule. Part of this commitment for MSs was already covered under the Kyoto Protocol up to 2020, the Regulation enshrines the commitment for the first time in EU law for the period 2021-2030. Whether emissions exceed removals is assessed over two consecutive periods, the first from 2021-2025 and the second from 2026 -2030. What is also new is that the scope is extended from only forests today to all land uses (including wetlands by 2026 and biomass used in energy). It provides Member States with a framework to incentivise more climate-friendly land use. Many of the instruments that will help actors in the most important land use sectors, such as farmers and foresters, will be implemented through the Common Agricultural Policy (CAP), see also next. Member States can buy and sell net removals to other Member States and a limited option to compensate with emission allocations under the ESR if emissions in the LULUCF sector would exceed removals.

It is also relevant to state that the ETS and the Effort Sharing Regulation are major EU policy instruments dictating GHG emission mitigation measures at national and regionl level. At the same time it should be kept in mind that in the GD it is announced that in 2021, the EC will have reviewed all relevant-climate related policy instruments and will indicate how they can be revised to reach climate neutrality by 2050. This will also include the adoption of a new, more ambitious EU strategy on climate change adaptation, an adjustment in the **Emission Trading System** and of the Regulation on land use, land use change and forestry (LULUCF) and an update in the Climate law. The carbon pricing instrument is expected to be introduced throughout the economy. At the same time the Commission will propose a carbon border adjustment mechanism, for selected sectors, to reduce the risk of 'carbon leakage'. This implies that the price of imports need to be adjusted (through for example a carbon tax) to reflect more accurately the carbon content.

4.3.2 EU Energy policy instruments

Current EU rules for taxing energy products and electricity are laid down in the **Energy Tax Directive 2003/96/EC**, which entered into force on 1 January 2004. Before, the Community framework for energy taxation only covered mineral oils. This 2003 Directive widened the scope of the minimum rate system to include to all energy products, including coal and coke, natural gas and electricity. It also updated the minimum rates for mineral oils, which had not been revised since 1992. So, the aim of this legislation was to reduce distortions caused by divergent national tax rates, remove competitive distortions between mineral oils and other (unlegislated) energy products, and create incentives for energy-efficiency and emission reductions.

The **Energy Tax Directive 2003/96/EC** included[3]:

- A common EU framework for taxing motor fuels, heating fuels and electricity
- Minimum rates for energy products used as motor or heating fuel
- Minimum rates for commercial and industrial purposes, such as agriculture, stationary motors and machinery used in construction and public works (Article 8)
- Some options for exemptions for use of energy products and electricity (Article 15)
- Special provisions for commercial diesel (Article 7(2))
- Out of the scope provisions for energy products and electricity (Article 2(4))

[3] https://ec.europa.eu/taxation_customs/business/excise-duties-alcohol-tobacco-energy/excise-duties-energy/excise-duties-current-energy-tax-rules_en

Setting targets for renewable energy in the EU started already in 2006 with the publication of the "**Renewables Roadmap**" (CEC, 2006) in which the EC proposed a 20% target for the year 2020 and a 10% target for the share of biofuels consumed by 2020. This than resulted in the approval of the **Renewable Energy Directive** (2009/28/EC) (*now often referred to as REDI*) that established an overall policy for the production and promotion of energy from renewable sources in the EU. It required the EU to fulfil at least 20% of its total energy needs with renewables by 2020 – to be achieved through the attainment of individual national targets specified in National Renewable Action plans (NREAPs) and to ensure that at least 10% of the transport fuels consumed in every EU country come from renewable sources by 2020.

Since 2015 the ambition of the EC is to create an Energy Union which became clear from the **Energy Union Strategy** (COM/2015/080), published on 25 February 2015. In this strategy the key priority set by the Juncker Commission (2014-2019) were building an Energy Union that gives EU consumers - households and businesses - secure, sustainable, competitive and affordable energy. The Energy Union builds five closely related and mutually reinforcing dimensions:

- Security, solidarity and trust - diversifying Europe's sources of energy and ensuring energy security through solidarity and cooperation between EU countries
- A fully integrated internal energy market - enabling the free flow of energy through the EU through adequate infrastructure and without technical or regulatory barriers
- Energy efficiency - improved energy efficiency will reduce dependence on energy imports, lower emissions, and drive jobs and growth
- Climate action, decarbonising the economy - the EU is committed to a quick ratification of the Paris Agreement and to retaining its leadership in the area of renewable energy
- Research, innovation and competitiveness - supporting breakthroughs in low-carbon and clean energy technologies by prioritising research and innovation to drive the energy transition and improve competitiveness.

In December 2018 an update of the REDI entered into force, the **recast Renewable Energy Directive** (2018/2001/EU), (*now often referred to as REDII*) as part of the 'Clean energy for all Europeans' package. It established new binding renewable energy target for the EU for 2030 of at least 32%, with a clause for a possible upwards revision by 2023. The final text of RED II also requires Member States to apply a mandate of 14% of transport fuels from renewable energy sources. The current 10% target which is binding on Member States (as specified in RED, 2009/28/EC) will be replaced by a requirement for Member States to introduce an obligation on fuel suppliers enabling the achievement of a 14% target for renewables including a sub target for advanced biofuels. The REDII also aims to phase out biofuels with a high ILUC risk and to promote biofuels with a low ILUC risk.

As concrete action to MSs it is required to draft 10-year **National Energy & Climate Plans (NECPs)** for 2021-2030. These NECPs therefore have two purposes: 1) to explain through which measures MSs will reach their emission reduction targets for 2030 as set in the 'Effort Sharing Regulation' and 2) to explain how MSs foresee to reach their renewable energy targets and emission reduction levels.

As explained in the former, draft NECPs for the period 2021-2030 were analysed by the EC and country-specific recommendations were published in June 2019 and by end of December the final NECPs were submitted by MSs.

Most of the other new elements in the new REDII need to be transposed into national law by Member States by 30 June 2021[4].

4.4 EU policy instruments for food, feed, forestry and fisheries

Many EU policies strongly influence the primary production sectors which are also important componenents of the bioeconomy. This particularly applies to the agro-food system for which the key policy interventions are organised through the **EU Common Agricultural Policy (CAP)** and the **Common Fisheries Policy (CFP).** Policies for forestry are mostly left to the legislation of the MSs although at EU level there is stratgic guidance in that sector too.

4.4.1 Agriculture

Pillar I of the CAP focuses on direct farm payments and limited market intervention and influences farm practices by means of Cross-Compliance and Greening. Pillar 2, providing funding for rural development programmes, contains a range of policy instruments which substantially influence the socio-economic environment for farms and their choices of farming practices.

The CAP was established in 1962, implementing the agricultural part of the 1956 Treaty of Rome. In 2016 it represented more than the 40% of EU budget in 2016 and is a key instrument in EU policy through which several of the ambitions for climate, environment, socio-economic development in rural areas and food security come together.

The current CAP policy instruments in place run within the 2014-2020 CAP period. Negotiations on the new CAP period 2021-2028 started as from June 2018 when the Commission published its proposals. In these proposals it is made clear that for the EU greater ambition is required if Europe is to meet its global, EU and national targets for biodiversity, water quality, greenhouse gas emissions, air quality as well as long-term food security. For an overview of the main CAP objectives 2021-2027 see Box 4.1.

[4] Furthermore, further implementation of energy policies are also supported by EU guidance such as Guidelines on State aid for environmental protection and energy 2014-2020 (2014/C 200/01), the European Commission guidance for the design of renewables support schemes (2013).

Box 4.1 Key aspects of the New CAP 2021-2027

(information derived from https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/future-cap_en

The proposal has 9 objectives:

- Support viable farm income and resilience accross the EU territory to enhance food security;
- Enhance market orientation and increased competetiveness including greater focus on research, technology and digitalisartion;
- Improve farmer's position in the value chain;
- Contribute to climate change mitigation and adaptation, as well as sustainable energy;
- Foster sustainable development and efficient management of natural resources such as water, soil and air;
- Contribute to the protection of biodiversity, enhance ecosystem services and preserve habitats and landscapes;
- Attract young farmers and facilitate business development in rural areas
- Promote employment growth, social inclusion and local development in rural areas, including bioeconomy and sustainable forestry;
- Improve the response of EU agriculture to sociatal demands on food and health, including safe, nutritious and sustainable food, as well as animal welfare.

Key characteristics of the proposal:

1) Income support will remain, and part of the basic payments will continue to be based on the farm's size in hectares. At the same time future CAP wants to prioritise small and medium-sized farms and encourage young farmers to join the profession. This is to be achieved through a higher level of support per hectare for small and medium-sized farms; to reduce the share of direct payments received above €60,000 per farm and to limit payments at €100,000 per farm; a minimum of 2% of direct support payments allocated to each EU country will be set aside for young farmers, complemented by financial support under rural development and measures facilitating access to land and land transfers; ensure that only genuine farmers receive support.
2) Higher ambitions on environment and climate through mandatory requirements for preserving carbon-rich soils through protection of wetlands and peatlands; obligatory use of a nutrient management tool to improve water quality, reduce ammonia and nitrous oxide levels and obligations on crop rotation instead of crop diversification. In addition, farmers will also have the possibility to contribute further and be rewarded for going beyond mandatory requirements. For this EU countries will develop voluntary eco-schemes to support and incentivise farmers to observe agricultural practices beneficial for the climate and the environment.
3) The future CAP proposes to boost the development of rural areas by helping new generations of farmers to join the profession, though mentoring of young farmers by more experienced ones, improving knowledge transfer from one generation to the next or developing succession plans; encouraging EU countries to do more at national level, for example through more flexible rules on taxation and inheritance, to improve access to land for young farmers; setting tougher food safety and quality requirements on farmers, by giving

financial support only when complying with rules on reducing the use of pesticides or antibiotics for instance.

The new CAP 2021-2027 also intends to bring several key changes as compared to the former still ongoing CAP programme (2014-2020). The first is that MSs obtain more freedom in deciding on their own priorities and increasing the national ownership of CAP interventions. These priorities need to be elaborated in national **CAP Strategic Plans (CSP)** which needed to be delivered to the EC by January of 2020. The CSPs should specify specific CAP objectives every MS intends to address, its intervention strategy including the targets it intends to achieve with respect to these objectives, and the interventions it plans to use. For further details on what should be in the CSPs is specified in detail in Box 4.2.

The second is that MSs are obliged to implement the so-called '**Green Architecture'** that establishes voluntary environmental measures for farmers, not only for Rural Development (Pillar 2) but also for Pillar 1 direct payments, so that the CAP makes a meaningful contribution to EU environmental and climate goals. Part of this Green Architecture is the development of voluntary eco-schemes to support and incentivise farmers to observe agricultural practices beneficial for the climate and the environment.

Box 4.2 Contents of the national CAP strategic plans

Given the new delivery model of the CAP in which Member States need to bear greater responsibility as to how they meet the objectives and achieve targets, the CAP strategic plans (CSP) should describe the following:

1) An assessment of needs: This should include an identification and description of needs for all nine specific objectives (see Box 3.1) regardless of whether they will be addressed in the CAP Strategic Plan or not. Needs in relation to risk management in connection with the specific objective of support for viable farm incomes and resilience should be specifically described. These needs should then be ranked and prioritised and a sound justification of the choices made should be given, including why certain identified needs might not be addressed or only partially addressed in the Strategic Plans. The inclusion of the related specific objectives for the general environment and climate objective is also mandatory.
2) An intervention strategy should be presented setting out quantitative targets and milestones to achieve per each specific objective in the Strategic Plan. Targets should be defined using a common set of result indicators set out in an Annex to the draft Regulation. The value of the targets should be justified by reference to the needs assessment under 1).
3) A description of the system of conditionality, including a detailed account of how each Good Agricultural and Environmental Condition (GAEC) standard in the Regulation will be implemented and, specifically, how it will contribute to the environmental and climate specific objectives under 1).
4) An explanation on the specific definitions for some of the terms in the Regulation that are left up to Member States; e.g. the definitions of agricultural activity, agricultural area, eligible area, genuine farmer, small farm and young farmer.
5) Description on the use made of technical assistance; on the functioning of payment entitlements where the Member State opts to continue their use; on the uses made of revenues raised by capping and degressivity; as well as an overview of the coordination, demarcation and complementarities between the EAFRD and other Union funds active in rural areas.

6) The target and financial plans and a description of the direct payments, sectoral and rural development interventions specified in the strategy. This should include the design of the intervention, its eligibility conditions, the annual planned outputs for the intervention, the annual planned unit amount of support and its justification; and the resulting annual financial allocation for the intervention. Member States should also show how the intervention relates to the criteria for determining whether measures are trade-distorting or not in the WTO Agreement on Agriculture, and whether the intervention falls outside the scope of Article 42 TFEU and is subject to State aid assessment. It should also detail transfers between Pillars I and II.
7) (A description of the governance and coordination system. The most important element here is information on the control system and penalties including the integrated administration and control system and the control and penalty system for conditionality. The monitoring and reporting structure should also be described.
8) A description of the elements that ensure modernisation of the CAP. This covers two specific obligations; 1) the fostering and sharing of knowledge, innovation and digitalisation and encourage their uptake, including a description of the AKIS organisational set-up and how advice and innovation services are provided; 2) a description of the strategy for the development of digital technologies in agriculture and rural areas and for the use of these technologies to improve the effectiveness and efficiency of the CAP Strategic Plan interventions.
9) A description of the elements related to simplification and reduced administrative burden for final beneficiaries.
10) In addition, each CAP Strategic Plan should contain the following annexes:
    a. Annex I on the ex-ante evaluation and the strategic environmental assessment (SEA);
    b. Annex II on the SWOT analysis;
    c. Annex III on the consultation of the partners;
    d. Annex IV on the crop-specific payment for cotton;
    e. Annex V on the additional national financing provided within the scope of the CAP Strategic Plan.

The final phase of the agricultural negotiations will overlap with the discussions on the 'European Green Deal' which began on 11 December 2019 with a Communication from the Commission (COM (2019) 0640). The GD plans to build a sustainable and climate-neutral growth model for 2050, which will have a major impact on the European agri-food system. Specific proposals are expected in March 2020, concerning several areas: amongst others, biodiversity, forests or levels of greenhouse gas emissions, including the so-called **Farm to Fork strategy** aimed at strengthening food security, reducing the consumption of pesticides, fertilisers and antibiotics, supporting agricultural innovation and improving consumer information (see also Annex II). The courses of action adopted under the GD will have to be followed up by national strategic plans to be presented during 2021, which will in principle be implemented in national policies from 2022 onwards.

4.4.2 Forestry

For forestry legislation is dealt with at Member State level. So, there is no common forestry policy for the EU, however the **EU Forest Strategy** defines general principles[5] it is complemented by a multiannual implementation plan (EC, 3.9.2015 SWD(2015) 164 final). Forest-related provisions are also included in legislation of related sectors such as the **Birds and Habitats Directives** and of course the Rural Development (RD) measures in the CAP-Pillar 2.

In 2010 **European Timber Strategy (EUTR)** and entered into force in 2013 and has as objective to prevent deforestation. It regulates that operators do not bring into the EU market illegally harvested timber and timber products, including e.g. fuel wood, wood in chips or particles or wood waste. A relevant addition to the EUTR are the Voluntary Partnership Agreements (VPAs) that are legally binding trade agreements between the EU and a timber-producing country outside the EU – to ensure that the timber and timber products from these countries are from legal sources, but they not necessarily guarantee other sustainability aspects of resources such as carbon stock losses. Several VPAs have been signed or are under negotiations, such as with USA and Canada that are major suppliers of wood products to the EU market.

4.4.3 Fisheries

The **Common Fisheries Policy** (CFP) is a set of rules for managing European fishing fleets and for conserving fish stocks[6]. It was first introduced in the 1970s and went through successive updates. Strategies[7] on fisheries, marine and maritime growth and aquaculture should support and regulate these sectors, for instance exploring increased use of algae as a source for biofuels, high added-value chemicals and bioactive compounds.

This EU Policy for fisheries has the following priorities:

[5] COMMUNICATION FROM THE COMMISSION A new EU Forest Strategy: for forests and the forest-based sector (COM/2013/0659 final)

[6] This concerns3 main legislations: Regulation (EU) No 1380/2013 the Common Fisheries Policy/ Regulation (EU) No 1379/2013 on the common organisation of the markets in fishery and aquaculture products/ Regulation (EU) No 508/2014 on the European Maritime and Fisheries Fund

[7] There are 3 relevant strategies: 1) Commission communication 'Reform of the common fisheries policy', 2) Commission communication 'Blue growth: opportunities for marine and maritime growth' and 3) Commission communication 'Strategic guidelines for the sustainable development of EU aquaculture'

- Fisheries management — Between 2015 and 2020, catch limits should be set at sustainable levels and should ensure the maintainance of the fish stocks in the long term. For example. the practice of throwing unwanted fish back into the sea is now prohibited. Almost all important stocks and fisheries are managed by means of a multiannual plan. The plans contain the goal for fish stock management, expressed in terms of fishing mortality and/or targeted stock size. Some plans also provide for a detailed and tailor-made roadmap for achieving the objective. Some multiannual plans include fishing effort restrictions as an additional instrument to the annual total allowable catches (TACs), and specific control rules.
- International policy — Regulates the operation of European fishing boats outside EU waters and the international trade in fisheries products.
- Market organisation — Including marketing standards, consumer information, competition rules and marketing intelligence.

The **European Maritime and Fisheries Fund** (EMFF) is used to co-finance projects, along with national funding[8]. Each country is allocated a share of the total Fund budget, based on the size of its fishing industry. Each country then draws up an operational programme, saying how it intends to spend the money. Once the Commission approves this programme, it is up to the national authorities to decide which projects will be funded. The type of activities that are financed through the fund are transition activities by fishermen to sustainable fishing, initiatives of coastal communities in diversifying their economies, projects that create new jobs and improve quality of life along European coasts and sustainable aquaculture developments. For example, the Fund is now also used to help MSs support local fishing and aquaculture communities through the Corona crisis.

4.5 EU Waste policy framework

At EU level there is an extensive policy framework addressing landfill and waste management in general. Currently the most important Directives in EU wide waste policy are: **Waste Directive 2008/98/EC** (revised in 2012), **Packaging and Packaging Waste Directive** 94/62/EC and the **Landfill Directive** 1999/31/EC. Since 2014 the EC also July 2014, the European Commission adopted a legislative proposal to review waste-related targets in these three Directives. The key elements of the revised waste proposal include[9]:

- A common EU target for recycling 65% of municipal waste by 2030;
- A common EU target for recycling 75% of packaging waste by 2030;

[8] https://ec.europa.eu/fisheries/cfp/emff_en

[9] Source: https://ec.europa.eu/environment/waste/target_review.htm

- A binding landfill target to reduce landfill to maximum of 10% of municipal waste by 2030;
- A ban on landfilling of separately collected waste;
- Promotion of economic instruments to discourage landfilling;
- Simplified and improved definitions and harmonised calculation methods for recycling rates throughout the EU;
- Concrete measures to promote re-use and stimulate industrial symbiosis –turning one industry's by-product into another industry's raw material;
- Economic incentives for producers to put greener products on the market and support recovery and recycling schemes (eg for packaging, batteries, electric and electronic equipment, vehicles).

So far this proposal is still pending as it has not yet been approved by the parliament, the Council and the EC. The proposed revisions for the modernisation of EU waste policies are also to be part of the recently adopted Circular Economy Package (see also Annex III).

First EU policy development in waste concentrated on management of packaging waste in the early 1980s. It resulted in Directive 85/339/EEC which set first rules on the production, marketing, use, recycling and refilling of containers of liquids for human consumption and on the disposal of used containers. Then some MSs started introducing their own measures in this area. As a consequence, diverging national legislation appeared, a situation that called for harmonization at European level and this resulted in the Packaging Directive 94/62/EC. Subsequentely the directive was further revised in 2004, 2005 and the last revision in 2013 which involved a revision in Annex I of the Directive containing the list of illustrative examples of items that are or are not to be considered as packaging. The latest revision of the Packaging and Packaging Waste Directive occurred on 29 April 2015 with the adoption of Directive (EU) 2015/720 of the European Parliament and of the Council amending Directive 94/62/EC as regards the consumption of lightweight plastic carrier bags.

The **Waste Directive 2008/98/EC** was revised in 2012 and three key principles were introduced in 2012 which is the waste hierarchy and the polluters pay principle and the extended producer responsibility.

The waste hierarchy that MSs must promote through legislation and political measure implies that MSs should prioritise prevention of waste production, followed by the re-use and recycling of waste. Following from that is the use of waste as a source of energy (i.e. recovery) and as a final resort, safe disposal (such as landfilling). The Waste Directive also requires MSs to describe their waste classification system, refer to whether waste has been classified as hazardous and whether their classification system deviates from the European List of Waste.

The extended producer responsibility principle implies that environmental costs associated with goods throughout their life-cycles need to be integrated into the market price of the products. This implies that manufacturer of the product responsible for the entire lifecycle of the product including for making requirements to take it back once it has reached its end of life, recycle and dispose of it.

The polluters pay principle makes the party responsible for generating pollution pay for any damage done to the natural environment. This can be particularly relevant with regards to regulated hazardous waste sites, when the polluters can be identified. In order to implement this principle MSs need to address this and thye need to report to the EC on how they did this.

To ensure the implementation of the three principles MSs are asked to describe the legislative and non-legislative measures that they have taken to establish the waste hierarchy, the extended producer

responsibility, and pollutor pays principle as well as take-back obligations and other measures to ensure re-usability or recyclability of products. MSs also need to verify compliance with targets set regarding the re-use, recycling and recovery of waste for each year of the three-year reporting period. They also need to explain how they manage hazardous waste, how they collect and treat waste oils, and how they collect and treat biowaste.

The **Groundwater Regulatory Framework** has an important indirect link to the Waste Framework Directive. This **Waste Framework Directive** (2006/12/EC) requires waste to be recovered or disposed of without endangering the environment and groundwater.

The **Landfill Directive 1999/31/EC** it defines the different categories of waste according to which landfills are divided. It also prescribes that all waste must be treated before being landfilled. The Directive also sets up a system of operating permits for landfill sites. The treatment of waste is for the three types of landfill sites is as follows:

- landfills for hazardous waste; only to be used for hazardous waste (given definition in the Directive)
- landfills for non-hazardous waste; must be used for municipal waste and for other non-hazardous waste;
- landfills for inert waste. must be used only for inert waste

There are also wastes defined in the Landfill Directive which may not be accepted in a landfill and these include liquid waste; flammable waste; explosive or oxidising waste; hospital and other clinical waste which is infectious; used tyres, with certain exceptions (see Annex II of the Waste Directive).

In the light of the three main Directives discussed in the former, MSs have various reporting obligations concerning implementation of waste legislation. The two main types of reports include:

1) Reporting on targets: annual (or bi-annual) reporting on the achievement of various targets for waste collection, re-use, recycling and / or recovery. These reports cover waste streams such as packaging waste, waste electrical and electronic equipment, end-of-life vehicles, waste batteries and accumulators, household and similar waste, and construction & demolition waste.
2) Implementation reports which are three-annual reports are based on questionnaires established in Commission Decisions together with the Member States, and cover the main aspects of implementation of waste legislation. Based on information reported by the Member States, the Commission prepares its own Implementation report summarizing the state of implementation of waste legislation in the EU

Beside the three Directives on waste, there is also a seperate **Directive on Sewage Sludge** (24/10/1994) which states that sewage sludge may be used in agriculture provided that it adheres to any conditions that the Member State may deem necessary to protect human or environmental health. Sludge may also only be used if it is regulated by the Member State. The use of sludge containing heavy metals levels above limit values is however prohibited. Sewage Sludge must be treated before it is used in agriculture, although Member States may authorise the use of untreated sludge providing their own conditions are met and that the untreated sludge is injected or worked into the soil. Other requirements relate to the way sludge need to be applied, limit values, sampling in the soils and very importantly the obligation that Mss must keep up to date registering of sludge produced, supplied for use in agriculture; composition and properties of sludge; the types of treatment carried out; and the

names and addresses of recipients of the sludge and the place where the sludge is stored. In Chapter 6 a good policy example that translates this EU requirement on the application of sludge as fertiliser on agricultural land is given. It relates to the use of sludge (effluents) from the virgin olive oil industry in Andalusia.

4.6 EU policy instruments regulating environment and biodiversity that have important influence on bioeconomy sectors

4.6.1 Biodiversity

As to biodiversity conservation the most recent EU biodiversity strategy has a main aim to halt the loss of biodiversity and ecosystem services by 2020. The strategy sets out 6 targets and 20 actions to achieve these objectives by 2020. EU nature legislation, consists of the **Birds and Habitats Directives** and these form the backbone of biodiversity policy and the legal basis for the **Natura 2000 Nature Protection Network**.

The **Birds Directive** aims to protect all of the 500 wild bird species naturally occurring in the European Union. Habitat loss and degradation are the most serious threats to wild birds and therefore the Directive establishes a network of Special Protection Areas (SPAs). There are several ways to further protect sub-groups in these 500 wild bird species which is specified in the annexes to the Birds Directive:

1) Annex 1: for 194 species MSs have to designate Special Protection Areas (SPAs). Since 1994, all SPAs are included in the Natura 2000 ecological network, set up under the Habitat Directive.
2) Annex 2: Only 82 bird species can be hunted, but he hunting periods are limited and hunting is forbidden when birds are at their most vulnerable: during their return migration to nesting areas, reproduction and the raising of their chicks.
3) Annex 3: In principle activities that directly threaten birds (e.g. deliberate killing, capture or trade, destruction of nests), are banned. However for 26 species MSs can with certain restrictions, allow some of these activities.
4) Annex 4: the directive provides for the sustainable management of hunting but Member States must outlaw all forms of non-selective and large scale killing of birds, especially the methods listed in this annex
5) Annex 5: the directive promotes research as listied in this Annex to underpin the protection, management and use of all species of birds covered by the Directive.

The Birds Directive requires MSs to follow all obligations as specified in the 5 annexes of the directive and to submit reports on the status and trend in bird populations and on derogations (article 9) they may apply to the directive's obligations.

The **Habitat Directive**[10] was adopted already in 1992 and it aims to protect animal and plant species (over 1.000 animal and plant species), and 200 habitat types which are listed in 3 Annexes:

1) Annex II species (about 900): core areas of their habitat are designated as sites of Community importance (SCIs) and included in the Natura 2000 network. These sites must be managed in accordance with the ecological needs of the species.
2) Annex IV species (over 400, including many annex II species): a strict protection regime must be applied across their entire natural range within the EU, both within and outside Natura 2000 sites.
3) Annex V species (over 90): Member States must ensure that their exploitation and taking in the wild is compatible with maintaining them in a favourable conservation status.

The European Commission has published guidance on species protection to help MSs to implement correctly the Habitat Directive such as **EU Species Action Plans**. The requirements placed on the MSs are of course to take all necessary measures to protect the species and habitats listed in the Habitat and Birds Directives and setup the Network of Natura 2000 sites, including the SPAs. Also regular reporting (every 6 years) on the conservation status of habitats and species in and outside Natura 2000 sites and aout the progress made with the implementation of the Habitat Directive is required (article 17 reporting[11]).

The compliance in farmland with the Habitat and Birds Directives are ensured through **Cross Compliance**. This implies that if farmers want to receive CAP payments under 1st of 2nd Pillar they have to comply with all Statutory Management Requirements (SMRs). The management requirements for environment that apply are the Birds and Habitats Directive and the **Nitrate Directive** (see next)[12].

[10] the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora

[11] https://ec.europa.eu/environment/nature/knowledge/rep_habitats/index_en.htm

[12] Beside these enviromental statutory management requirments there are also SMRs on public, animal and plant health and animal welfare:

- general food law (EU regulation 178/2002)
- hormones ban directive (Council Directive 96/22/EC)
- regulations on identification and registration of pigs, bovine, ovine and caprine animal (EU regulation 1760/2000, Council Directive 2008/71/EC, EU regulation 21/2004)
- regulation on prevention, control and eradication of transmissible spongiform encephalopathies (TSE) (EU regulation 999/2001)
- regulation on plant protection products (EU regulation 1107/2009)

Although not obligatory, the Habitats Directive strongly recommends the use of **Natura 2000 Management Plans** as a means of setting objectives and measures. This is particularly relevant in Natura 2000 sites where different functions are combined, such as agriculture and forestry and nature conservation.

The link to sites included in the Natura 2000 network and the production of dedicated biofuel crops is also regulated in the Renewable Energy Directive (2018). For biofuels that can contribute to the sustainable biofuel target it prescribes that they cannot come from land with a high biodiversity value. The latter includes lands that have been designated as nature protection areas such is the case for all land that is part of the Natura 2000 network.

Beside the Habitat and Birds Directive which are important instruments which need to be taken into account when developing the several bioeconomy activities in the EU, there is also a more recent EU regulation that influences for example on the opportunities to produce biomass from dedicated crops. This is the **EU regulation on Invasive Alien Species (IAS)** that came into force in 2015[13]. In this regulation it is indicated in annexes what species are seen as invasive and these lists are continiously updated with input of the MSs. MSs must submit a risk assessment to a Scientific Forum and the IAS Committee, consisting of Member State representatives, to include species on the Union list. The regulation specifies three types of actions: prevention, early detection and repid eradication and management of invasive species. Member States are required to take action on pathways of unintentional introduction, to take measures for the early detection, in the form of setting up surveillance systems to monitor the introduction and spread of IAS, and rapid eradication of these species, and to manage species that are already widely spread in their territory.

The IAS regulation also influences the choice of new crops that may provide new biomass sources for the bioeconomy. In some countries certain biomass crops are categorizes as invasive alien species. On the other hand, eradication measures for invasive alien species may also deliver biomass which can obtain a useful use in some bioeconomy pathway towards bioenergy for example.

- directives on the protection of calves, pigs and animals kept for farming purposes (Council Directive 2008/119/EC, Council Directive 2008/120/EC, Council Directive 98/58/EC)

[13] Regulation (EU) 1143/2014 on invasive alien species (the IAS Regulation) entered into force on 1 January 2015, fulfilling Action 16 of Target 5 of the EU 2020 Biodiversity Strategy, as well as Aichi Target 9 of the Strategic Plan for Biodiversity 2011-2020 under the Convention of Biological Diversity.

4.6.2 Water

For the management of water quality and quantity in the EU there are three main EU directives relevant. The first is the **Water Framework Directive** and the second the **Ground Water Directive** and the third a **Nitrates Directive**. The Water Framework Directive of 2000 with the following main aims:

- expanding the scope of water protection to all waters, surface waters and groundwater
- achieving "good status" for all waters by a set deadline
- water management based on river basins
- "combined approach" of emission limit values and quality standards
- getting the prices right
- getting the citizen involved more closely
- streamlining legislation

For specific water pollution problems additional EU directives have been disigned. These are the **Urban Waste Water Treatment Directive** and the **Nitrates Directive**, which together tackle the problem of eutrophication and microbial pollution in bathing water areas and nitrates in drinking water); and the **Industrial Emissions Directive**, which deals with chemical pollution. The aim is to co-ordinate the application of all these directives to meet the objectives of the **Water Framework Directive** and manage them at the level of a river basin. If the existing legislation works well the objective of the Water Framework Directive is attained. However, if it does not, the Member State must identify exactly why, and design whatever additional measures are needed to satisfy all the objectives established. These might include stricter controls on polluting emissions from industry and agriculture, or urban waste water sources.

An important requirement on MSs from the Water Framework Directive is the development and follow up of a River Basin Management Plan. This plan is a detailed overview of how the objectives set for the river basin (ecological status, quantitative status, chemical status and protected area objectives) are to be reached within a certain timescale. The plan should include the river basin's characteristics, a review of the impact of human activity on the status of waters in the basin, estimation of the effect of existing legislation and the remaining "gap" to meeting these objectives; and a set of measures designed to fill the gap and finally also an economic analysis of water use within the river basin must be carried out.

In addition to the Water Framework Directive the **Groundwater Directive** was introduced in 2006. It complements the WFD and requires that groundwater quality standards are to be established, pollution trend studies are carried out, pollution trends are to be reversed so that environmental objectives are achieved set out in the WFD; measures are taken to prevent or limit inputs of pollutants into groundwater following WFD environmental objectives, reviews of technical provisions of the directive to be carried out every six years and compliance with good chemical status criteria are met based on EU standards of nitrates and pesticides and on threshold values established by Member States.

The **Nitrates Directive** (91/676/EEC) aims to reduce and prevent water pollution caused by nitrates from agricultural sources. It obliges Member States to designate vulnerable zones in MSs whose waters – including groundwater – are or are likely to be affected by nitrate pollution. Vulnerable zones are defined as those waters which contain a nitrates concentration of more than 50 mg/l or are susceptible to contain such nitrates concentration if measures are not taken. Nitrate contamination levels should

not be over 50 mg/l. The measures for action of the nitrates directive are also listed in the Water Framework Directive (Annex VI) and the Groundwater Directive (Annex IV, part B).

4.6.3 Pollution by industrial activities in biochemicals and biomaterials

The **Integrated Pollution Prevention and Control** (IPPC) Directive (96/61/EC) lays down measures designed to prevent or reduce air, water or soil pollution. The directive applies to a significant number of mainly industrial activities with a high pollution potential such as the energy sector, the production and processing of metals, the mineral and chemical industries, waste management facilities, food production and non-industrial activities such as livestock farming. It establishes provisions for issuing permit for existing and new installations. The permits include requirements to ensure the protection of soil and groundwater and set emission limits for pollutants. The **Directive on Industrial Emissions** 2010/75/EU (IED) entered into force on 6 January 2011 and was to be transposed into national legislation by Member States by 7 January 2013. The IED replaces the IPPC Directive as of 7 January 2014.

4.7 EU policy for industry and products

There is no policy strategy or legislation specifically dedicated to the bio-based industry. However, bio-based products and industrial biotechnology have been identified as selected market and selected technology for which several EU wide initiatives have now been started such as the the 'lead markets initiative for Europe', the key enabling technologies (KETs) strategy, the communication 'A stronger European industry for growth and economic recovery' and the communication 'For a European industrial renaissance'[14].

Bio-based chemicals and materials have to comply with requirements for chemicals and materials in general, especially the regulatory framework for the management of chemicals (REACH, EU 2006). The European Chemicals Agency manages this integrated system for the registration, evaluation, authorisation and restriction of chemicals.

Only for the bio-based chemicals and materials there is specific EU legislation to comply with, which is the Regulatory Framework for the Management of Chemicals (REACH, EU 2006)[15]. The European

[14] See https://ec.europa.eu/knowledge4policy/bioeconomy/topic/policy_en

[15] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32006R1907

Chemicals Agency manages this integrated system for the registration, evaluation, authorisation and restriction of chemicals.

There are no specific EU policies and legislation in other sectors which traditionally use biomass, such as the textile, wood and wooden furniture and pulp and paper sectors, unless they are categorized as activity with a 'high pollution potential' to which the IPPC Directive applies (see the former). Activities in this group are also covered by cross-cutting initiatives and policies such as the '**raw material initiative'**, which emphasises the scarcity of biomass and the circular economy package. They are also subject to the more generally applicable legislation such as 'product safety standards' and of course like all products to internal market legislation. In the GD it is announced that action will also specifically focus on resource-intensive sectors such as textiles, construction, electronics and plastics. For plastics for example the Commission will follow up on the 2018 Plastics Strategy. Measures will be introduced to tackle intentionally added micro plastics and unintentional releases of plastics (e.g. from textiles and tyres). The measures also aim to provide a regulatory framework for biodegradable and bio-based plastics, and it will implement measures on single use plastics.

There are also more very specific regulations for products, including bio-based products, which are very detailed and cannot all be discussed here. An example is the **Construction Product Directive** (89/106/EC) which provides provisions for regulating construction products that could pose a threat to the health of future occupants or neighbours as a result of pollution or poisoning of water or soil.

As announced in the GD and the Circular Economy Strategy, the EC will soon take **a sustainable product policy legislative initiative** of which the core will be to widen **the Ecodesign Directive**[16] beyond energy-related products to make it applicable to the broadest possible range of products and make it deliver on circularity. In this legislation the following sustainability principles will also be regulated:

- improving product durability, reusability, upgradability and reparability,
- addressing the presence of hazardous chemicals in products, and increasing their energy and resource efficiency;
- increasing recycled content in products, while ensuring their performance and safety;
- enabling remanufacturing and high-quality recycling;
- reducing carbon and environmental footprints;

[16] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products, OJ L 285, 31.10.2009, p. 10.

- restricting single-use and countering premature obsolescence;
- introducing a ban on the destruction of unsold durable goods;
- incentivising product-as-a-service or other models where producers keep the ownership of the product or the responsibility for its performance throughout its lifecycle;
- mobilising the potential of digitalisation of product information, including solutions such as digital passports, tagging and watermarks;
- rewarding products based on their different sustainability performance, including by linking high performance levels to incentives.

Measures are to be expected from the EC to encourage businesses to offer and to allow consumers to choose, reusable, durable and repairable products.

Also announced in the GD is that false green washing claims will be tackled and reduced through the introduction of standard methodologies to assess products impacts on the environment, digitalisation and information access on sustainable and circular characteristics of products (e.g. electronic product passport) and encourage public authorities to ensure their procurement is green through guidance and legislation on green public purchasing.

Beside the strategies and measures announced in the new Circular Economy Strategy, the GD also aims to secure further the access to resources, particularly for critical raw materials necessary for clean technologies, digital, space and defence applications, by diversifying supply from both primary and secondary sources.

4.8 SMART specialisation and research and innovation

In 2010 a communication on '**Smart specialisation'** was published by the EC in order to give guidance to the role regons can play in unlocking the growth through innovation innovation, R&D, entrepreneurship and ICT. It acknowledges that growth and innovation in the EU starts at regional level. The design of national/regional research and innovation strategies for smart specialisation is encouraged and should lead to an integrated approach towards smart growth in all regions. To make this happen regions can make use of the financial support from the **European Structural and Investment Funds** (ESIF) which consist of five main funds which support economic development across all EU countries:

1) European Regional Development Fund,
2) European Social Fund,
3) Cohesion Fund,
4) European Agricultural Fund for Rural Development (EAFRD)
5) European Maritime and Fisheries Fund

Research and innovation in the field of bioeconomy is also extensively facilitated at EU level[17]. In 2014-2020, most funding comes from Horizon 2020 and the European Structural and Investment Funds summarized above. Furthermore, there is also a European Fund for Strategic Investment supports areas like infrastructure, research and innovation and financing SMEs. The later particularly provides new financing opportunities to bioeconomy projects with high-risk profiles.

The EU also tries to stimulate public-public (P2P) and public-private partnerships (PPPs). The core instrument to make this happen in the bioeconomy field is throuh the Bio-based Industries Joint Undertaking (BBI JU). BBI-JU was founded in 2014 and is a PPP between the EU (EC) and the industrial partners, represented by the Bio-based Industries Consortium (BIC). The specific objective of the BBI JU is to develop sustainable and competitive bio-based industries in Europe based on advanced biorefineries that sustainably source their biomass. The budget (€ 3.7 billion) comes from EU public funds and private investment. The BBI sets out research and innovation tenders within the same framework as the Horizon2020 programme.

The EU countries and regions are of course challenged to facilitate as much as possible that companies, research institutions participate as much as possible in H2020 research and innovation. These activities need actions in terms of streamlining national and EU research and innovation strategies, cofinancing also from national funds and information and communication ctivities.

In relation to the SMART specialisation regions and countries are encouraged to set up Innovation and technology clusters or platforms, such as the good policy examples discussed in chapter 6 in Bavaria and Piemonte.

4.9 Financial support to implement Green Deal ambitions

The ambitions of the GD and the Circular Economy Strategy are very large. Many actions will be needed, and it will require many investments both by public and private sector. In the GD therefore, an overview is given of several green finance and investment instruments that are in place or that will be developed. These include amongst others:

- A **Sustainable Europe Investment Plan** will be presented soon by the EC. One aspect adressed in this fund will be the introduction of a 'Just Transition Mechanism, including a Just Transition Fund', to leave no country/region behind. This is meant to focus on the regions and sectors

[17] See https://ec.europa.eu/knowledge4policy/bioeconomy/topic/research-innovation_en

that are most affected by the transition because they depend on fossil fuels or carbon-intensive processes. In this fund, attention will also be for a socially just transition. This implies that investments need to be provided for affordable solutions to those affected by carbon pricing policies, for example through public transport, as well as measures to address energy poverty and promote re-skilling.

- The EC has proposed a 25% target of the budget for climate objectives across all EU programmes and it will also contribute financially out of revenue sources which the EC expects to obtain from a tariff levy system on non-recycled plastic-packaging waste and through allocating 20% of the revenue from the auctioning of EU Emissions Trading System to the EU budget.
- At least 30% of the **InvestEU Fund** will contribute to fighting climate change.
- The private sector is also expected to play a key role in the financing of the green transition. Long-term signals are needed to direct financial and capital flows to green investments. This will require several actions. Firstly, the European Parliament and Council adopted the taxonomy for classifying environmentally sustainable activities. Secondly, companies and financial institutions will need to increase their disclosure on climate and environmental data so that investors are fully informed about the sustainability of their investments. How to stimulate this will still need to be further assessed by the EC, but the idea is to review the Non-Financial Reporting Directive and to support businesses and other stakeholders in developing standardised natural capital accounting practices within the EU and internationally. Thirdly, opportunities need to be increased that provide for investors and companies to identify sustainable investments and ensuring that they are credible, for example through clear labels for retail investment products and by developing an EU green bond standards. Fourthly, by integrating climate and environmental risks into the financial systems. This will involve both adaptation, resilience and mitigation to climate change and other related environmental risks.
- National budgets also play a key role in the transition. To this purpose the EC will work with MSs to screen and benchmark green budgeting practices. The purpose is to move more to green budgeting tools that will help to redirect public investment, consumption and taxation to green priorities and away from harmful subsidies. There is a need that MSs ensure rapid adoption of the Commission's proposal on value added tax (VAT) rates currently on the table of the Council, so that Member States can make a more targeted use of VAT rates to reflect increased environmental ambitions. Also evaluations are underway of the relevant State aid guidelines including the environmental and energy State aid guidelines. The guidelines will be revised by 2021 supporting a cost-effective transition to climate neutrality by 2050, phasing out of fossil fuels, in particular those that are most polluting, ensuring a level-playing field in the internal market and aim to create more options to address market barriers to the deployment of clean products.
- More measures are to be taken to mobilise research and innovation to support the GD ambitions through incrreasing the EU research budget in Horizon Europe, in synergy with other EU programmes, and national public and private investments. At least 35% of the budget of Horizon Europe will fund new solutions for climate, which are relevant for implementing the Green Deal.
- Activating education and training toward the GD transition such as through develop and assess knowledge, skills and attitudes on climate change and sustainable development, make education buildings and operations more sustainable and direct the European Social Fund+ to helping Europe's workforce to acquire the skills they need to transfer from declining sectors to growing sectors and to adapt to new processes.

4.10 Conclusions on EU policies

Basically, all European policy fields come together in the circular bioeconomy. This is also why all many European policy fields and instruments are addressed in the GD. In the following Table 4.1 an overview is given of the main strategies and regulations developed by the EC in the last decades addressing all relevant bioeconomy sectors such as agriculture, forestry, fisheries, waste and parts of [the] chemical, biotechnological and energy industries and reaching overall sustainability in these. Most of these policies must be or have been translated in national and regional policies and are therefore an important basis for the development of the national policy actions for setting up the bioeconomy in EU MSs. The overview in Table 4.1 it is summarized in the last column which actions for national and regional governments are expected. These can take the form of developing strategies, plans, monitoring and reporting obligations and transposition of policies into national and regional regulations or other policy instruments. The content of different policies in Table 3.1 was further explained in the formers sections of this chapter.

Table 4.1 Overview of EU policies and strategies related to bioeconomy that require active strategy development and implementation actions at national and/or regional level

Topic	Main EU policy instruments	Description	Type of actions required at national/regional level
Climate & Energy	2003 **European Union (EU) Energy Tax Directive**	It sets national emission reduction targets for 2030 for all MSs, from 0% to -40% from 2005 levels (and reductions between 20%-0% for 2020, except for Croatia & Bulgaria). These targets concern emissions from most sectors NOT included in the EU Emissions Trading System (EU ETS), such as transport, buildings, agriculture and waste.	Member States are responsible for national policies and measures to limit emissions from the sectors covered by Effort Sharing legislation. The policies need to include actions in wide fields such as in transport and building sector. MSs had to submit National Energy and Climate plans **NECPs** for the period 2021-2030 to EC (31 December 2018). These were analysed by the EC which resulted in country-specific recommendations (June 2019). Taking these recommendations into account, Member States were then required to submit their **final NECPs** (31 December 2019). MS also need to submit a **progress report** every two years sothat the EC can monitor and report on EU progress on achieving targets. MSs are also required to submit **national long term strategies** looking forward to 2050 (January 2020).
	Effort sharing Regulation (2018)	One of the first instruments that resulted was the the 2003 European Union (EU) Energy Tax Directive. ,	MSs are required to set minimum rates for the taxation of energy products

Topic	Main EU policy instruments	Description	Type of actions required at national/regional level
	Emission Trading System (ETS)	EU emission trading system (ETS) set a cap on GHG emissions from large-scale facilities in the power and industry sectors and the aviation sector. Within the overall EU-wide cap set in ETS, companies receive or buy emission allowances (for CO_2, N_2O and PFCs) which they can also trade. Emission caps become smaller every new phase: with a 21% cut in emissions covered by the EU ETS by 2020 and 43% by 2030.	This is entirely organised at EU level, without putting any requirements of MSs.
	Regulation on the governance of the energy union and climate action (EU)2018/1999 (December 2018)	The regulation emphasises the importance of meeting the EU's 2030 energy and climate targets and sets out how EU countries and the Commission should work together, and how individual countries should cooperate, to achieve the energy union's goals.	As above: NECP for the period 2021-2030 to EC, 2-yearly progress reports and National long term strategies on climate and energy actions.
	Land Use, land Use Change and Forestry (LULUCF) Directive	The LULUCF Regulation implements also the land use sectors should contribute to the EU's 2030 emission reduction targets. It sets a binding commitment for each Member State to ensure that accounted emissions from land use are entirely compensated by an equivalent removal of CO_2 from the atmosphere, the "no debit" rule. It provides Member States with a framework to incentivise more climate-friendly land use	MSs have to submit National Inventory reports (NIR) on the emissions related to LULUCF. MSs also have to report regularly on the actions they are taking to reduce net emissions from LULUCF. Member States also have to submit National Forestry Accounting Plans that contain a proposed "Forest Reference Level", which acts as a baseline for future greenhouse gas emissions and removals from managed forest land.
	New **Renewable Energy Directive** (RED II)	It established new binding renewable energy target for the EU for 2030 of at least 32%, with a clause for a possible upwards revision by 2023.	See above; **National Energy and Climate Plans (NECPs)** for the period 2021-2030
Agriculture and rural development	**Common Agricultural Policy** (CAP) 2021-2027	Pillar I of the CAP focuses on direct farm payments and limited market intervention and influences farm practices by means of Cross-Compliance and Greening. Pillar 2, providing funding for rural de-velopment programmes, contains a range of policy instruments which substantially influence the socio-economic environment for farms and their choices of farming practices. 40% of EU budget (2016) to CAP. Key instrument through which several EU ambitions for climate, environment, socio-economic development in rural areas and food security come together. The current CAP policy instruments in place 2014-2020 CAP period.	MSs need to submit by January 2020 **CAP Strategic Plans (CSPs)** and these should specify specific CAP objectives every MS intends to address, its intervention strategy including the targets it intends to achieve with respect to these objectives, and the interventions it plans to use. CAP payments and measures are to be reported by the MS according to strict monitoring rules both for Pillar 1 and 2 payments.

Topic	Main EU policy instruments	Description	Type of actions required at national/regional level
		Negotiations on the new CAP period 2021-2028 started as from June 2018 when the Commission published its proposals.	
Forestry	**EU Timber Legislation** (2010) **Land Use, land Use Change and Forestry** (LULUCF) Directive	EUTR provides obligations for operators who place timber and timber products on the European market with the objective to counter the trade in illegally harvested timber and timber product (incl. fuel wood, wood in chips or particles or wood waste). So it aims to prevent deforestation. LULUCF; It sets a binding commitment for each MS to ensure that accounted emissions from land use, including forestry are entirely compensated by an equivalent removal of CO_2 from the atmosphere ("no debit" rule). It provides Member States with a framework to incentivise more climate-friendly land use, including forestry	MSs also have to report regularly on the actions they are taking to reduce net emissions from LULUCF. Member States also have to submit **National Forestry Accounting Plans** that contain a proposed "Forest Reference Level", which acts as a baseline for future greenhouse gas emissions and removals from managed forest land. These accounts should cover territory falling within afforestation, reforestation, deforestation, forest Management CAP payments and measures are to be reported by the MS according to strict monitoring rules both for Pillar 2 payments that can also target forests such as afforestation.
Fisheries	**EU Regulation Common Fisheries Policy** (No 1380/2013) **EU Regulation on the common organisation of the markets in fishery and aquaculture products** (No 1379/2013) **EU Regulation on the European Maritime and Fisheries Fund** (No 508/2014)	These 3 regulations make up the Common Fisheries Policy. The main objectives are: 1) Fisheries management (catch limits, prohibits throwing unwanted fish back) 2) International policy that regulates the operation of European fishing boats outside EU waters and the international trade in fisheries products. 3) Market organisation (e.g. marketing standards, consumer information, competition rules and marketing intelligence).	Each country needs to make an operational programme specifying how it intends to spend the money from the EMFF
Waste	**Packaging Directive** **Waste Framework Directive** (2008/98/EC), **Landfill Directive** (1999/31/EC) **Sewage sludge Directive**	At EU level there is an extensive policy framework addressing landfill and waste management in general of which these 4 are most relevant in relation to the BBE sectors. Since 2012 there are three main principles guiding waste management in the EU which is the waste hierarchy and the Polluters Pay principle and the extended producer responsibility.	MS need to implement through legislative and non legislative measures the requirements of the 4 directives. This involves follow up on the implementation of the waste hierarchy, the extended producer responsibility, and pollutor pays principle as well as take-back obligations and other measures to ensure re-usability or recyclability of products.

Topic	Main EU policy instruments	Description	Type of actions required at national/regional level
		The Sewage sludge Directive specifies how sludge must be treated, under what requirements it can be used as fertiliser on agricultural land and what reporting and monitoring obligations are regarding production and use of sewage slude.	MSs also need to verify compliance with targets set regarding the re-use, recycling and recovery of waste. Need to do three-year reporting on waste management and results including information on how they manage hazardous waste, how they collect and treat waste oils, and how they collect and treat biowaste.
Biodiversity & ecosystem services	**Habitats Directive** (92/43/EEC) **Birds Directive** (2009/147/EC) **Regulation on Invasive Alien Species** (No 1143/2014)	The Habitats Directive aims to maintain biodiversity. It protects over 1000 animals and plant species and over 200 types of habitat. It also established the EU-wide Natura 2000 network of protected areas. The Birds Directive provides comprehensive protection to all wild bird species naturally occurring in the EU. IAS Regulation provides for a set of measures to be taken across the EU in relation to invasive alien species included on the Union list. These can be prevention, early detection and management to prevent spreading.	These Directive require MSs to 1) to establish strict protection regime for all wild European bird species and other endangered species listed in Annexes of the Habitats and Birds Directives both inside and outside Natura 2000 sites. 2) Set-up Natura 2000 ecological network 3) Member States monitor progress and report back to the EC every six years on the status of the species and habitats of present in their country (article 17).
Water	**Water Framework Directive** **Groundwater Directive** **Nitrates Directive**	Water protection is one of core priorities of EC. The EC Water Policy should get polluted waters clean again, and ensure clean waters are kept clean. This is arranged through several	MSs were obliged to develop River Basin Management plans, follow up on the actions to reach the objectives of the WFD in the plans. Regular reporting on the achievements needs to be done. For the Nitrates Directive MSs have to also draw up Nitrate action programmes aimed at limiting nitrogenpgift per hectare to 170 kg/ha and take measures to manage this. Regular reporting about the effectiveness of the measures needs to be done.
Bioeconomy and circularity	**New European bioeconomy strategy** 2018 **New Circular Economy Action plan** ' (COM(2020) 98 Final, March 2020)	New Circular Economy Action plan 'For a Cleaner and more competetive Europe' (COM(2020) 98 Final) published in March 2020	Sofar, no obligation to MSs exist. However, it is strongly encouraged to develop **National Bioeconomy Strategies** and at regional level **SMART Specialisation Clusters**

Topic	Main EU policy instruments	Description	Type of actions required at national/regional level
Industry, Biochemicals & materials	**Integrated Pollution Prevention and Control (IPPC)** Directive (96/61/EC) **REACH**, EU 2006	Only for the Bio-based chemicals and materials there is specific EU legislation to comply with which is the regulatory framework for the management of chemicals. A more general IPPC framework industrial activities with a high pollution potential. It establishes provisions for issuing permit for existing and new installations to prove that requirements are followed to ensure the protection of soil and groundwater and set emission limits for pollutants.	No MSs requirements. The European Chemicals Agency manages this integrated system for the registration, evaluation, authorisation and restriction of chemicals. The Directive on industrial emissions 2010/75/EU (IED) entered into force in January 2011 and was to be transposed into national legislation by Member States by January 2013.
Research and innovation	**SMART Specialisation** – regional policies **EU research and development framework programmes** (e.g. FP7, H2020) **BBI-JU** **European Structural and Investment Funds** (ESIF) which consist of five main funds	SMART specialisation encourages and facilitated the setting up of Technology and Innovation clusters at regional level Research, development and innovation in the BBE is faclitaed through several EU wide programmes: Horizon 2020, the **European Structural Funds** and the European Fund for Strategic Investment EU encourages strongly the Public Private Partnership constructions. The BBI is an example particularly focussed on BBE in which EC and companies participate and finance research and Innovation.	No obligation to EU countries and regions exist but involvement is logical in setting up **SMART technology and innovation clusters**. As to other research and innovation countries and regions are challenged to involve as much as possible local companies, research institutions to participate in H2020 research and innovation. This requires streamlining national and EU research and innovation strategies and funding (cofinancing from national funds) and information and communication ctivities. For the spending from regional and structural funds every MSs has to specify its own spending targets in plans and adopt and traslate these in national actions and legal framework.

It is also clear that the EU wide policy framework is dynamic. Through the Green Deal and the recently published EU Circular Action Plan several new actions towards further adjustment and strengthening of regulations, clearer short term and long term goal settings and several financial support mechanisms can be expected that are particularly addressing the BBE. The Circular Action Plan can be seen as the core of the European Green Deal and the EU roadmap towards climate-neutrality. This is not surprising, since half of total greenhouse gas emissions come from resource extraction and processing and it is therefore not possible to achieve the climate-neutrality target by 2050 without transitioning to a fully circular economy. The Circular Action Plan announces initiatives for the entire life cycle of products, from design and manufacturing to consumption, repair, reuse, recycling, and bringing resources back into the economy. It introduces legislative and non-legislative measures and targets areas where action at the EU level brings added value. Further stricter measures to reduce the EU's consumption footprint, particularly through the pricing of carbon can be further expected. The EC will review all national action plans such as the Energy action plans and the national CAP strategic plans and the Green architectural

plans more strictly from the perspective of reaching the ambitous climate goals and therefore can be expected to be particularly critical in relation to plans that are not suffiently ambitious.

At the same time it is clear that this transition towards a bio-based and circular economy also provides opportunities to create many new jobs.

For the realisation of the ambitious targets set in this dynamic policy field, the action for implementation will need to come from the MSs and the regions. The EU sets out the ambions, the direction of the actions, the support instruments and guide strongly on an equal level playing field, but creation of bioeconomy activities, jobs, shifts to circularity will need to be implemented locally.

5 CHARACTERISATION OF POLICIES IN PLACE FOR BIO-BASED ECONOMY

5.1 Introduction

There have been many good experiences with specific policy instruments that have significantly contributed to bio-based economy development. In this chapter, we will explore the characteristics of some examples among these policies. These findings can be helpful for regions designing policies or searching for instruments to replicate. Two aspects have to be considered when searching for policy example instruments:

1. The stage of bioeconomy development. From previous research (e.g. BERST; Bergeret et al. 2018) we know that specific policy instruments play a major role in the initial stages of bioeconomy development, while other instruments are more relevant at later and more mature stages. This means that the current stage of bioeconomy development has to be taken into account.

2. The definition and type of bioeconomy development. A bioeconomy based on forestry and mainly focused on bio-energy may require another set of instruments compared to for instance a bioeconomy based on biochemistry and green materials. This means that the chosen bioeconomy perspective may play a role in the identification of instruments to apply.

To explore the characteristics of policy examples, the POWER4BIO team has developed a long list of policy example instruments (included in Annex IV of this report). This long list will be the basis of the analysis in this chapter and will also be the guiding instrument in the selection of 10 good policy examples to be explained in Section 4 of this chapter.

5.2 Approach to develop the long list of examples of policy instruments

The POWER4BIO team has developed a long list of 72 policy instruments that are experienced to play an important role in the development of regional bioeconomies in Europe. This long list was developed based on three main sources of information:

1. previous research like S2Biom[18], BERST[19] and desk research made by partners involved in T4.2.
2. Furthermore, we have interviewed the POWER4BIO regional partners about policy instruments that played a major role in progressing the bioeconomy (at the workshop organised for the POWER4BIO regions on 20 January 2020, Munich and also by email conversation with the regions in March 2020). We mainly tapped upon the experiences of the more mature regions, since they are a rich source of experience with various policy instruments.
3. Experts of our research team suggested policies and we also used analysis of the literature to identify policy examples outside the examples provided by the regional partners.

This approach has resulted in the long list of 72 policy instruments. This chapter aims to characterise these 72 policy instruments. The long list can be found in the Annex V. An identification number is attached to each policy instrument (ID_policy instrument) to label the policy instruments in the analysis. Most of the instruments are coming from the German regions (27), 9 instruments are coming from Belgium, 7 from Hungary. There are 6 from Spanish and 6 from Italian regions, 5 from the Netherlands, 4 instruments from Poland, and 3 from Slovakia and from Austria. Finally, there is 1 Danish, 1 French, 1 Luxembourgish and 1 Ukrainian instrument. One instrument was deployed jointly in Belgium, the Netherlands and Luxembourg (Figure 5.1). Some countries are "overrepresented", because there are partners in the POWER4BIO and we had easier access to information on their policy instruments. But also because these countries simply are in a more mature phase in the bioeconomy development.

[18] https://www.s2biom.eu/en/

[19] https://www.berst.eu/

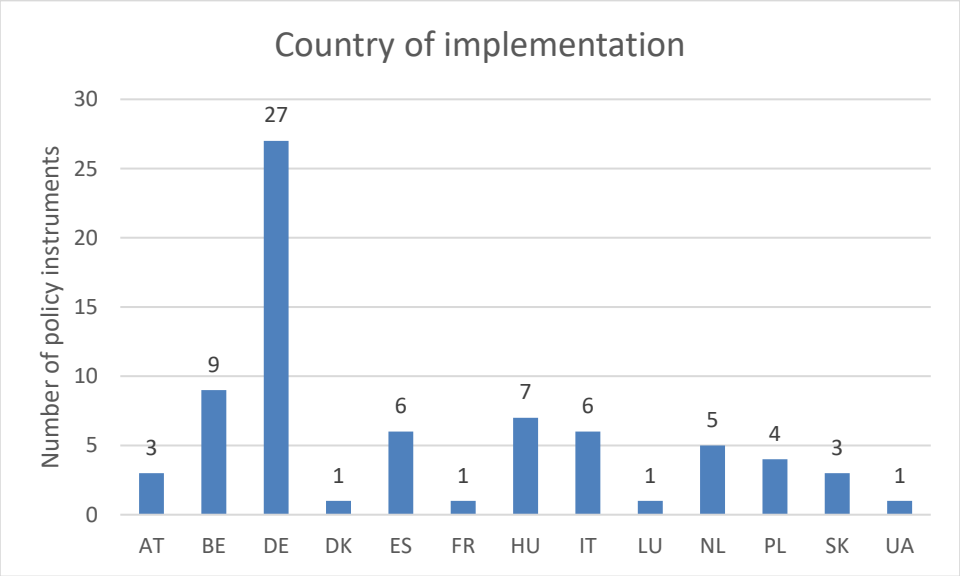


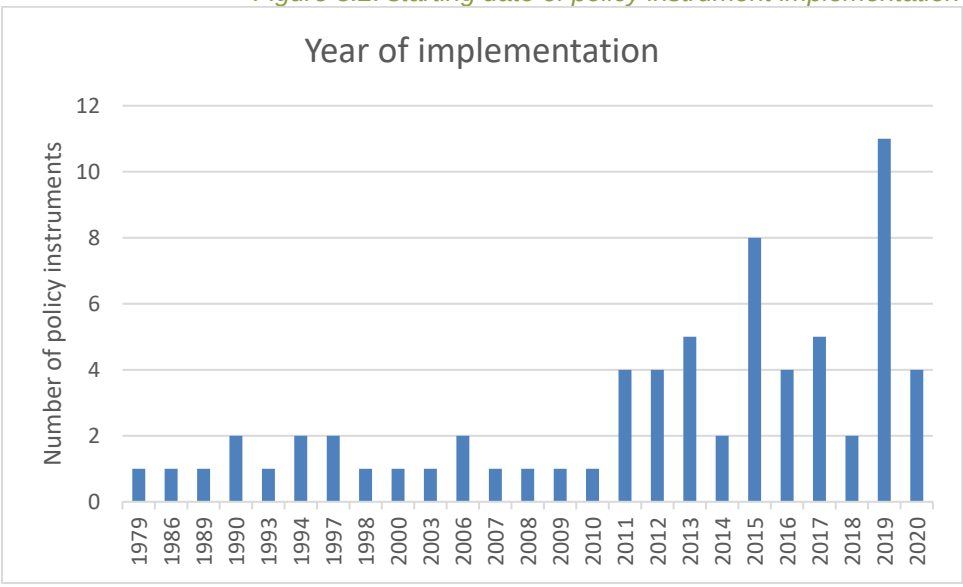
Figure 5.1: numbers of policy instruments implemented in the respective countries

5.3 Overall characterisation of examples policies in place

5.3.1 Start of implementation

The sampled policy example instruments have starting dates of implementation that goes back to 40 years ago. These early policy instruments were initially not focused in driving bioeconomy development as such, like the German Environment Innovation Programme, but they appear to play a role in bioeconomy development many years later. The majority of the sampled policy example instruments started to be implemented in the past 10 years (Figure 5.2).

Figure 5.2: starting date of policy instrument implementation



5.3.2 Type of policy instruments

This section describes the long list according to the types of policy instruments. We have developed a categorisation of instruments based on common policy instrument categorisations that are used in policy research.

- Fiscal and financial instruments
- Regulatory instruments
- Information and advisory instruments
- Networking, collaboration and joint planning instruments
- Voluntary instruments
- Other instruments

We are aware that other categorisations can be used by other studies (Bergeret et al. 2018) but have opted for this categorisation because it fits best with the purpose of this study.

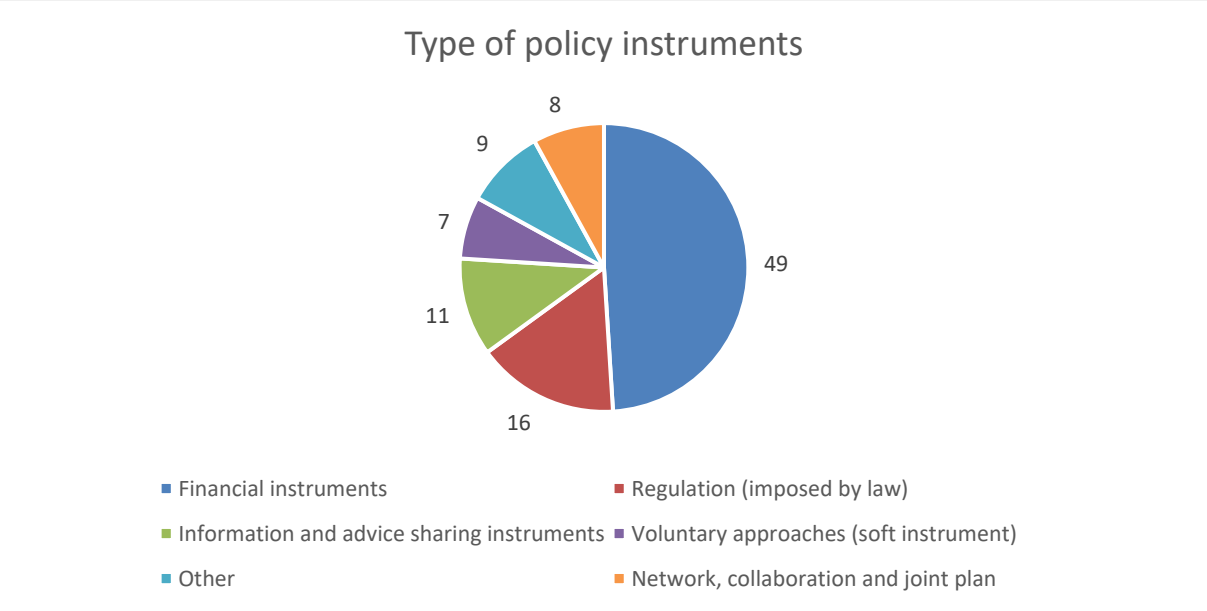


Figure 5.3 Relative distribution over policy instruments of long list policies

The type of policy instrument that supports the development of the bioeconomy is dominantly financial (49 policy instruments, see Figure 5.3). Among the fiscal (like taxes) and financial instruments, we observe the following categories (Table 5.1):

- Subsidies, grants and funding programmes by EU and national government:
    - *Subsidy and funding programmes for R&D projects:* many policy instruments related to programmes that fund research and development projects like the Flemish Generic R&D instruments that allow companies and research institutes to apply for subsidies to conduct R&D and subsidy percentage vary according to the maturity of the research; or the Bavarian Research Foundation that funds cooperation and research

projects in the fields of life sciences, materials sciences, energy and environment and other disciplines.
    - *Subsidies for pilot installations that have high financial risk* like the German Environmental Innovation Programme that provides funding for large-scale pilot projects with demonstrative character and environmental relief potential or Flanders Future Tech Fund that finances pilot installations.
    - *Subsidy and funding programmes to decrease the financial costs of installation* of specific bio-based facilities like the Spanish Biomcasa II and GIT programmes that finances biomass projects for thermal use in buildings through the Energy Service Companies.
    - *Subsidies to ease the mobilization of biomass/ease the use of bioproducts/biofuels* like the Hungarian Rural Development Progamme Measure- VP5-8.6.2-16 - Activities to mobilize forest production potential via EAFRD funding or the Italian Biomethane Decree to support bio-methane injection in transport sector.
- Feed-in tariff and feed-in premium systems, which are mainly found related to renewable energy as for instance in the German Renewable Energy Sources ACTS EEG, the Hungarian Brown Premium or the Dutch subsidy for renewable energy.
- Tax and tax detraction instruments like the ALSAG in Austria that taxes waste production or the Danish Act on the Carbon Dioxide Tax on Certain Energy Products. The Italian Renewable Heat Incentive is an example of Tax detraction when costs are made on renewable energy technology installement.
- Credit, loans and angel investment programmes
    - Providing credit or loans to lower financial risks, compared to banks, like the Loan program for bioeconomy in the Ukrainian or the Slovakian microloan programme to support small businesses to procure property, reconstruction or materials.
    - Setting up a network of Business Angels in Slovakia, which is a network of entrepreneurs and managers that want to invest money, expertise and time into start-ups.

Table 5.1 Type of financial policy instrument

Category of instrument	ID_policy instrument (see longlist in Annex I)[20]
Subsidy and funding programmes for R&D projects	8, 9, 10, 13, 16, 17, 18, 19, 27, 29, 32, 36, 47, 57, 56, 58, 59, 63
Subsidies for pilot installations that have high financial risk	11, 15, 37
Subsidy and funding programmes to decrease the financial costs of installation	12, 25, 30, 31,34, 43, 46, 49, 55, 61
Subsidies to ease the mobilization of biomass/ease the use of bioproducts/biofuels	5, 7,21, 45, 51, 53, 54, 67
Feed-in tariff	22, 23, 49, 56, 61
Tax and tax detraction instruments	2, 5, 6, 20, 40, 55
Credit, loans and angel investment programmes	70, 71, 72

Regulatory instruments are found among 16 of the policy instruments (see Table 5.2). We have observed three categories of regulatory instruments:

- Regulation that aims to regulate and mobilize biomass production like the Spanish Decree 29/12/2011 that regulates which forest biomass can be used as renewable energy source or the Directive in Austria on the recycling of waste wood.
- Regulation that aims to increase the consumption and use of bio-based products, mainly renewable energy like the German Renewable Energies Heat Act that request builders of new buildings to generate a share of their heating from renewable energy sources or the Italian Biomethane Decree to support the use of biomethane in the transport sector.
- Regulation that aims to secure the sustainable harvesting of biomass like the German biowaste regulation that regulates the recycling of biowaste on agricultural, forestry and horticultural soils or the Hungarian Decree on sustainability requirements and certification of biofuels and bioliquids.
- Regulation that aims to monitor bioeconomy development like the Dutch Parliament requested.

[20] ID_policy instrument refers to the identification number of the policy instrument as found in the long list of policy instruments in the Annex I.

Table 5.2 Type of regulatory policy instrument

Category of instrument	ID_policy (see longlist in Annex I)
• **Regulation that aims to regulate and mobilize biomass production**	1, 2, 22,35, 41, 69
• **Regulation that aims to increase the use of bio-based products, mainly renewable energy**	23, 24, 39, 42, 44, 46, 56
• **Regulation that aims to secure the sustainable harvesting of biomass**	38, 48
• **Regulation that aims to monitor bioeconomy development**	62

Table 5.3 Type of information and advice policy instrument

Category of instrument	ID_policy instrument
• **Information and advisory policy instrument that are oriented to citizens and consumers in order to demonstrate and inform about bioeconomy**	3,4, 20, 26, 27
• **Information and advisory policy instruments that are oriented to policymakers and businesses to guide their investment decisions**	14, 18, 33, 62, 63, 64

There are 11 policy instruments of the type of 'information and advisory' (see Table 5.3). We can detect two categories:

- Information and advisory policy instrument that are oriented to citizens and consumers in order to demonstrate and inform about bioeconomy like the Brussels Waste Management Plan that has set up a network of waste advisors to advise business on their waste management or the German support programme,use of biomass as an energy source' that informs via demonstration and pilots.
- Information and advisory policy instruments that are oriented to policymakers and businesses to guide their investment decisions like the Bavarian Bioeconomy Council that advises the Bavarian State on further development of the bioeconomy or the Dutch Topsector Agenda Bioeconomy that guides investments decision on research.

Bioeconomy development requires collaboration among different actors. Policy instruments that encourage networking, collaboration and joint planning are therefore found 8 times: ID_instrument: 4, 13, 16, 33, 57, 58, 59, 71 in Annex I). Examples are the Slovakian Business Angels Network, the Italian

Innovation Poles, the German Platform Chemistry4Climate + Roadmap Chemistry 2050, The Brussels Waste Management Plan.

We have also specified a category of voluntary approaches. These policy instruments are often a mix of policy instrument types. They can be self-regulatory and other industry-led initiatives but also financial incentive schemes that encourage people to show desired behaviour. These voluntary approaches are often a mix of other policy instruments, in particular information and advice instruments or financial instruments. In the long list of policy examples, we have observed the following categories of voluntary approaches (7 instruments, see Table 5.4):

- Voluntary approaches in combination with information sharing like the Dutch framework for sustainable biomass use that will provide information to the actors in the bioeconomy on how to guarantee the sustainability of biomass mobilization and use or the Austrian waste advisors that advise on successful waste management.
- Voluntary approaches in combination with financial instruments like incentives to install bio-based equipment like the Slovakian microloan programme for small businesses or the Dutch scheme for sustainable energy (SDE+ scheme) that support consumers and businesses to shift towards renewable energy use and production.

Table 5.4 Type of voluntary policy instruments

Category of instrument	ID_policy instrument
• **Voluntary approaches in combination with information sharing**	3, 64
• **Voluntary approaches in combination with financial instrument**	15, 24, 25, 45, 55, 61, 70, 72

The last category is labelled 'other instruments'. This category mainly refers to strategies, plans and roadmaps that are developed by government but that are not enforced by law. 9 policy instruments of this type are detected in the long list (ID_policy instrument: 26, 28, 57, 60, 63, 65, 66, 68, 69). These instruments play a major role in fostering collaboration and providing longer term continuity. Examples are for instance the German National Bioeconomy Strategy, the Italian smart specialisation strategy for Piemonte region, or the Polish Strategy for sustainable rural development, agriculture and fisheries 2030. The analysis of the different policy instruments has made clear that the policy instruments are often a mix of different types of policy instruments.

5.3.2 What are the value chain changes that these policy instruments have contributed to?

Bioeconomy development requires numerous changes in the value chain, in order to shift from the fossil based economy. Policy instruments are implemented to foster these changes. Table 5.5 positions

the policy instruments in the long list with regard to their purpose and also the component affected in the bioeconomy system presented in Figure 2.1 (Chapter 2).

The Table 5.5 makes clear that many of the policy instruments are oriented to the renewable energy value chain. This is mainly because many technologies are oriented to energy production in the low maturity phase of regions. Instruments that focus on the production part of the value chain mainly aim to mobilise biomass in a sustainable way. There are policy instruments specifically for biomass from waste, from forests, from agriculture.

Instruments focussing on the processing part aim to decrease investment costs and financial risks. It is also clear that there are not yet many instruments that aim to support consumption, apart from the renewable energy value chain. The instruments that relate to the 'end-of-life' are mainly waste management policy instruments.

Instruments that are focussing on the enabling environment of the bioeconomy transition are generic and can be applied on all types of value chains. There are many instruments focussing on research and on innovation, mainly by providing financial support. And there are some instruments that provide long-term perspective, joint planning and collaboration.

Table 5.5 Policy instruments in perspective to the purpose, type of biomass and bio-based product

		Biomass feedstock/bio-based product						
Bioeconomy system component addressed	**Purpose of the instrument with regard to the value chain**	**No specific biomass/no specific product**	**Waste/no specific product**	**Forest/No specific product**	**Forest/renewable energy**	**Agriculture/no specific product**	**No specific biomass/renewable energy (incl. biofuels)**	**No specific biomass/ materials and chemicals**
Production	Mobilisation of biomass by regulating		1	7	41,69		21, 22	
	Mobilise biomass by financial incentive			51,53, 54			5, 45	
	Sustainable harvesting of biomass/limiting environmental impact	2,64, 67	1, 35		41	34	48	
Processing	Decrease investments costs of installations	70. 71, 72					26, 49, 60	
	Decrease investment costs of pilots	11, 37						
	Promote sustainable generation of bio-based products						22	
	Regulation of Guarantees of Origin (GOs) of electricity produced from RES and high efficiency CHP generation plants						44, 46	
	Decreasing financial risk to produce renewable energy due to market fluctuation						61	
	Convince industry to make use of renewable	70,72					15, 23, 25, 30, 31, 55, 56	

		Biomass feedstock/bio-based product						
Bioeconomy system component addressed	**Purpose of the instrument with regard to the value chain**	**No specific biomass/no specific product**	**Waste/no specific product**	**Forest/No specific product**	**Forest/renewable energy**	**Agriculture/no specific product**	**No specific biomass/renewable energy (incl. biofuels)**	**No specific biomass/ materials and chemicals**
	energy/bio-based products by decreasing costs							
Consumption	Convince consumers to make use of bio-based product by decreasing costs/making bioproducts more attractive financially						24, 40., 43, 52, 61, 602	
	Convince municipalities to make use of bio-based product by decreasing costs						12	
	Oblige consumers to use bio-based product						39	
End of life	Organise the recycling of waste	3, 4, 20, 35, 38	1, 6					
Enabling environment	Provide finance to do research	8, 10, 18, 47					29	32
	Fostering industry – research collaboration	8, 9, 13, 16, 57, 63						17,19, 27, 36, 58, 59
	Policies: long term strategy/roadmap	28, 65, 66, 68						
	Policies: advise on long term strategy	14						33
	Monitoring progress	62						

5.3.3. What sectors are supported by example policy instruments?

We have also analysed to what sectors the policy instruments provide support. To analyse this, we made use of the Figure 2.1 and considered the bio-based economy as a holistic system. We specified the typical sectors that play a role in the value chain and also the sectors that play a role in the enabling environment of the value chain, like for instance sector innovation and research, sector environment, sector clustering, cooperation and networking (see Figure 5.4 and Table 5.6).

The energy sector is clearly the sector that gains most of the support from the examples of policy instruments. The agricultural, environment and the waste sector also gain substantial support to shift towards bioeconomy, followed by the research and innovation sector, the forestry sector and the industry, enterprise and commerce sector. Sectors that are less often targeted according to our sample of national and regional policy example instruments are consumer, clustering/cooperation and networking, climate, chemical, development, support and advisory and fisheries sectors.

Figure 5.4 Supporting policy instruments per sector

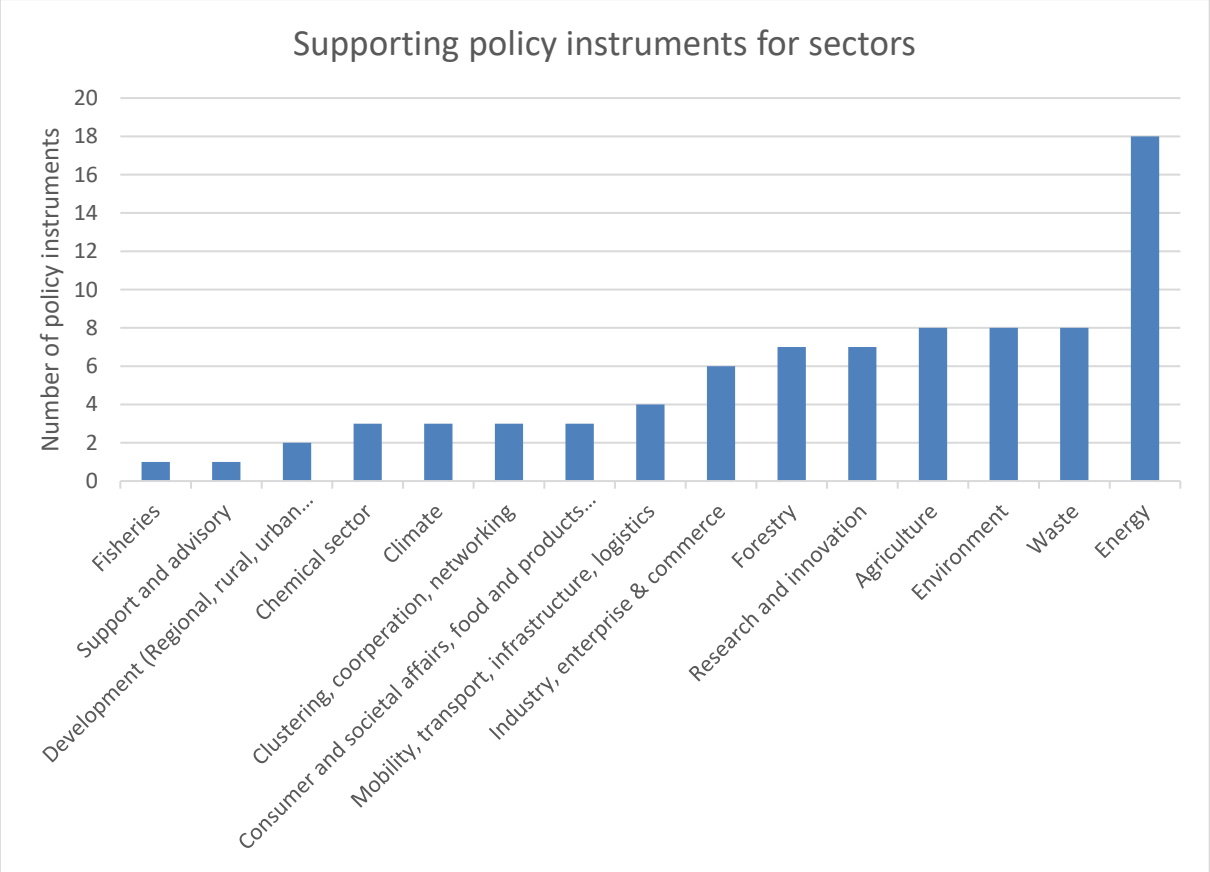


Table 5.6 Policies in long list (Annex V) distributed over sectors

Sector	ID_policy instrument
BBE sectors	
Fisheries	65
Chemical sector	32,33 62
Consumer and societal affairs, food and products labelling, quality & safety	12, 24, 55
Mobility, transport, infrastructure, logistics	5, 40, 48, 56
Industry, enterprise & commerce	2, 30, 40, 42, 45, 69
Forestry	7, 41, 51, 53, 54, 65, 69
Agriculture	21, 34, 42, 45, 52, 62, 63, 65
Waste	1, 2, 3, 4, 6, 20, 35, 38, 42, 63
Energy	12, 15, 21, 22, 23, 24, 25, 26, 40, 41 43, 44, 52, 55, 58, 63, 66, 69
Sectors that indirectly impact BBE	
Clustering, coorperation, networking	4, 13, 59
Research and innovation	16, 17, 18, 19, 27, 29, 34
Support and advisory	14
Development (Regional, rural, urban development)	24, 58, 67
Climate	31, 32, 66
Environment	1, 4, 6, 23, 25, 26, 1, 60, 67

5.3.4 The role of European policy to drive bioeconomy development

When analysing if the policy instruments follow up on EU policy in terms of being transposed to national/regional level or in terms of policy to reach EU policy targets, we can conclude that the European Commission have played a significant role to drive regional bioeconomy development. The large majority of all identified policy example instruments are following up on EU policy such as transposing of EU policies to national or regional level, implementation of instruments at national and regional level or are (co)financed by the European Funds. On the other hand, some of these policy instruments were good starting points for EU policy development as well such as the early waste management policies in Austria and PAYT schemes in the Netherlands.

The European policies that are mentioned to contribute to bioeconomy development at regional level are:

- Rural development policies
- Climate and energy policies
- Cohesion policies, in particular SMART specialisation policy
- Waste management policies
- Bioeconomy policies

5.3.5 Policy instruments with regard to the different maturity phases of development

The sample of policy example instruments illustrates that policy instruments are needed and available for all stages of the bioeconomy development – from low maturity to high maturity. Many of the policy instruments are applicable in multiple maturity stages.

In regions that are in the early stage (low to medium maturity) of bioeconomy development, we observe policy instruments that are often oriented to renewable energy and energy production from biomass and recycled waste. We observe that the policy instruments are focussed on:

- Mobilization of biomass (ID_policy instrument: 1, 5, 7,21, 41, 69)
- Stimulate production of bio-based products (ID_policy instrument 61)
- Subsidies to support consumers to make use of renewable energy (ID_policy instruments: 12, 43, 52)
- Regulation to shift consumers (ID_policy instrument: 39)
- Funding for research (in the early stages) (ID_policy instrument: 18)

Policy instruments that play a specific role in medium mature regions:

- Funding for industry and companies to make use of renewable energy (ID_policy instrument: 23, 30, 31, 55, 56)
- Funding to produce biogas/energy after start-up phase (brown premium) (ID_policy instrument: 49, 60)
- Regulation to ensure the sustainable generation and recycling of bio-based products (ID_policy instrument:22, 38)
- Regulation of Guarantees of Origin (GOs) of electricity produced from RES and high efficiency CHP generation plants (ID_policy instrument: 44)

Regions that are in medium to high maturity stage of bioeconomy development have often surmounted the stage of renewable energy production and are focussing on bio-based products of higher value like bio-based chemicals, bio-based materials. Related policy instruments are:

- Funding for research and innovation (ID_ policy instrument: 10, 29,32)
- Funding to support clusters, innovation networks and technology platforms (ID_policy instruments: 9, 13, 16, 17, 19, 36, 58; 59)
- Expert groups to advise further development of the bioeconomy (ID_policy instruments: 14, 33)

There is also a whole range of policy instruments that can be applied in all stages of maturity:

- Mobilize and regulate biomass (ID_policy instruments: 45, 53, 54)
- Instruments for waste management (ID_policy instruments: 3, 4, 6, 20)
- Regulation and support to safeguard the environment and prevent environmental impact (ID_policy instrument: 2, 34, 35, 48, 64, 67)
- Financing pilots (ID_policy instruments: 11, 37)

- Loans to help companies to finance bio-based facilities (ID_policy instruments: 70, 72; 15, 24, 25, 46, 50, 51)
- Funding for research and research agenda (ID_policy instrument: 8, 27, 47, 63)
- Strategy for bioeconomy development (ID_policy instrument: 28, 65, 68)
- Monitoring progress of bioeconomy (ID_policy instrument: 62)

5.4 Selection of 10 good policy examples

From the long list presented in the former sections 10 good policy examples were selected for more extensive description. The objective is that these 10 policies are to serve as good policy examples for regions that have ambitions to further develop their policy framework for enhancing bio-based activities.

To make this selection, criteria were developed. These criteria were not based on an extensive literature review on good policies but on the experiences with policy development and (lack of) implementation in the focus regions in POWER4BIO project. The reason to involve these region partners in this selection is because the policy examples to be selected should also serve as examples of policies that could be replicated in other regions.

So, on the one hand there are regions in POWER4BIO that have already developed many policies that have supported the bio-based economy that is already in a medium to high development state. This is particularly the case in regions such as Bavaria, central Germany (Saxony, Thuringia and Saxony-Anhalt) Flanders, several Italian regions and the region of Andalusia in Spain. On the other hand, there are regions in POWER4BIO that have started only recently to develop their bio-based economy, such as Nitra in Slovakia, South Bohemia in Czechia, Mazovia in Poland, the Southern great plain of Hungary and Lviv in Ukraine. In these regions policy instruments to support the bio-based economy development are still limited. Because of this diverse situation in the POWER4BIO regions the interregional collaboration and knowledge exchange is a key activity in this project and the 10 policy examples to be selected serve as inspiring examples of policies that may be replicated in other regions.

The selection criteria for good policy examples were compiled with input from all partner regions in POWER4BIO during a working meeting in January 2020 in Munich (see also Chapter 1). Before the meeting the regional partners were asked to prepare for answering the following questions:

1 *Can you think of policies (in your region, country or in other EU countries) addressing (aspects of) bioeconomy that may serve as good policy examples for other regions?*
2 *Why do you think this/these is/are a good policy example(s)?*
3 *What criteria are to be used to select the 10 good policy examples to be worked out in detail in POWER4BIO (task 4.2) so that they can serve as exemplar policies for other regions (including your own)?*

The exchanges and meeting with the regional partners resulted in the following criteria that obtained the highest priority for selecting good policy examples:

1) Policy following up or transposing EU-policy

2) Policy instrument that has already proven to have a large impact, so implemented for several years
3) The policy instrument is general enough to replicate in other regions
4) For the policy there is enough information available on it's impact and success (preferably it has been evaluatated/monitored)
5) The policy is an interesting example for regions that are still in a low or intermediate state of development of bioeconomy
6) In the final selection of 10 policy examples there is diversity in bioeconomy sectors addressed by the policy
7) In the selection of policy examples there is enough diversity in the different stages of the biomass delivery chain addressed, from biomass sourcing, processing and end use
8) In the selection of policy examples there is enough diversity in biomass types and in bio-based end products addressed
9) In the selection of policy examples the diversity of policy instruments is covered (see section 2.2 on policy type instruments)

After the consultation with the region partners one additional selection criterion was added:

10) Similar policy instruments that were seen to be in place in a wider number of EU regions.

The reason for this last point is that replication of a certain policy instrument can be regarded as a confirmation of the wider relevance of the instrument. More implementations also provide a wider amount of information on the experiences with the development and implementation of this policy instrument.

Application of the 10 selection criteria to the long list results in the sub-selection of 10 instruments presented in Table 5.7. These 10 selected good policy examples have been described extensively in 10 policy fact sheets included in Annex V of this report. The content of the fact sheets is further used to make the integrated analysis of these policies presented in the next Chapter (Chapter 6) focussing particularly on lessons to be learned from these policies and replicability options.

It should also be mentioned that the policies described in the factsheets are based initially on the selection of one of the policy instruments in the long list. However, more policies can be described in one fact sheet in case there are related policies or policies of similar nature implemented in more European regions.

Table 5.7 Selected 10 good policy examples worked out in the policy factsheets (Annex Y) and presented in an integrated analysis in chapter 6.

No. of factsheet (Annex I)	Title	Region	Main objective	Sector	Type of instrument	Biomass value chain position
2 & 3	Austrian landfill tax, known as the 'Altlastensanierungsbeitrag' ('ALSAG') Abfallvermeidungsprogramm - Waste Prevention Programmes	Austria	To stimulate and fund the identification and clean-up of contaminated land and stimulating treatment and recycling of waste The waste advisors network was set-up to raise separate collection rates saving costs and generating new follow-up jobs.	Waste, industry Households, economic sectors	Regulation & financial Voluntary instrument	End of life, waste recycling

No. of factsheet (Annex I)	Title	Region	Main objective	Sector	Type of instrument	Biomass value chain position
6	Pay As You Throw (PAYT) scheme Dutch municipalities	Netherlands	To let households, pay for collection of certain waste categories with the objective to increase recycling and reduce residual waste collection from households	Households, municipalities, waste	Financial	End of life, waste recycling
13	Cluster Initiative Bavaria	Bavaria, Germany	The Bavarian Cluster Initiative promotes cooperation between companies and research institutions in 17 branches and technologies with high importance for the future bioeconomy of Bavaria.	Industries, R&D	Information and advice sharing instrument	Whole biomass value chain
61	Stimulation of Sustainable Energy Production - Stimulering Duurzame Energieproductie (SDE+)	Netherlands	Energy producers can receive financial compensation for the renewable energy they generate based feed-in premium (FIP) system. Aim is to increase the renewable energy share in energy production and consumption.	Energy	Financial	Processing
22	Ordinance on the Generation of Electricity from Biomass (Biomass Ordinance - BiomasseV)	Germany	Regulates which substances are classed as biomass and how the related tariffs are calculated when used in bioelectricity generation	Energy	Regulation	Biomass, Processing
40	Act on the Carbon Dioxide Tax on Certain Energy Products	Denmark	The act introduces a tax on certain energy products depending on their CO2 emissions. The Act on the Carbon Dioxide Tax on Certain Energy Products and the Act on the Energy Tax on Mineral Oil Products oblige companies producing, processing, possessing, receiving or dispatching energy products to pay a defined amount of tax. Main aim is to reduce GHG emissions in energy systems.	Energy	Financial	Processing, End use
41	Regulation on the use of biomass from forest for energy (Decree 29/12/2011)	Andalucía, Spain	The aim is to stimulate the sustainable production and harvesting of forest biomass used for bioenergy production.	Energy, Forestry	Regulation	Biomass, end use
42	Regulation of the use of residual biomass from olive oil industries (D 4/2011)	Andalucía, Spain	Objective of this decree is to stablish juridical status for the use as agricultural fertilizer of the biomass residues from virgin olive oil extraction at the mills.	Agriculture	Regulation	Biomass, end use
56	Biomethane Decree	Italy	Support to stimulate bio-methane injection (into the gas network), the electricity generation from	Energy	Financial	Biomass, end use

No. of factsheet (Annex I)	Title	Region	Main objective	Sector	Type of instrument	Biomass value chain position
			bio-methane and the use of bio-methane in the transport sector			
58	Bioeconomy Technological Platform (Smart Specialisation Strategy)	Piemonte, Italy	Technological Platforms aim at supporting industrial research and experimental development through collaborative projects by private and public actors, The Piemonte Region in 2018 indicated the priority areas of "Agrifood" and "Green chemistry/Cleantech" for the development of the Bioeconomy	Agriculture, Industry (chemistry), R&D	Information and advice sharing instrument, Financial	Whole biomass value chain

6 GOOD POLICY EXAMPLES

6.1 Introduction

In the last Section of chapter 5 a description was given of the criteria according to which the 10 policy examples were selected from the long list of policies compiled in this report and decribed in Chapter 5. In this chapter we will first further describe the 10 selected good policy examples for which 10 detailed factsheets have been eleborated (see Annex V). In the next section 6.2 this is done according to the main criteria used to select the examples from the long list. In section 6.3 the coherence with other EU and national policies for the 10 examples is discussed. Section 4 presents what we know of the impact and evaluation outcomes of the 10 good examples. Section 5 discusses the reasons why the 10 examples can further be called good example policies. In Section 6.6 the replicbility of the good example policies in other countries and regons is discussed. In the last section a bridge is made between the barriers and opportunities for policy development and implementation described in chapter 3 and the 10 good policy example. This will illustrate how barriers and opportunities work in practice.

6.2 Characteristion of good example policies to illustrate the diversity of policies that are needed to support the bio-based economy development

An important criterion for the selection of the 10 policy examples was that they represent different policy instruments, address different sectors included in the bioeconomy, address different componenents of the biomass value chains and focus on different end-products. In addition to this we also choose examples of policies that were either rather unique or that are more common policy instruments that are in place in more EU countries or regions. In the Table 6.1 it is shown how the 10 selected good policy examples cover this diversity.

The chosen good policy examples are all coming from countries and regions that are already in a high or medium BBE development stage. This ensures longer term policy implementation and experience in the case of the examples choosen. The examples come from Austria, Germany, Netherlands, Spain, Italy and Denmark. In the factsheets, however, reference is made to similar or linked policy instruments that also occur in other countries (see Table 6.1).

The sectors covered by the 10 good policy examples are also diverse although the energy and waste sectors are clearly over represented (see Table 6.1). This has to do with longer term policy experience in these sub-sectors of the BBE.

Table 6.1 Selected 10 good policy examples worked out in the policy factsheets (Annex III) and presented in an integrated analysis in chapter 6.

No. of fact-sheet (Annex I)	Title	Country/ region	Sector	Purpose of the instrument with regard to the biomass value chain	Bioeconomy system component addressed	Other policies described in same fact sheet
2 & 3	Austrian landfill tax, known as the 'Altlastensanierungsbeitrag' ('ALSAG') Abfallvermei-dungsprogramm - Waste Prevention Programmes	*Austria*	*ALSAG*: Waste, industry *Waste prevention programme*: Households & economic sectors	Limiting environmental impact Mobilise biomass by financial incentive	End of life	• Austrian recycling of waste wood directive • 24 other countries have a landfill tax instrument Examples of appointment of waste advisors also exist in Germany, UK and Belgium.
6	Pay As You Throw (PAYT) scheme Dutch municipalities	Netherlands, but examples of other BNELUX countries discussed too	Households, municipalities, waste	Limiting environmental impact Mobilise biomass by financial incentive	End of life, organise the recycling of waste	Many PAYT systems exist now adays in EU countries. Longer term experiences discussed here are from Belgium, and Luxembourg
13	Cluster Initiative Bavaria	Germany - Bavaria	Industries, R&D	Enabling environment: Fostering research collaboration	Whole biomass value chain	There are many smart specialisation cluster initiatives in EU such as Bio-based Delta in the Netherlands, BioVale in the UK, IAR in France.
61	Stimulation of Sustainable Energy Production - Stimulering Duurzame Energieproductie (SDE+) in Netherlands	Netherlands, but FITs in other countries also discussed	Energy	Processing: Decreasing financial risk to produce renewable energy due to market fluctuation	Processing	Feed-in tariff systems exist in almost every EU country. The other example in the long list and discussed in from Germany and Hungary.
22	Ordinance on the Generation of Electricity from Biomass (Biomass Ordinance - BiomasseV) in Germany	Germany	Energy	Mobilisation of biomass by regulating Sustainable harvesting of biomass/limiting environmental impact	Biomass, Processing	The whole package of policies in Germany in relation to renewble energy is discussed in fact sheet: covering other policies in the long list such as: •Renewable Energies Heat Act (EEWärmeG): •Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz – EEG) •Biomass Electricity – Sustainable Development Ordinance (Biomassestrom-Nachhaltigkeitsverordnung – BioSt-NachV):

No. of fact-sheet (Annex I)	Title	Country/ region	Sector	Purpose of the instrument with regard to the biomass value chain	Bioeconomy system component addressed	Other policies described in same fact sheet
40	Act on the Carbon Dioxide Tax on Certain Energy Products in Denmark	Denmark, but other CO_2 taxation systems also discussed	Energy	Convince consumers to make use of bioenergy by decreasing costs/making bioproducts more attractive financially	Processing, End use	-At EU level there is the ETS systems and the relation with this instrument is discussed -There are many countries in the EU and outside EU that tax CO2 in the energy system. Often this is combined with energy taxation systems. This is discussed in the fact sheet.
41	Regulation on the use of biomass from forest for energy (Orden 29/12/2011)	Spain - Andalusia	Energy, Forestry	- Sustainable harvesting of biomass/limiting environmental impact - Mobilisation of biomass by regulating	Forest & Renewable energy	There are more countries in the EU that specifically regulate the use of different forest biomass resources for energy. An overview of countries and systems that regulate more strictly the sustainable use of solid biomass resources for energy is given .
42	Regulation of the use of residual biomass from olive oil industries (D 4/2011) Andalusia	Spain - Andalusia	Agriculture	Mobilisation of biomass by regulating	Biomass, end of life use	Similar policy instrumentsare discussed that occur in other Spanish autoomous regions and in other southern European countries.
56	Biomethane Decree Italy	Italy	Energy	Convince consumers to make use of bioenergy by decreasing costs/making bioproducts more attractive financially Mobilise biomass by financial incentive	Biomass, end of life use	In Denmark the economic and political environment focuses on the use of biomethane in Combined Heat and Power (CHP) units
58	Bioeconomy Technological Platform Piemonte (Smart Specialisation Strategy)	Italy - Piemonte	Agriculture, Industry (chemistry), R&D	Enabling environment: Fostering industry – research collaboration particularly in bio-materials and chemicals	Whole biomass value chain	There are many smart specialisation cluster initiatives in EU such as the other example presented as good example policy in Bavaria, Bio-based Delta in the Netherlands, BioVale in the UK, IAR in France.

We have also ensured that the good example policies choosen are diverse in the biomass value chain stages they cover. There are good example instruments addressing the sourcing of biomass in the bio-oeconomy, often most developed for bioenergy, the conversion process and the end use. With regard to the last point, there are several instruments enhancing more circularity in the waste sectors. In terms of purpose of the instruments to the biomass value chains there are several good policy examples that combine the mobilisation of biomass use by financial incentives or regulations with imposing requirements on the avoidance of adverse environmental impacts. A couple of example instruments have the purpose to convince consumers to make use of bioenergy by decreasing costs/making bioproducts more attractive financially. One example has an objective to decrease financial risk to produce renewable energy due to market fluctuation. Two of the 10 examples are in the category of SMART specialisation initiatives in Europe and have as an objective to foster industry – research collaboration particularly in bio-based economy sectors such as in bio-materials and chemicals, bioenergy & food.

Diversity in good example policies regarding type of policy instruments

Of the 10 examples 5 instruments are of financial nature which either require the payment of a tax or fee, to avoid unsustainable practices, or payment of a premium to enhance a sustainable practice/activity. The other five instruments are either regulatory, information and advice sharing instruments or voluntary instruments or a combination. The combination for example applies to the Austrian Landfill tax (ALSAG) instrument which is a legislative and financial instrument at the same time. This also applies to the bioeconomy technology platform of Piemonte that can be seen as an information and advice sharing instrument first but is also a financial instrument as the implementation is supported from Piemonte's share in the European Regional Development Funding programme.

Diversity in financial instruments selected as good examples

Two instruments were selected that require a tax or fee to be paid to dispose of waste but otherwise are completely different. The Austrian landfill directive (ALSAG) imposes a tax on landfilling waste and is to be paid by the waste management sector and applies at national level. The ALSAG was already introduced in Austria in 1990 and sets at a national level for all landfill sites the rates to be paid according to weight, type of waste and the standard of technology at the landfill site. It also requires a tax paid over exports of waste for the purpose of landfill deposited abroad. The other instrument taxes or pricess the disposal of different types of wastes by households. These PAYT schemes are generally applied locally at the scale at which collection systems are organised (e.g. municipality, region) and may create large differences in waste collection within regions and countries. There are differences in the way PAYT schemes price unit-based collection of waste which can be according to weight, volume, number of waste bags offered, frequency of collection or a combination af all or some of these. The PAYT schemes are also different in terms of the type of waste that is charged, e.g. only the residual (non-biological) waste, while in other regions it also applies to the collection of biowaste or recyclables. Usually for these last 2 categories the charges are much lower than for residual waste.

Both financial instruments have in common that the revenues coming from the taxation are reinvested in the waste system. In the case of the ALSAG scheme revenues were used for the identification of landfill sites, the administration, the direct containment and clean-up of sites, the construction or im-

provement of waste treatment plants as far they are required for the clean-up of sites and the development of new technologies for containment or treatment. PAYT schemes can be seen as cost recovery mechanisms for waste management and financial incentives to adopt more environmentally sound behaviour. Revenues raised from the PAYT are used for covering (part of) the cost of waste management. But since the revenues are variable in a PAYT scheme (the less you waste, the less you pay), waste management cannot strictly rely only on revenues from PAYT schemes.

What is also similar for both taxation schemes is the requirement for adaptation of schemes to the changes in the system achieved. The ALSAG scheme has undergone significant amendments, including regular rate increases because of higher returns needed to cover new technologies in landfill clean-up and containment and in incineration technologies to keep them at 'state of the art' technology level. PAYT schemes need to be adjusted after some time to stimulate households further to reduce and separate waste into recyclable parts. So once the objectives are reached, higher standards to be reached are set.

Beside the taxation of waste, the emissions of CO_2 can also be taxed to stimulate the lowering of these emissions. A good practice example selected here is the Danish CO_2 tax on certain energy products. In the current Danish system, which changed several times in the past, because of adaptation to the newly introduced EU ETS system, which is an EU CO_2 taxation (see chapter 3), there are CO_2 taxes paid by households and certain business sectors. The household sector pays a CO_2 tax on energy consumption, the business sector only pays a CO_2 tax on energy for room heating and cooling, the diesel used for railway operations is also subject to a CO_2 tax and the agriculture and fisheries sector pays CO_2 tax on fossil-based diesel use. Like for the former taxation examples, carbon tax revenues are used for further improvements in CO_2 mitigation and it is dynamic as it keeps on encouraging companies to further increase energy savings and reduce GHG emissions. Revenues from the taxation are turned into environmental subsidies and 60% of the revenues were returned to industry. These returned taxes were used to invest in for example industrial restructuring. The Danish government also offers 25% reduction of the CO_2 tax to the companies that sign an energy savings agreement with the Ministry of Transportation and Energy.

The two-remaining financial good policy examples aim at stimulting renewable energy production and consumption through a premium system. The first example is the Dutch feed in premium (FIP) system, SDE+, introduced in 2011. The SDE+ tendering scheme offers to compensate electricity generation companies for the difference in price between the market price and the costs of renewable energy generation over a period of 8, 12 or 15 years, depending on the type of technology used. This means that producers will sell their generated electricity at the current market price and receive a premium for the difference between this price and a predetermined price per kWh. This is called a 'floating premium determination' mechanism and means that operators receive a higher premium when electricity prices are lower, and this implies that generators will not be exposed to the risk of the price fluctuations in the electricity market. Support in SDE+ is only received for a fixed amount of full load hours per year and this maximum is technology specific. The main goal of the SDE+ istrument is to encourage to generate as much renewable energy at the lowest costs possible and thereby be in line with the various goals and sustainability requirements of the national government and the EU Directives, Renewable Energy Directives I and II. The Dutch government creates a budget plan annually that includes the available funding for tendering schemes that will be opened in that year. This budget is

created from a levy on energy bills (from the taxes on energy levied on households and economic entities) called *"opslag duurzame energie*" (ODE). The Dutch government opens two tendering schemes per year for SDE+ subsidy application. The scheme consists of sequential bidding rounds where the government defines a base amount with predetermined prices and producers can offer a respective volume. The SDE+ example presented is from the Netherlands, but we could as well have selected another similar instrument from another country because these Feed-in tariff or feed-in premium systems are rather common in most EU countries. However, there are large differences in the way they work and how they have evaluated in time. The Dutch SDE+ example was selected here because it is organised through a tendering procedure, applies a 'floating premium determination' mechanisms, it is carefully and regularly evaluated and published, and it is paid from returns from energy taxes levied on households and other economic entitties.

The other premium system chosen as a good policy example is from Italy and focusses specifically on stimulating both the generation and use of biomethane. The interesting aspect of this policy is the narrower focus on biomethane and the recent adjustments in this policy instrument now more aimed at increasing the biomethane production that can be considered 'advanced' according to the new EU Renewable Energy Directive. Beside this it is also novel that the decree introduces a support system that stimulates the construction of new filling stations for bio-CNG or bioLNG, to also enhance the consumption of (advanced)biofuels. First, between 2008-2012 the biogas sector in Italy grew considerably as it was supported by a fixed feedin tariff ("tariffa onnicomprensiva") (0,28 €/KWh) to produce renewable electric energy. Between 2013 and 2017, the Italian biogas support scheme substantially changed as, compared to the past, the subsidies decreased and the subsidy period was extended from 15 to 20 years, depending on the size of the plant (the smaller the biogas plant is, the higher is the subsidy) and to the feedstock (the more by-products or organic waste you use, the higher is the subsidy). They also introduced a ranking system for the new biogas plants ("registri") and a special bonus for the enhancement of the thermal energy and for the reduction of the nitrogen content in the digestate. In March 2018 a new biomethane decree was introduced particularly supporting advanced biomethane used as biofuels as these have a higher production costs than traditional fuels. The decree seeks to support biomethane producers with a premium to fill the cost gap. For this 'certificates of Emission of Biofuel in Consumption' (CICs) are issued either through selling the prescribed amount of biofuel in return for a corresponding amount of CICs, or through purchasing the obligation share of biofuels not injected into the market from producers or other obliged entities with a CIC surplus. The new biomethane decree also specifies very precisely on which biomass the biomethane needs to be based to consider it as advanced and allow it to fall under the CIC system. The payment for advanced biomethane is 375 € for a 10-year CIC; after this time, producers are only entitled to receive CICs at a price defined by the market, in addition, advanced biomethane entitles producers to receive one CIC per 5 GCal (double counting).

Legislatory instruments as good example policies

Four legislative instruments were selected as good examples addressing very different aspects in the bioeconomy. ALSAG landfill tax instrument, described already under financial instruments in the former, is implemented at national level through a regulation. The Austrian landfill tax was introduced in 1989 through the 'Clean-Up of Contaminated Sites Act'. Previously most issues regarding contaminated land and landfill sites were arranged in the older Water Act and also in the Landfill Ordinance (1996) which introduced the TOC ban (TOC=total organic carbon), that entered into force in January

1997. Since the introduction of the landfill tax the regulation on which is is based has experienced several amendments regarding tax rate changes and alterations in the taxing system.

The second regulation example is the German Ordinance on the Generation of Electricity from Biomass (BiomasseV). It is called in short, the 'Biomass Ordinance'. This Biomass Ordinance regulates which substances are classed as biomass, the substances for which an additional 'substance-based tariff' may be claimed, which energy related reference values are to be used to calculate substance-based tariff and how it is to be calculated, which technical procedures for electricity generation from biomass fall within the scope and which environmental requirements must be met in generating electricity from biomass. There are two substance tariffs: class I includes food-based energy crops (such as maize, cereals and sugar beets) substance tariff class II contains mostly residual biomass (e.g. straw, manure and wildflower cuttings). The tariffs for substance class II are set higher than those for substance class I.

The BiomasseV does not stand alone. It is complementary to the *Renewable Energy Sources Act (EEG) (2017) which* specifies what renewable electricity plants are eligible for feed-in tariffs. The bioelectricity feed in tariffs are therefore regulated by both acts. Small RES-E plants up to 100 kW are eligible for feed-in tariff. The tariff payment period is 20 years from the day of commissioning. For most technologies, there is an annual degression. From 2017 onwards, funding rates for renewable electricity systems with an installed capacity larger than 1 MW will no longer be fixed by government but will be determined via a market-based auction scheme. Photovoltaics, wind onshore, wind offshore and biomass are the eligible renewable energy technologies for tenders. For each technology target corridors have been defined. For biomass the annual capacity addition is 100 MW.

The two-other regulatory good policy examples are from the region of Andalusia. The first is the 'Regulation on forest biomass use for energetic purposes' and the second 'Regulation on use of olive mill waste waters (effluents) from olive oil industry as fertilisers on agricultural soils'. The first regulates the use of woody biomass coming from mountains or forest lands in Andalusia as a renewable feedstock for use in energy generation. The focus is entirely on forest biomass from vegetation that covers the mountains and/or forest lands of Andalusia. Two types of forest biomass can be used for energy generation; firstly, biomass obtained from forest areas that have specifically been planted with the objective to produce biomass for energetic uses. Secondly, primary residues from logging activities and biomass that is removed for the creation and maintenance of firebreaks for the prevention of forest fires.

The second Andalusian example regulates the use of waste waters/effluents of the oil extraction activity of the olive and bring these back to the olive fields as fertilizers in agricultural soils, restoring part of the nutrient extractions caused by the cultivation. The reason for regulating this is that using effluents has both advantages, bringing back nutrients into the olive oil production system, but may also have adverse environmental risks. This regulation does not stand alone, it is a whole package of regulations together that determine the amount of effluents that can be applied, the location where it is used and the compositional characteristics of the effluent allowed to be applied on soil. These aspects were made consistent with the prescriptions in other laws such as the Laws that regulate water quality and the law that regulates the integrated management of environmental quality in agriculture.

Information and advice sharing instruments as good examples

Three of the instruments described a good policy examples can be classed as information and advice sharing instruments. They are the 'Bio-based economy cluster inititative in Bavaria', the Bioeconomy Technological Platform in Piemonte and the Austrian waste prevention programmes. The technology platform in Piemonte and the cluster initiative in Bavaria are both instrumental to reach the EU objectives with regard to the smart specialization policy that was initiated by the EU in 2011. Smart specialization is a place-based policy concept promoting regional economic transformation and investment through innovative activities in selected domains.

In Piemonte it is one of the main funding schemes of the Piemonte's European Regional Development Funding programme. A technology platform supports the collaboration and coordination of industrial and research stakeholders around a relevant technological trajectory identified among the key sectors of the regional Smart Specialization Strategy. In Piemonte it specifically targets to promote large and strategic R&D projects within the Green Chemistry/Clean Tech and Agrifood, focusing on their connection in the framework of a circular economy approach. The Platform aims at promoting circular productive ecosystems at regional level by leveraging regional supply chains, thus enabling sustainable growth processes.

The Bavarian Cluster Initiative also aims to foster collaboration for innovation between companies/industries and research institutes. There are seventeen sub-cluster platforms that are connected to high potential sectors and technologies to drive bioeconomy transition in the Bavarian region. Mainly the clusters of environmental technology, biotechnology/nutrition, forestry and wood, chemistry as well as new materials, can be seen as strong bioeconomic topics. The collaboration is promoted by the state government with the aim to improve the competitiveness and to be a dynamic and self organizing process of creating growth and development.

The last information and advice sharing instrument is the waste prevention programme. It is part of the whole waste prevention and avoidance of landfill policy package in Austria. This programme, aims at establishing waste advisor's networks. The advisors help to educate the households and enterprises in order to prevent and separate better the waste instead of paying extra fees or dispose the waste incorrectly. Their communication work is mainly focused on waste prevention, reuse, separate waste collection and sustainable consumption and lifestyles in general within the local/regional context although they cover other environmental-related areas too. They have been also contributing in planning and implementing collection schemes, and communication projects and campaigns as well as in developing waste management strategies and concepts. They work as a representative of public entities at different levels. They are employed by municipalities/local authorities, provincial authorities, associations under public contract, cities or provincial authorities.

6.3 Good example policies and how they have supported integration of EU and national policies

Practically all good example policies selected are linked directly to the EU policy framework, most often directly. This becomes clear from the overview in Table 6.2 in which it is indicated to which EU policies the instrument is linked.

The three good examples policies from Austria on the landfill tax combined with the Waste prevention programme and the Pay as you Throw (PAYT) systems and the Andalusian olive oil effluent regulation are clearly embedded in the EU waste policy framework. However, the two first country examples presented here already started much earlier implementing their waste policy instruments then that the EU waste policy framework was initiated. One can rather see these examples of policies developed at local and national level as front runner policies. These forced the EU to take action to harmonization of rules on waste treatment and waste avoidance. In the last decade however, the EC can generally be seen as frontrunner in developing more ambitious waste policy targets while most EU MSs are mostly in the role of following these ambitions up in new policy measures at national and regional levels. Particularly in the context of the recent circular economy strategy. The front running position of the EU is also illustrated by the fact that the 2014 ambitious adopted a legislative proposal to review waste-related targets in the three main waste related Directives is still not approved. The dynamics in the EU waste ambitions also dictate EU MSs to adapt their waste instruments in time.

In the case of the two Austrian good example policy instruments, Austria already started with their waste prevention program in 1986 and their landfill tax was levied from 1990 which was earlier then the EU Packaging Directive (94/62/EC), the Waste Directive (2008/98/EC) and the Landfill Directive. Now the Austrian tax and waste prevention programs facilitate the national translation of the EU's waste management policies to reach its ambitions particularly on the waste hierarchy and the Polluters Pay principle, the disposal of waste requirements for landfilling and the principle in the Waste Directive that waste is to be recovered or disposed of without endangering the environment and groundwater.

Also in the case of the PAYT scheme example for several Dutch municipalities when these were introduced there was not yet any EU wide legislation that dictated this. At the time they were a response to the growing amount of municipal waste and the challenge of managing it. But soon with the introduction of the Packaging and Packaging Waste Directive (94/62/EC) in 1994 the introduction of PAYT schemes was further stimulated in other EU regions. This Packaging Waste Directive was designed by the EC to harmonize national measures concerning the management of packaging and packaging waste and to prevent or reduce its impact on the environment and ensure the functioning of the internal market by avoiding obstacles to trade and distortion and restriction of competition. PAYT schemes are also a local measure to follow up on the three principles introduced through the revised Waste Directive introduced in 2012 of waste hierarchy, the Polluters Pay principle and the extended producer responsibility. The latter requirement, which is further arranged through the Packaging Waste Directive let in the Netherlands to the set-up of the the extended producer responsibility (EPR) scheme ' Nedvang' which plays an important role in facilitation of PAYT schemes in municipalities.

The Andalusian regulation on the use of fertilisers of olive oil efluents follows on the EU Waste Directive 2008/98 / EC. This directive establishes, the conditions that must be met for a substance resulting from a production process that can be considered as a by-product and therefore not as a waste. This directive prescribes that effluents from industries can be used as fertilisers. The Andalusian Law

is therefore a further specification of complementary requirements applying specifically to olive oil mill effluents. After all, the EU Waste Directive applies to effluents in general but there is no EU legislation regulating olive mill waste management, and standards are left to be set by individual countries.

Table 6.2 Good example policies and relation with EU policy instruments

No. of fact-sheet (Annex I)	Name of policy instrument	EU policy Instrument link
2 & 3	Austrian landfill tax, known as the 'Altlastensanierungsbeitrag' ('ALSAG') Abfallvermeidungsprogramm - Waste Prevention Programmes	-Packaging Directive -Waste Framework Directive (2008/98/EC), -Landfill Directive (1999/31/EC)
6	Pay As You Throw (PAYT) scheme Dutch municipalities	-Packaging Directive -Waste Framework Directive (2008/98/EC), -Landfill Directive (1999/31/EC)
13	Cluster Initiative Bavaria	SMART Specialisation – regional policies EU research and development framework programmes (e.g. FP7, H2020)
61	Stimulation of Sustainable Energy Production - Stimulering Duurzame Energieproductie (SDE+)	Renewable Energy Directives (RED I and II) Effort sharing regulation Regulation on the governance of the energy union and climate action
22	Ordinance on the Generation of Electricity from Biomass (Biomass Ordinance - BiomasseV)	Renewable Energy Directives (RED I and II) Effort sharing regulation Regulation on the governance of the energy union and climate action
40	Act on the Carbon Dioxide Tax on Certain Energy Products	Effort sharing Regulation (2018) Emission Trading System (ETS)
41	Regulation on the use of biomass from forest for energy (Orden 29/12/2011)	Renewable Energy Directives I and II
42	Regulation of the use of residual biomass from olive oil industries (D 4/2011)	EU waste Directive
56	Biomethane Decree Italy	Renewable Energy Directives I and II
58	Bioeconomy Technological Platform (Smart Specialisation Strategy) Piemonte	SMART Specialisation – regional policies EU research and development framework programmes (e.g. FP7, H2020)

The good policy examples regulating and/or stimulating the production of sustainable energy such as the Feed-in Premium (FIP) in the Netherlands (SDE+), the German Ordinance on the Generation of Electricity from Biomass (BiomasseV) and the Italian Biomethane Decree all follow up on the realization of the targets from the EU Renewable Energy Directive I and II particularly on reaching the renwable energy targets to which every country has been committed and also the realisation of the reduction in GHG emissions by 2020, 2030 and 2050.

It is also interesting to see how the three renewable energy policy examples developed in time in line with the more ambitious EU wide targets set for reaching GHG mitigation. The examples show how regulation has shifted from overall wide support to bioenergy production without putting very strict requirements on efficiency and type of biomass use, toward more strict requirements for energy efficiency and higher feed-inn tariff support for the bioelectricity and heat produced from more sustainable biomass types, particularly those with no or low ILUC impacts. The latter for example particularly applies to the biomethane decree particularly stimulating the generation and supply system for advanced biofuels.

The two SMART specialisation clusters of Piemonte and Bavaria are instrumental in reaching the EU objectives of Smart specialization policy that was initiated by the EU in 2011. Smart specialization promotes regional economic transformation particularly in innovation and investment through innovative activities in selected domains, which often overlap with the domains covered by the BBE. The Bavaria cluster particularly aims to contribute to the Europe 2020 ambitions of 350.000 new jobs, 140.000 start-ups and 15.000 new products on the market. For Bavaria, the introduction of the EU smart specialization was not new but rather a confirmation of the implemented instruments as the cluster was already set-up in 2006. The integration in the EU SMART specialisation framework has been helpful to get better access to EU funds.

As to the Piemonte this Bioeconomy, which was launched in 2018 as a direct follow-up of the EU SMART specialisation policy and facilitation of funding sources. This Technological Platform is funded through European Regional Development Fund (ERDF) and supports the implementation of the Regional Smart Specialisation Strategy (RIS3). Piemonte Bioeconomy Technology Platform specifically targets the promotion of large and strategic R&D projects within the S3 priority sectors of Green Chemistry/Clean Tech and Agrifood, focusing on their connection in the framework of a circular economy approach. This Regional Smart Specialisation Strategy is a precondition to access the ERDF and is therefore part of the European Cohesion Policy (Period 2014-2020).

The Danish Act on the Carbon Dioxide Tax on Certain Energy Products within the framework of the 2003 European Union (EU) Energy Tax Directive, which sets minimum rates for the taxation of energy products in EU member states. Furthermore, the CO_2 and energy taxing systems in Denmark have been integrated with the **EU ETS** so that industries do not pay double carbon taxes (or receive a full refund). Now it is also instrumental in reaching the CO_2 mitigation targets and the targets for shares of renewable energy in consumption in the RED II. However, the CO_2 taxation system was originally not set-up as an instrument following up EU policy. The predecessor of the current carbon Tax systems was introduced in 1977, as a fossil fuel (oil products, coal and electricity consumption) tax as a response to the oil crisis in the 1970s. Denmark was one of the first and still is one of the leading countries in implementing CO_2 taxation on energy. At this moment (as at 1 July 2018), the main tax on CO_2 in Denmark is arranged through the Carbon Tax (*CO2-afgift*). As from 2013, Danish government decided on alterations to bring it in line with the EU CO_2 taxation and effort sharing frameworks. The carbon tax on the

business sector was removed and an alternative payment of energy taxes on the EU minimum level was came instead. Now, the business sector only pays a CO_2 tax on energy for room heating and cooling. The household sector continues to pay a CO_2 tax on energy consumption. This carbon tax removal in certain industries of course has to do with the fact that Denmark also participates in the EU emissions trading system (ETS). Facilities that are covered by the ETS (power and energy intensive industries) do not pay the carbon tax (or receive a full refund). Heat inputs into district heating plants are, however, subject to the CO_2 tax, irrespective of whether they are also covered by the EU ETS.

The Andalusian regulation on the use of biomass from forests for energy is also embedded in wider EU policy. It should help Spain and the region of Andalusia, to reach the goals of the first (RED) and Revised Renewable Energy Directive (RED II) related to reaching renewable energy targets and now it has also become instrumental in following up the stricter sustainability criteria for biomass use in energy as specified in the RED II.

6.4 Impact and evaluation practices of good example policies

All of the good example policies were evaluated in terms of impact and/or money spent, with the exception of the Andalusian forest biomass use directive for which a systematic monitoring or evaluation was not published (or we could not find it). In Table 6.3 a summary is given of what was published on the impacts and outcome of evaluation and moitoring of the instruments.

Table 6.3 Good example policies and impact and evaluation

No. of fact-sheet (Annex I)	Title	Impact, evaluation & monitoring
2 & 3	Austrian landfill tax, known as the 'Altlastensanierungsbeitrag' ('ALSAG') Abfallvermeidungsprogramm - Waste Prevention Programmes	A lot of monitoring has been done which resulted in following observations: ALSAG: • 99 contaminated sites were cleaned up (1991-2000) • GHG emissions from landfill were reduced by 80% (between 1990-2004) • the share of waste sent untreated to landfills fell from 28.5 per cent in 1999 to 7.7 per cent in 2004 • Total revenues from the tax for the period 1990-2014 were around EUR 1.229 billion Waste prevention programme – waste advisors network: • Since they were first created (in 1986) the network contributed to raising separate collection rates (in some regions it raised from 0% to over 70 %), saving costs and generating new follow-up jobs
6	Pay As You Throw (PAYT) scheme Dutch municipalities	• Evaluation among 126 Dutch municipalities (1998-2000) Dijkgraaf (2004) showed overall large reductions in waste according to different PAYT schemes. The effects of the bag-based and weight-based systems are the most effective and in the same range as reduction in waste was 36%-38%. Compostable waste diminishes by 36%- 60%. Unsorted waste reduced by around 50%. • Schemes based only on frequency of collection or on volume of collection have lower effect with reduced total waste levels of -21% and -6% respectively So choice of container size are the least effective. Recycling rates are the highest for the sack-based scheme, but this is partly explained by the increase in the amount of waste available for recycling.

No. of fact-sheet (Annex I)	Title	Impact, evaluation & monitoring
		• The administrative cost of the bag-based pricing system, which is also the most effective, is the lowest as compared to the weight-, frequency and volume-based systems. However, only a part of the cost of waste management can be covered by PAYT schemes. Furthermore, the revenues raised are variable and in principle even declining as the objective is to bring waste generation down.
13	Cluster Initiative Bavaria	• Since 2006 the government has invested 63 million euro in the cluster initiative. Furthermore, more than 248 million euro federal funds were acquired and this was added with over 39 million euro of EU funding. • By April 2017, over 10,000 events were organized, in which 562,000 participants took part. • 1,500 projects were initiated and 9,900 participants collaborated in these projects. • The clusters have proven to be effective in national cluster competitions and have received Bronze, Silver or Gold Label of the European Cluster Excellence initiative.
61	Stimulation of Sustainable Energy Production - Stimulering Duurzame Energieproductie (SDE+)	• Between 2011 and 2018 SDE+ realized 5,824 MW of new installed energy capacity (incl 3,185 MW for electricity) • Review showed that without it most capacity could not have been installed. • FIP rates used for compensation of producers are broadly in line with market values, with around 5-15% free ridersl, which is low compared to the rate in other EU countries for FIP schemes • Between 2011-2016 the realised share was largest in bioenergy and between 2017-2019 this share decline and solar energy became most dominant. • The realization and utilisation rate of projects under SDE+ was low: around 20-25% of the SDE+ budget has not been utilised per year
22	Ordinance on the Generation of Electricity from Biomass (Biomass Ordinance - BiomasseV)	Evaluating the effectiveness of this Ordinanceis difficult, as it is part of a wider package of policy instruments. Overall one can conclude that German support to renewable energy had large effect and created a biogas plant boom in the last two decades. Biogas installations rose from 1,050 in 2000 to 8,856 (with an installed capacity of 4,018 MW) in 2015. This 2017 revision is aimed to support the reaching of the much more ambitious 2050 targets for decrease in gross final energy consumption for the significant GHG emission reduction.
40	Act on the Carbon Dioxide Tax on Certain Energy Products	• In period 1996-2013 it reduced the CO_2 emissions by 4.6 % (1.8 % reduction from the energy efficiency agreements and investment grants) • Macro-economic negative effects of the carbon taxation were extremely limited. The impact on GDP and employment was positive • The carbon taxation (and the Emission Trading System) are the main reasons for the energy efficiency development in the Danish industrial sector • From 1990 to 2010 primary energy intensity declined by 26% and CO_2 emissions were reduced by 25% per produced unit from 1993 to 2000. This can not only be attributed to the carbon taxes
41	Regulation on the use of biomass from forest for energy (Orden 29/12/2011)	No systematic evaluation of the impacts has been published. In general terms in was seen that: • bioelectricity production in Andaluscia increased between 2010 and 2019 from 210 MW to 274 MW. The main biomass sources are secondary residues from the olive oil industry and also wood from dedicated forest biomass production, particularly eucalyptus.

No. of fact-sheet (Annex I)	Title	Impact, evaluation & monitoring
		• The heat production based on biomass has also increased since 2010 to 1,776 MW per year in 2019. Wood biomass is the most important source used.
42	Regulation of the use of residual biomass from olive oil industries (D 4/2011)	• In Andalusia in 2016/2017 114 effluent management plans were approved, covered 14,207 hectares. At the end on only 2,468 hectares the effluents were applied. • In a national study on olive oil residuals it was concluded that 96% of the effluents produced in the spanish mills are also reused in or outside the mills, volumes of these residues have increased considerably in recent years and no general adverse impacts are expected on human health and environment given the way it is regulated by local ordinances like the one in Andalusia
56	Biomethane Decree Italy	Only recently implemented so too early for evaluating the results. The scheme has an indicative budget of €4.7 billion. It started in 2018 and will run until the end 2022.
58	Bioeconomy Technological Platform (Smart Specialisation Strategy) Piemonte	The impact between 2018 and spring 2019 is : - 9 projects approved (out of 11 submitted) - 2/3 of approved projects (6 out of 9) focused on Circular Economy - 46,6m€ total value of approved CE projects (out of 66m€) - 20,2m€ ERDF contribution granted to CE projects (out of 29,2 m€) - 112 partners involved in approved CE projects: 87 companies (both large, leading companies and SMEs), 33 Research Organizations

As to the Austria landfill tax and waste prevention programme much monitoring was done and this information was also published. Both Austrian measures have been extremely effective (see Table 6.3). Total revenues from the tax for the period 1990-2014 were around EUR 1.229 billion. In the beginning of the implementation of the Landfill tax programme so much money was raised that 99 landfill sites could be cleaned up between 1991 and 2000. Furthermore, improved technologies could be introduced for managing landfill sites which lowered their adverse environmental impacts, including reducing greenhouse gas emissions from landfills by over 80% from 1990 to 2014. The introduced the TOC ban (TOC=total organic carbon), that was part of the ALSAG Ordinance made the share of waste sent untreated to landfills to fall from 28.5 per cent in 1999 to 7.7 per cent in 2004. The development of the waste advisors network through the waste prevention program has also had very positive results. Since the creation of the nework (in 1986) separate collection rates increased strongly in most regions; in some regions an increase from around zero to over 70 % was seen and this saved costs seriously and also generated new follow-up jobs.

As to the Dutch Feed-in Premium system SDE+ monitoring and evaluation of the programme was done very carefully. It showed that between 2011-2016 the realised share was largest in bioenergy and between 2017-2019 this share declined, and solar energy became most dominant. Up to January 2018 the SDE+ has realized approximately 5,823.6 MW of new installed energy capacity, including 3,185.2 MW for electricity. For this capacity a study of financial data and investment plans of individual projects under SDE+ concluded that the rates used for compensation of producers are broadly in line with market values and that they minimised the number of free riders to around 5-15%. This is considered low compared to the rate of free riders related to energy policies in other EU countries.

At the same time the study also concluded that around 20-25% of the SDE+ budget has not been utilised per year. Administrative costs of managing the scheme were seen as reasonable in comparison with the amount in EUR of subsidies provided.

The Bavarian cluster initiative that exists since 2006 has been very successfull in setting up projects and organising funding. Furthermore, the quality of the clusters that were setup was high which is proven by the numerous rewards of Bronze, Silver or Gold Labels of the European Cluster Excellence initiative. Since 2006 a total of 450 million Euro has been spent in the clusters from the Bavarian government, federal funds and EU funding. Until April 2017 1,500 projects were initiated and 9,900 participants collaborated in these projects; the number of events organised amounted to over 10,000 in which 562,000 participants took part.

As to the other SMART specialisation initiative of the Technology Platform in Piemonte which is from a more recent data as it was only launched in 2018 the evaluation results only cover a short period. But up to the spring of 2019; in total 9 projects were approved, of which 6 focused on Circular Economy. 112 partners were involved in the approved projects which consisted of 87 companies (both large, leading companies and SMEs) and 33 Research Organizations. As to the related budget € 46,6 million was approved of the total €66 million EU budget alocated to the cluster. In addition, €20,2 million was allocated from the total granted ERDF contribution of €29,2 million.

The PAYT schemes are generally well evaluated as these systems exist already for a long time. The evaluation among 126 Dutch municipalities (1998-2000) by Dijkgraaf (2004) showed large reductions in waste but the effectiveness of the schemes was very different. The effects of the bag-based and weight-based system are most effective and in the same range as reduction in waste was 36%-38%. Compostable waste diminishes by 36%- 60%. Unsorted waste reduced by around 50%. While the effect of the system based on frequency or volume of collection reduced the amount in total collected waste only by 21% and 6% respectively. Furthermore, recycling rates are also the highest for the sack-based scheme as in this scheme the amount of waste available for recycling increases, while compostable waste declines because of strong increases in home composting. Overall, it is also clear that given the strong reduction in mixed waste and the increase in waste in assorted fractions that is fit to be recycled, PAYT schemes are very effective instruments needed to reach lower landfill levels. Finally, as to the economic effects of PAYT schemes, it was shown that only a part of the cost of waste management can be covered and that the revenues raised are variable and in principle even declining as the objective is to bring waste generation down. So, revenues need to be supplemented by charges raised from fixed rate fees for the whole waste management.

It is difficult to evaluate the effectiveness of the German Ordinance BiomassaV regulating the generation of electricity from biomass since 2017, as it is part of a wider package of policy instruments. Overall however, one can conclude that the whole bioenergy package of regulations and support systems for renewable electricity created a stable support basis which was enhancing the technological, environmental and economical developments in the sector in time. It led to a German biogas plant boom in the last two decades which was larger then in any other country. The number of biogas installations rose from 1,050 in 2000 to 8,856 (with an installed capacity of 4,018 MW) in 2015. This 2017 revision is aimed to support the reaching of the much more ambitious 2030 and 2050 targets for decrease in

gross final energy consumption and for the significant GHG emission reduction with lower ILUC effects then before.

The other Good example policy affecting strongly the biogas sector development is the Italian Biomethane Decree. Unfortunately, there are no monitoring or evaluation results for this programme as it only started in 2018 and evaluation will be done by 2022 which is the end of the programme. The scheme has an indicative budget of €4.7 billion so the impact is expected to be quite considerable on the facilitation of biomethane production and distribution systems and the boost it can give to bringing advanced biofuels to the market in Italy.

Evaluations of the Danish Carbon tax system come from two studies. The first by Green Budget Europe (2015) and two inter departmental evaluations over the period 1998-2013 concluded that CO_2 emissions reductions were in line with ex-ante evaluations and amounted to 4.6 % of which 1.8 % reduction came from the energy efficiency agreements and investment grants. This decline in GHG emissions was also confirmed by the OECD (2018) study that concluded that primary energy intensity declined by 26% from 1990 to 2010 and CO_2 emissions were reduced by 25% per produced unit energy from 1993 to 2000. As for the latter, it is not clear to what degree this can be attributed to the carbon taxes only as there were also other energy taxes in place. The Green Budget Europe (2015) claims however that since the business sector until recently have had the energy taxes fully reimbursed, the carbon taxation and the Emission Trading System are the main reasons for the energy efficiency development in the Danish industrial sector. As to economic effects, the two inter departmental evaluations showed that macro-economic negative effects of the carbon taxation were extremely limited. The OECD study also showed the impact on GDP and employment was generally positive.

For the 2 Andalusian good policy examples evaluation and monitoring is available for the olive effluent use ordinance but not for the Ordinance on biomass use for energy from forests. As for the latter no systematic evaluation of the impacts has been published (or detected by us). But in general terms in was seen that there was and increase in bioelectricity production in Andaluscia between 2010 and 2019 from 210 MW to 274 MW. The main biomass sources used are secondary residues from the olive oil industry and also wood from dedicated forest biomass production, particularly eucalyptus. The heat production based on biomass has also increased since 2010 to 1776 MW per year in 2019. Wood biomass is the most important source used.

For the evaluation of the effects of the ordinance on olive effluent use as fertiliser data for 2016/2017 were published. In this period a total of 114 effluent management plans were approved in Andalusia which covered 14,207 hectares. At the end on only 2,468 hectares the effluents were applied. In a national study on olive oil residuals with the purpose to validate whether these residuals can be declared by-products instead of waste, which is crucial for their lawfull application in line with the EU waste Directive (2008) the following was concluded: 96% of the effluents produced in the spanish mills are also reused in or outside the mills. It was also concluded that the volumes of this production residue have increased considerably in recent years. The report concludes that although the production is large and increasing the olive oil industry can manage the processing of the residue, including for fertilisation use. With respect to the protection of human health and the protection of the environment, it is concluded that no general adverse impacts are expected given the way it is regulated by local

ordinances like the one in Andalusia. Within Spain, beside Andalucía, the autonomic regions of Cataluña (since 2015) and Valencia (since 2018) have regulated the use of effluents from the olive oil mills as fertilisers on land.

6.5 Why can these policies be seen as good example policies

In the Table 6.4 an overview is given of the main argument why these policies can be seen as good examples. The arguments are not claimed to be exhaustive. There are likely be more arguments in favour of the policies and also showing the negative aspects. Here we concentrate on the positive aspects. In the next section we will also pay attention to challenges encountere in developing and implementing the 10 policy examples.

Table 6.4 Arguments for good characterisation as good example policies

No. of fact-sheet (Annex I)	Title	What makes these policies good examples
2 & 3	Austrian landfill tax, known as the 'Altlastensanierungsbeitrag' ('ALSAG') Abfallvermeidungsprogramm - Waste Prevention Programmes	Austria's waste management is among the top performers because several policy instruments are combined that both address the waste generation, prevention and separation behaviour of the waste producing sectors (households and economic sector) and the waste processing sector. • The municipal waste landfilling rate is very low (2%) compared to the EU average that amounts to 24%. • Austria is the only Member State where the revenue from the landfill tax (around EUR 1.2 billion in total up to 2014) is used exclusively to clean up contaminated sites. • The municipal waste recycling rate (58 %, of which 32 % is composting) was well above the EU level in 2017. • Austria has already met the EU 2020 recycling target for municipal waste and is also in front of most countries in the transition to more circularity
6	Pay As You Throw (PAYT) scheme Dutch municipalities	• PAYT schemes are clearly effective in bringing down the total amount of household waste, particularly of the unseparated fraction which is also the most environmentally unfriendly waste stream • PAYT schemes experience and effectiveness has been proven and are now also widely implemented in EU countries • The effectiveness of the different type of PAYT schemes is clearly understood and there is flexibility in adapting the type of PAYT scheme to local circumstances. • PAYT schemes are a very suitable instrument to fulfill the EU waste directive requirement of the polluter pays principle and the extended producer responsibility • PAYT schemes can make policies to avoid and decline landfilling much more effective. • PAYT schemes are a key instrument in the transition to a more circular economy
13	Cluster Initiative Bavaria	• It has already been proven in the Bavarian case how effective it has been in boosting the bioeconomy through the tremendous increase in clusters and collaboration projects in innovation and knowledge development. • The high quality of the clusters set-up in Bavaria was confirmed by the several received Bronze, Silver or Gold Label of the European Cluster Excellence initiative.

No. of fact-sheet (Annex I)	Title	What makes these policies good examples
		• The instrument also supports the marketing and branding of a region, therefore attracting new companies to the regions and setting up international collaborations. • This instrument plays an important role to drive regions to more mature bio-based development stages, create additional income and employment opportunities in innovate sectors of the bioeconomy.
61	Stimulation of Sustainable Energy Production - Stimulering Duurzame Energieproductie (SDE+)	• The goal of the SDE+ is to increase renewable energy generation at the lowest possible cost. • First technology neutral subsidy scheme in Europe and is open for renewable electricity, renewable gas and renewable heat or a combination thereof. Eligible technologies are biomass, geothermal, hydro, solar photovoltaics, solar thermal, and onshore wind energy, which all compete for the same budget. • Gives opportunity to develop a competitive renewable energy sector which focuses on real market aspects (cost efficiency, sale of energy at the time interval of higher prices) while in the same time optimises expenditures of the government by supporting the most cost effective solutions.
22	Ordinance on the Generation of Electricity from Biomass (Biomass Ordinance - BiomasseV)	• Positive already that biomass use in bioelectricity is regulated. Many countries in lower bioeconomy development stage have no such ordinance, which makes their development more difficult and less sustainable. • Helps to avoid conflicts between bioenergy generation and food security and biodiversity by classifying energy crops (such as maize and sugar beets) in the group of substances with lower tariff thereby stimulating the processing of non-food substances. • The policy package in Germany (not only this BiomasseV) is a good example of how regulation can evolve in time from overall wide support to bioenergy production without putting very strict requirements on efficiency and type of biomass use, toward (since 2017) more strict requirements for energy efficiency and higher feed-inn premium support for the bioelectricity and heat produced from more sustainable biomass types, particularly those with no or low ILUC impacts.
40	Act on the Carbon Dioxide Tax on Certain Energy Products	• In the first place the carbon taxation turned out to indeed deliver to the objective of reducing GHG emissions and it did not hamper economic growth • High benefits have been created with relatively low car-bon tax cost. • The effect is also large because the tax covers many sectors ranging from of natural gas, coal, electricity and light and heavy fuel oil. • The policy was evaluated well and adjustments were made to the policy to integrate it with new EU policy developments such as the EU ETS and with market developments and energy taxing systems. • Carbon tax revenues were not for the government budget but instead 40% of this tax revenue was used for environmental subsidies and 60% was returned to industry. These returned taxes were used to invest in for example industrial restructuring. • The Danish government also offers 25% reduction of the tax to the companies that sign an energy savings agreement with the Ministry of Transportation and Energy. So, it keeps on encouraging companies to further increase energy savings and reduce GHG emissions.
41	Regulation on the use of biomass from forest for energy (Orden 29/12/2011)	• Positive already that forest biomass use in is regulated. Many countries in lower bioeconomy development stage have no such ordinance, which makes their development more difficult and less sustainable. • It provides clear guidance on which forest biomass can be used for energy production. This stimulates the use of forest biomass and is also

No. of fact-sheet (Annex I)	Title	What makes these policies good examples
		providing some guidance on the sustainable production of biomass in forests planted for bioenergy. • The regulation also wood harvested from forests to maintain fire breaks. This instrument is therefore not only focused on enhancing the residual woody biomass supply for energy, but particularly linking biomass provisioning with landscape fire risk reduction.
42	Regulation of the use of residual biomass from olive oil industries (D 4/2011)	• It is good that the use of olive oil mills effluents are regulated in a way that they can be declared by-products according to the EU Waste Law. This is not the case in all Mediteranean regions. • This legal arrangement supports the more circular use of these olive oil residues and supports both the environmental and economic sustainability of the olive oil sector. • In countries and regions where this is not arranged, the options to create a more circular olive oil production system are more limited.
56	Biomethane Decree Italy	• Connects to the EU level goals and policies (REDII), creating opportunities for economic sectors to step into biomethane market. • The instrument helps the country to reach the EU level biofuel and environmental protection quotas and at the same time helps bio-based technologies to be more competitive and attractive on the market. • The clear specification on what is to be considered biomass for advanced fuel generation also stimulates introduction of double-counting fuels in the biomethane supply. • It stimulates the construction of new filling station for bio-CNG or bio-oLNG, which is a key aspect in the spreading of biomethane based transportation, because without enough specific filling stations the vehicle owners can't even think about that kind of transportation.
58	Bioeconomy Technological Platform (Smart Specialisation Strategy) Piemonte	• This instrument is a good policy example because the new explorative collaboration projects between research and industry may result in new products and technologies that can be sold on the bio-based market. • The technology platforms are the arena where experimentation for new products and technologies take place, resulting in improved level of technological readiness. • The platforms are the motors to bioeconomy development and play a major role in improving regional competitiveness and creating new jobs.

As for waste management Austria is among the top performers and this is likely related to the early start that was made in managing waste, well before EU waste policy regulations were established. Another important reason is that several policy instruments are combined that both address the waste generation, prevention and separation behaviour of the wastep roducing sectors (households and economic sector) and the waste processing sector. That Austria is among the top performars and that confirm the strength of the policy instruments presented here is that the municipal waste landfilling rate is very low (2%) compared to the EU average that amounts to 24%. Austria is the only Member State where the revenue from the landfill tax (around EUR 1.2 billion in total up to 2014) is used exclusively to clean up contaminated sites. The municipal waste recycling rate (57.7 %, of which 32 % is composting) was well above the EU level in 2017. Because of all these factors Austria has already met the EU 2020 recycling target for municipal waste and is also well in front of all countries introducing measures to transition from a linear to a more circular economy.

The PAYT schemes, which may be combined with measures as taken in Austria are also typical examples of policies that have been proved very effective in bringing down the total amount of

household waste, particularly of the unseparated fraction which is also the most environmentally unfriendly waste stream. PAYT schemes need to be among the core instruments to reach larger circularity in the economy of every country.

PAYT schemes are a very suitable instrument to fulfill the EU waste directive requirement of the polluter pays principle and the extended producer responsibility to which all EU countries and regions have commited. In addition PAYT schemes can make policies to avoid and decline landfilling, which is obligatory in all EU countries according to the EU landfill Directive, much more effective. Long term evaluated experiences already exists with PAYT schemes and are therefore good instruments to be widely implemented in EU countries. Furthermore, the schems can be implemented at local level and there is enough flexibility possible to adapt the type of PAYT scheme to local circumstances. The last strength to mention is that if PAYT schemes are well introduced and monitored they can lead to higher and increasing effectiveness on waste decline and waste seperation levels. It is however more of a challenge to also make PYT schemes fully cost-effective. The better the household performs inreducing and separating its waste, the less it will pay. So the more effective the scheme the lower the returns received.

As to the two SMART specialisation policy instruments in Bavaria and Piemonte these are good policy examples because they have both proven to be very effective in attracting several new innovative bio-economy activities and collaborations in the form of PPPs. The Bavarian example has already proved it's long term effectiveness by the number of projects, collaborations and the amount of money attracted, but also the quality of the projects has been confirmed already by the several received Bronze, Silver or Gold Label of the European Cluster Excellence initiative. In the case of the Piemonte technology platform the effectiveness is also already proven, even if it was only recently launched. There is already good prove from EU evaluation that the platforms are in fact the motors to bioeconomy development and play a major role in improving regional competitiveness and creating new jobs. •The technology platforms are the arena where experimentation for new products and technologies take place, resulting in improved level of technological readiness.

As to the Dutch SDE+ FIP system for renewable energy there are several arguments why it can be seen as a good example policy. The goal of the SDE+ is to increase renewable energy generation at the lowest possible cost. To this end it was introduced as the first technology neutral subsidy scheme in Europe and is open for renewable electricity, renewable gas and renewable heat or a combination thereof. Eligible technologies are biomass, geothermal, hydro, solar photovoltaics, solar thermal, and onshore wind energy, which all compete for the same budget. This system gives opportunity to develop a competitive renewable energy sector which focuses on real market aspects (cost efficiency, sale of energy at the time interval of higher prices) while in the same time optimises expenditures of the government by supporting the most cost-effective solutions.

The ordinance Biomasse V in Germany is a good example already purely because of its existence. The ordinance regulated biomass use in electricity and aims at regulating the take up of higher efficient use of the biomass in terms of energy, GHG efficiency and land use (avoidance of ILUC). Many countries in lower bioeconomy development stage have no such ordinance, which makes their development harder, slow, uncertain and if there is development of bioelectricity this may be less sustainable then what is happening in Germany. Without appropriate, stable and long term focused policies the biomass based electricity production sector can't develop, because private sectors do not invest in uncertain

fields. Thereby a similar ordinance would gain the biomass based energy sector regulative and economic stability as well. This instrument also helps food security and biodiversity by classifying energy crops (such as maize and sugar beets) in the group of substances with lower tariff thereby stimulating the processing of non-food substances. Finally, this instrument shows how regulation has shifted from overall wide support to bioenergy production without putting very strict requirements on efficiency and type of biomass use, toward (since 2017) more strict requirements for energy efficiency and higher feed-in premium support for the bioelectricity and heat produced from more sustainable biomass types, particularly those with no or low ILUC impacts.

The last good example instrument focussed on renewble energy, the biomethane decree in Italy is a good example policy for several reasons. It connects to the EU level goals and policies, thereby from the regulatory side it can be implemented easier in the other EU member states. The instrument helps the country to reach the EU level biofuel and environmental protection quotas and at the same time helps bio-based technologies to be more competitive and attractive on the market. The clear specification on what is to be considered biomass for advanced fuel generation also stimulates introduction of double-counting fuels in the biomethane supply. It also stimulates the construction of new filling station for bio-CNG or bioLNG, which is a key aspect in the spreading of biomethane based transportation, because without enough specific filling stations the vehicle owners can't even think about that kind of transportation.

There are several reasons why the Danish Carbon taxation programme is a good example policy instrument. In the first place the carbon taxation turned out to indeed deliver to the objective of reducing GHG emissions and it did not hamper economic growth as was also seen in all Nordic countries where this instrument exist. In the specific Danish situation, it delivered declines in GHG emissions. Household carbon emission levels were reduced by 25% and industrial carbon emissions dropped by 23% between 1990 and 2005. High benefits have been created with relatively low carbon tax cost. The effect is also large because the tax covers many sectors ranging from of natural gas, coal, electricity and light and heavy fuel oil. A second reason to call this a good policy example is because the policy was evaluated well and adjustments were made to the policy to integrate it with new EU policy developments such as the EU ETS and with market developments and energy taxing systems. So for example to keep the efficient tax rate, the government decreased energy tax level when carbon tax was established. But, it was increased in 2005 as carbon tax was decreased. A third reason is, that the carbon tax revenues were not for the government budget but instead 40% of this tax revenue was used for environmental subsidies and 60% was returned to industry. These returned taxes were used to invest in for example industrial restructuring. The Danish government also offers 25% reduction of the tax to the companies that sign an energy savings agreement with the Ministry of Transportation and Energy. So, the positive aspect of this policy is that it is dynamic and that it keeps on encouraging companies to further increase energy savings and reduce GHG emissions.

The two Andalusian examples are already good policy examples because they regulate important activities that facilitate the bioeconomy development and the circular use of residues which in many other countries and regions are not regulated at all and therefore lead to uncertainty. As for the regulation of forest biomass use for energy one can conclude that it is generally not common that the use of forest biomass is regulated by regions. However, some EU countries like Belgium, Finland, and the Netherlands have prohibited the use of certain biomass feedstocks for bioenergy. Belgium and Hungary aim to ensure that the use for energy is the last step in the use hierarchy of biomass feedstocks.

This is being referred to as the 'cascading principle' and is derived from EU's Waste Framework Directive (Directive, 2008/98/EC) in which it is referred to as the ' waste hierarchy'..

The UK has introduced specific sustainable land use criteria such as no harvest of wood from carbon rich forests or from high biodiverse forests is allowed for energy use. Sourcing woody biomass from forests for energy requires certification when (for both home produced and imported biomass).

The Andalusian regulation is quite unique because it provides clear guidance on which domestic forest biomass can be used for energy production and also regulates the production of energy wood in dedicated forests. This stimulates the use of forest biomass and is also providing some guidance on the sustainable production of biomass in forests planted especially for providing biomass for energy. The regulation also specifies that primary residues from forest can be used for energy generation and the same applies to wood harvested from forests to maintain fire breaks. This instrument is therefore not only focused on enhancing the residual woody biomass supply for energy, but particularly links biomass provisioning with landscape fire risk reduction which is particularly relevant in Europe where forest firerisk is increasing every where where the lands are under influence of climate change and other factors, e.g. land abandonment.

Also, for the use as fertiliser of olive effluent it is generally not common in all Mediterranean countries to regulate it in a way that they can be declared by-products according to the EU Waste Law. This legal arrangement supports the more circular use of these olive oil residues and supports both the environmental and economic sustainability of the olive oil sector. In countries and regions where this is not arranged, the options to create a more circular olive oil production system are more limited. Olive oil waste regulations exist in Italy, Greece, Spain, Cyprus and Portugal. Specification of these regulations are, however different and not necessary up to date with the EU waste directive hampering the more sustainable and circular application.

6.6 Replicability of the good example policies

Not all selected good example policies can be implemented in all member countries. The replicability of a policy in different regions mainly depends on three factors:

- Is the particular policy based on EU level policies?
- Can the particluar policy be implemented at the current BBE development stage of the region?
- Is the policy targeting BBE system processes which are relevant for the region?

If the particular policy refers to an EU level policy than probably all member states have similar legislative environment in the affected fields, which make repiblicability much more feasible. The link between the selected good example policies and EU policies and legislations is described in Chapter 6.3.

The mayority of these policies could be implemented in all member states, but some policies require a higher level of knowledge and experience on the affected bioeconomy related fields. For example, to support cooperation between companies and research institutes in a particular field by cluster initiative there has to be a minimum number of companies and research intitutes in the region on that

field. Also some policies should not be replicated in countries with high BBE development stage, because these countries have their own policies which were developed focusing on their own particular state and market by their own experiences from the last years or decades. For example, Denmark should not implement Italy's Biomethane Decree, since Denmark in the last couple of years developed a well-functioning system which uses biomethane in Combined Heat and Power (CHP) units instead of using it in transport sector.

Some policies are targeting unique fields and thereby they could be interesting only for a few regions. For example, Andalusian Regulation of the use of residual biomass from olive oil industries can be interesting only in those countries which have considerable olive oil industries.

Similar policies have been founded in different countries, some examples can be found in Table 6.5.

Table 6.5 Good example policies, their BBE development stage and some examples for similar policies from other countries

No. of fact-sheet (Annex I & Annex III)	Title	Similar policies described in other regions/countries	Recommended BBE development stage
2 & 3	Austrian landfill tax, known as the 'Altlastensanierungsbeitrag' ('ALSAG') Abfallvermei-dungspro-gramm - Waste Prevention Programmes	24 other countries have a landfill tax instrument Examples of appointment of waste advisors also exist in Germany, UK and Belgium.	All (Low, medium, high)
6	Pay As You Throw (PAYT) scheme Dutch minucipalities	Many PAYT systems exist nowadays in EU countries. Longer term experiences discussed here are from Belgium, and Luxembourg	All
13	Cluster Initiative Bavaria	There are many smart specialisation cluster initiatives in EU such as Bio-based Delta in the Netherlands, BioVale in the UK, IAR in France.	Medium-high
61	Stimulation of Sustainable Energy Production - Stimulering Duurzame Energieproductie (SDE+)	Feed-in tariff systems exist in almost every EU country. The other example in the long list and discussed in from Germany and Hungary.	Low-medium
22	Ordinance on the Generation of Electricity from Biomass (Biomass Ordinance - BiomasseV)	Countries with high BBE development level have similar policies e.g. Italy and Denmark.	Medium

No. of fact-sheet (Annex I & Annex III)	Title	Similar policies described in other regions/countries	Recommended BBE development stage
40	Act on the Carbon Dioxide Tax on Certain Energy Products	Several other EU countries introduced carbon taxes of variable values e.g. Finland, Sweden, Latvia, Slovenia, Estonia, Croatia, Ireland, France and Portugal.	All
41	Regulation on the use of biomass from forest for energy (Orden 29/12/2011)	Similar policy can be found in Wallonia, Belgium.	All
42	Regulation of the use of residual biomass from olive oil industries (D 4/2011)	Within Spain, beside Andalusia, the autonomic regions of Cataluña (since 2015) and Valencia (since 2018) have regulated the use of effluents from the olive oil mills as fertilisers on land.	Low-medium
56	Biomethane Decree	In Denmark the economic and political environment focuses on the use of biomethane in Combined Heat and Power (CHP) units	Medium
58	Bioeconomy Technological Platfrom (Smart Specialisaton Strategy)	For instance the Polish Technology Platform of bioeconomy or Bio-based Circular Business Platform in the Netherlands or SAS PIVERT in France.	Medium-high

6.7 Typical barriers and solutions encountered when implementing the good example policies

In the review of the 10 policy examples we also tried to identify the typical barriers and (related)solutions followed in the development and implementation of these policies. Several of the barriers and solutions were recognizable and already discussed in chapter 4, but it also delivered new additional views on barriers and opportunities ncountered in bioeconomy policy instruments. An overview of the encountered barrirs and opportunities is given in Table 6.6 per good policy example.

6.7.1 Barriers

Not surprisingly, the collaboration challenges were typically encountered in the two SMART specialisation examples in Piemonte and Bavaria. The barriers indicated here are typical for SMART specialisation clusters in general and these were reviewed specifically in the BERST project already. They

showed that these communication problems are particularly a challenge in the initial stage of a cluster and involve:

- Lack of central management at the initial stage that affect efficient communication and transfer of knowledge
- Communicating the importance of clusters and innovation to policy makers remains a challenge, especially when it is initiated by the academic sector.
- Lacking active participation by entrepreneurs in cluster activities due to strong focus on big industrial actors for energy and fuels. Initial interaction with entrepreneurs may be time consuming and required effort to communicate benefits of bio-based innovations.

In the case of the Piemonte Technology platform this was also confirmed. It turned out to be difficult to engage farmers and forestry sector as well as SMEs in the R&D projects. These companies do not have the operational, financial, technical and planning capacity to carry-on projects with a mid/long-term vision. They need to see a benefit on the short term but bioeconomy technologies are often not mature yet on a short term. This has also hampered the technology exchange and intake by SMEs and the production sector.

Difficulties to access finances for the implementation of the policies was also a barriers encountered especially in the Smart specialisation clusters. In Piemonte a large part of the funding for the Bioeconomy Technological Platform is coming from ERDF, and due to different rules and procedures, the combination with EAFRD (that would have been useful in order to involve farmers) proven to be very difficult. Moreover, the different State Aids rules applicable to industrial and agricultural activities make it almost impossible to fund a complete regional value chain with a single fund.

On the other hand, in clusters the private funds can be difficult to secure too, particularly during the initial stage as the cross sector transfers, respective methods and products are not yet developed. This was also an issue in both SMART specialisation platforms.

The issue of secure funding has also been a challenge in the Dutch SDE+ programme and likely a reason for the low realization and utilisation rate of projects under SDE+ as around 20-25% of the SDE+ budget has not been utilised per year. Entrepreneurs had trouble securing funding of the often high risk renewble energy projects even with the SDE+ support secured. Furthermore, competition with low priced fossil based energy alternatives made it even more challenging.

Lack of training was encountered as a challenge in the Piemonte technology platform. This was particularly an issue among stakeholders from the agricultural and forestry sectors and from SMEs in R&D which do not have the operational, financial, technical and planning capacity to carry-on projects with a mid/long-term vision.

There were also several market barriers encountered in the good example policies. For example, in the technology platforms the commercialisation of innovations is always a challenge which increases the investment risks. There are several reasons for this:

- Private funds can be difficult to secure during the initial stage as the cross-sector transfers, respective methods and products are not yet developed and/or mature
- Commercialization of new bio-based products is a slow process which requires secure policy and financing conditions to minimize the investment risk

- Highly innovative products or components require long and consistent efforts for training, education and knowledge transfer to entrepreneurs prior to commercialization.

Table 6.6 Overview of barriers encountered in the 10 examples

	Barriers/	Dutch FIT SDE+	PAYT schemes	Austrian ALSAG' & Network of waste advisors	Danish Carbon Dioxide Tax on Certain Energy Products	Italian Biomethane Decree	German BiomasseV decree	Piemonte Bioeconomy Technological Platfrom	Andalusian regulation olive oil effluent use as fertiliser	Andalusian regulation on forest biomass use for energy	Cluster Initiative Bavaria
		Barriers									
Collaboration difficulties	Difficulties to engage value chain partners in R&D due to lack of capacities							X mainly SME's and farmers			X mainly entrepreneurs
	Difficulties due to no clear added value – communication difficulties							X			X
Difficulties to access finance	Administrative burden of EU funding programmes							X			
	Private funds difficult to secure in initial stage							X			X
	Lack of securing funding	X									
Lack of training framework and education	Lack of training framework and education										X

	Barriers/	Dutch FIT SDE+	PAYT schemes	Austrian AL-SAG' & Network of waste advisors	Danish Carbon Dioxide Tax on Certain Energy Products	Italian Biomethane Decree	German BiomasseV decree	Piemonte Bioeconomy Technological Platfrom	Andalusian regulation olive oil effluent use as fertiliser	Andalusian regulation on forest biomass use for energy	Cluster Initiative Bavaria
		Barriers									
market	Difficulties to commercialise due to investment risks							X			X
	Favouring specific technologies					X					
	Fossil fuel consumption subsidies	X						X			
Perverse policy effect	More illegal disposal of waste; travelling to other municipalities without PAYT		X								
	Inequality poor income households		X								
	Long lead time – to implement policy			X							
	Difficulties to establish waste pre-treatment installation due to costs			X							

The problem that certain technologies have a market advantage was encountered as a barrier particularly for the biomethane decree in the predecessor policy. It stimulated too many inefficient biogas installations for which the sustainability impacts were not that possitive and only produced for the bioelectricity market. In the new Decree of 2017 subsidies have therefore been decreased and have been extended from 15 to 20 years. This subsidy system favoures the smaller biogas plants and plants using more by-products or organic waste. It also prioritises subsidies to biogas installations producing biomethane which can be used in the transport sector in order to extend it particularly with advanced fuels one of the goals of the REDII.

A last issue in which the current market situation is a barrier was particularly encountered in the SDE+ and the Peimonte Technology platform and is related with low fossil energy prices. Many renewable energy initiatives and R&D initiatives in Piemonte could not reach a sufficiently cost-effective project design to get in financed. Lower priced fossil alternatives played a role, although not the only.

Perverse policy challenges were encountered in the PAYT schemes both in relation to illigal disposal in neighbouring regions where PAYT schemes did not apply and challenges to price waste in the case of low income households.

6.3.2 Opportunities

Difficult market competition is also typically encountered in policies to bring landfilling down. As long as landfilling at low costs is possible and allowed, it is difficult to establish the infrastructure for a waste pre-treatment. Also the landfill tax is a revenue raising mechanism. If it is introduced at a too high rate it will encounter a lot of opposition. So the challenge is to get the rates riight sothat it does not encounter significant opposition.

Furthermore, the implementation of major changes in landfill tax in short periods of time without prior announcement can be problematic in a sector which is characterised by long lead times. As such, the implementation should be phased over a period of years, depending upon the rate of tax already applied in the Member State concerned. Solutions to restructure the landfilling markets can also be the introduction of differentiated landfill tax rates for new and state of the art landfills and older, lower standard technology landfills is intended to address an imbalance between the costs associated with developing and operating the two types of landfill. However, if the tax differential for the two types of landfills is not substantial enough to offset the additional costs, it might be difficult for new sites to compete with old ones.

Landfill tax creates the opportunity to supplement different approaches of national strategies to divert Biodegradable Municipal Waste from landfills. The approach might be separate collection policy supported by additional measures such as compost ordinance regulating the quality of compost produced of waste or landfill ban, as was the case in Austria. Also the programme of waste advisors helped to improve waste separation at the source in Austria.

In order to ensure that landfill taxes generate movement of waste into upper tiers of the hierarchy, it is suggested that a tax is implemented on incineration. The landfill tax, together with the landfill ordinance encourages recycling and recovery of waste.

An important opportunity for almost all good policy examples was the presence of an EU regulation or stimulation framework. This EU framework provided a lot of guidance to set-up the policy instruments in the first place and/or to organise the instrument in such a way that it was instrumental to one of

the several requirements EU policies impose on MSs. The link between the EU policy frameworks and the 10 policy examples was already discussed in Section 6.3. Beside regulation the provision of financial support through regional and structural development funds have also been very stimulating for developing certain instruments, particularly the SMART specialisation platforms. The new REDII has certainly been very guiding in the organisation of the recent revisions in the renewable energy regulation and support systems in Germany, Italy and will be in the SDE++ system in the Netherlands which is expected to be introduced this year. In this new scheme the focus will be on reduction of CO_2 (instead of generation of renewable energy) and it will also allow CO_2 reducing industrial technologies to participate.

The role of political interest in bio-based development and reaching sustainability goals and/or new business opportunities, which can often be translated in several national and regional strategies can also be very supportive in the development of targetted policy instruments. This certainly played a role in the Dutch, German, Italian, Andalusian and Danish good policy examples.

As a last opportunity is should be mentioned that policy support instruments should leave enough room for competition between different technologies as this may accelerate technology development and results in lower market prices. This happened in the previous phase of the SDE+, when technologies were separated in terms of budgets, there was an aggressive lobby taking place of different parties to significantly increase the available budget under SDE+ for their specific technology. This has led to a change in design for the current SDE+, so that now all technologies are bundled in one budget plan. Technologies can compete among themselves for this budget, which leads to significant price reductions and thereby a more cost-effective policy. On the other hand, too tight support levels have also shown in the SDE+ programme under achieved as around 20-25% of the SDE+ budget has not been utilised per year. From this point of view, SDE+ was “too little too late” because the budget was increased too late, so that a significant part of new installations will only become operational around or after 2020.

Table 6.7 Overview of opportunities encountered in the 10 examples

Opportunities											
	Opportunities	**Dutch FIT SDE+**	**PAYT schemes**	**Austrian ALSAG' & Network of waste advisors**	**Danish Carbon Dioxide Tax on Certain Energy Products**	**Italian Biomethane Decree**	**German BiomasseV decree**	**Piemonte Bioeconomy Technological Platfrom**	**Andalusian regulation olive oil effluent use as fertiliser**	**Andalusian regulation on forest biomass use for energy**	**Cluster Initiative Bavaria**
Policy framework	EU policy framework in place	X				X	X	X	X	X	X
Information on bioeconomy	Political interest and commitment				X		X				X
	Research programmes available						X				X
	Increasing consumer demand						X				X
	Clear and focussed policy – resulting in achieving biofuel obligations	X			X	X					
Availability of funding	National & regional funding	X				X		X			X
	EU funding							X			x
Research and education	Competition among technologies has resulted in decreased market price	X									
	Differentiated landfill tax rates			X							

7 CONCLUSIONS AND RECOMMENDATIONS FOR TRANSFERABILITY OF GOOD EXAMPLE POLICIES

7.1 Introduction

The information developed and presented in this report directly supports the realisation of three main objectives of the POWER4BIO project.

Firstly, this report includes a lot of information on the SMART specialisation policies that were developed at EU level and regional level to set-up of Regional Bioeconomy Hubs. This report explains the key policy instruments at different levels, including finacial instrument and expriences with policy integration, implementation, barriers and opportunities encountered in general and in the existing clusters of Piemonte and Bavaria.

Secondly, this report can be used as a portfolio of support policies suitable for local deployment in EU regions. As such, we recommend al region partners in POWER4BIO to use this report as such. It can serve as inspiration on policy development and improvement for developing regional bio-economy strategies and roadmaps. In the recomendations presented in the third section of this chapter several suggestions are made that will support regions that have the ambition to develop a bioeconomy startegy and/or a SMART specialisation cluster.

Thridly, the information in this report serves as the main source for the POWER4BIO training programme to increase the capacity of regional and local authorities regarding policy development for bioeconomy regulation and stimulation.

7.2 Conclusions

The bioeconomy is a complex system, but the EU has given the Member States much guidance on how it is defined and how it should be developed. The bioeconomy in the 2012 and 2018 bioeconomy strategy is defined as the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy. It includes agriculture, forestry, fisheries, food, and pulp and paper production, as well as parts of chemical, biotechnological and energy industries.

Shifting from non-renewable resources to biomaterial is an important innovation aspect of the circular economy agenda too. The bioeconomy and the circular economy are thus conceptually linked and therefore most recent EU policy ambitions and guidance comes from both the Green Deal and the recently published Circular Economy Action Plan, both discussed extensively in Chapter 4.

Exploiting biomass in a bioeconomy is not necessarily sustainable. Processed biomaterials are not always biodegradable and mixing them with fossile-based materials can hamper recycling. In addition, exploitation of biomaterials may increase pressure on natural resources and dependence on use of non-biological materials with considerable environmental impact, such as agrochemicals. A further development of the bioeconomy has substantial impacts which can work out positively and negatively

on the environment and the economy and need careful guidance through strategy development, an extensive policy framework and the creation and facilitation of joined action and collaboration between a wide network of stakeholders.

7.2.1 Understanding the bioeconomy system and the way it can be regulated by policies at different scales

Central in the system is a biomass delivery chain that starts with the biomass production or harvesting, via logistics, pretreatment to conversions to distribution and then to end products and uses. These chains are all based on renewable biological resources and can include conversion into food, feed, bio-based products and bioenergy. It includes production processes taking place in agriculture, forestry, fisheries, food, and pulp and paper production, as well as parts of the chemical, biotechnological and energy industries.

Activities in the bioeconomy system encompass not only activities within the biomass value chain, but also the wider food and industrial environment and the 'enabling environment'. The wider food and industrial environment covers aspects such as food and product labelling and promotion, minimal quality requirements access to food and products which can partly be arranged through different policy measures but also through voluntary certification and agreements between economic actors. As to the enabling environment it creates the conditions in which the system functions and covers factors such as transport, infrastructure, R&D and regulations. Consumer's relationship to food and non-food bioproducts and how they manage the waste that comes from their consumption are also central in the bioeconomy system. The different activities in the bioeconomy system have outcomes within the system in socio-economic and environmental and climate terms and these outcomes are also feedback loops which occur between parts of the biomass delivery chain (production, processing, distribution and consumption) and from the socio-economic and environmental outcomes of bio-based product production and consumption (such as on food security and biodiversity impacts).

7.2.2 Type of policy instruments influencing on the bioeconomy system

Policy instruments can be organised in 3 main groups namely regulation, economic instruments and other more soft instruments such as voluntary, information and advice sharing, market based signalling and other more strategic or vision development instruments. The most common is the regulation which is a command and control approach using obligatory standards and licenses that require people/companies/market players to change their behaviour and punishes them if they are detected to be non-compliant. Economic instruments include price incentives (taxes, subsidies, feed-in premium), but also quantity constraints ((tradable) quota, tariff rate quota), and charges. These instruments give people incentives to voluntary (e.g. based on their own rational cost-benefit calculations) or obligatory taxes to bring about behavioural change. All these types of instruments are needed when a good policy framework needs to be developed for supporting and guiding the development of the bioeconomy. In all these categories there are policies that influence on the biomass supply, the logistics of bringing the biomass to the conversion and processing installation, the biomass conversion process itself, the distribution of the bioeconomy products and the circular end use and markets. Beside policies that impact on the full biomass chain there are also policies needed that influence the wider environement in

which bioeconomy activities function such as the research and policy enabling environment, food and industrial environment, business services, consumer preferences and behaviour. Finally, there are also many policy instruments that address the relation between the bio-based economy activities and the environmental and socio-economic context and impacts. So, it is clear that the bioeconomy is a wide concept that can be influenced directly and indirectly through policies impacting on many different aspects of the bioecoomy.

7.2.3 EU policy instruments of relevance for bioeconomy and circularity

Many of the regulations, roadmaps and action plans developed at EU level are the basis for further policy development at national and regional level. Several of the EC regulations require national implementation/transposition policies while other EC ambitions require national roadmap or strategy development or formulation of policy targets to be reached within a certain time. Most of the EU policy instrument which require national or regional policy translation and that are accompanied by spending of public money require first strategic plans and, once implemented, regular monitoring and reporting to the EC.

At this moment there are two key strategies setting out EU policies towards further development of the bioeconomy and circularity as instruments to reaching goals for GHG mitigation targets, economic growth and further sustainability in relation to biodiversity conservation, water, soil and air quality. These are the Green Deal and the circular economy action plan.

The Green Deal is a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use. The communication presents an initial roadmap of the key policies and measures needed to achieve the European Green Deal and it is foreseen that all EU actions and policies will have to contribute to the European Green Deal objectives.

The more recent circular economy action plan is at the core of the European Green Deal, the EU roadmap towards climate-neutrality. It states that it is not possible to achieve the climate-neutrality target by 2050 without transitioning to a fully circular economy because half of total greenhouse gas emissions comes from resource extraction and processing. It therefore announces initiatives for the entire life cycle of products, from design and manufacturing to consumption, repair, reuse, recycling, and bringing resources back into the economy. It introduces legislative and non-legislative measures and targets areas where action at the EU level brings added value. The aim of the Action Plan is to reduce the EU's consumption footprint and double the EU's circular material use rate in the coming decade, while boosting economic growth. Measures in the Circular Economy Action plan cover measures for products, on design, for consumers and public buyers. It will affect specifically electronics and ICT sectors, textiles, plastics, construction and building, packaging, batteries and vehicles, food and all production processes. Very importantly for waste, much emphasis is placed on reduction targets for more complex streams and enhancement of the recently adopted requirements for Extended Producer Responsibility schemes. EU funds will be further mobilised for innovations and investments. More EU and international actions will come on plastics too. The setting up of a well-functioning market for secondary raw materials will need to become reality.

For the development of bioeconomy action plans at national and regional level it is logical to streamline as much as possible announced actions in the GD and the Circular Economy Action plan with the ambitions at lower policy levels. This will be a large challenge, particularly because almost all European policy fields come together in the circular bioeconomy. In chapter 3 a summary overview was made of the main strategies and regulations developed in EU policy in the last decades addressing all relevant bioeconomy sectors such as agriculture, forestry, fisheries, waste and parts of chemical, biotechnological and energy industries and reaching overall sustainability in these. Most of these policies have to be or have been translated into national and regional policies and are therefore they are an important basis for the development of the national policy actions for setting up the bioeconomy in EU MSs and regions. Taking careful notice of these policy instruments at EU, national and regional level is crucial together with a gap analysis of policy instruments are still missing, out of date, or constraining innovations in bioeconmy and circularity.

7.2.4 Typical barriers for the BBE development and for effective policy frameworks and policy instruments

The typical barriers can be summarised as follows:

1) Biomass availability and mobilisation: The sustainable mobilisation of sufficient and good quality biomass is essential to build the bio-based economy. Obstacles are among others low cooperation of farmers and foresters, absence of whole-year availability of the biomass (seasonallity), uncertain provenance, challenging logistics, low quality and sustainability.
2) Lack of public acceptance and awareness: Acceptance by the public is crucial to make sure bio-based products are taken up by the market. Problems are public's resistance to change, lack of consumer knowledge and confidence in product quality.
3) Lack of supporting market mechanisms: Developing a bio-based economy requires a shift in the whole value chain, from producers to consumers. This shift is not easy to make, given the current market mechanisms, for instance the price competition from the petro-chemistry.
4) Vague goals and no operationalisation: Policies often miss clear goals and ways to measure and evaluate progress in meeting policy targets. The policy documents are described in a strategic but qualitative way and rarely include indicators to monitor the progress of the bioeconomy development
5) Timeframe of policy is uncertain: Long term vision and policy continuity are needed to build up investor confidence and to catalyse investment.

There are also several opportunities for policy development and wider action that help to overcome these barriers. These key opportunities are:

1) The mobilisation of biomass is an important key for further deployment of the bio-based economy. A good understanding needs to be created of the unutilized biomass potential in agriculture, forestry and industry. The advantage of industry by-products and residues is that they are already available at a central location.
2) Commodities from biomass have to be created. They have the advantage of being fully tradable, of stable quality, complying with storage facilities, with shipping and conversion processes. As a result, contracting is easier, markets open faster and more options to finance become available.

3) Established governance mechanisms support supply and demand side policy instruments, create policies for innovation, align principles of different policies, prioritise thematic areas or values chains/cycles, take decisions on investments.
4) General support on behalf of existing policy framework Provides a stable regulatory framework while remaining neutral concerning choices of technologies and promoting competition both with existing technologies and other sectors. A supportive policy framework is also able to bring bio-based economy closer to society.
5) Follow the EU's bioeconomy and circularity strategies as much as possible as they already build on established policy frameworks and give solid guidance taking account of policy integration needs.
6) The goals of the bioeconomy strategy can be achieved only by tackling existing policy fragmentation, engaging the civil society to a greater extent and putting in place the national and regional strategies. For example there are goals in EU regulation and priorities that conflict with national goals when being transposed, implemented and enforced by member states (Aggestam et al., 2017). EU policies like the Common Agricultural Policy leave responsibility to the member states to transpose policies into national regulation, which results in differences in terms of the level playing field for actors in the bioeconomy: the implementation of policy also depends on the different interests and political positions of stakeholders.
7) The alignment of principles of sustainable bioeconomy with principles of circular economy would involve systemic approaches across sectors leading to optimized value networks and minimized losses and waste.
8) Close cooperation and adaptation of the new research outcomes, new innovative business opportunities, in (existing) BBE networks and platforms such as the BBE-JU, BIC, and BioEast in Central and Eastern European countries. Countries and regions have to use all their ambitions to benefit equally from participation in different EU funded programs by matching bottom-up initiatives with top-down processes.

7.2.5 Is there a match between typical barriers that hamper bioeconomy in different phases of development?

Although the literature analysis of the barriers did not clearly indicate a distinction between the three bioeconomy development phases (low, medium and high), some conclusion could be drawn. Poor infrastructure is a barrier that may specifically hamper in the initial stage. Lack of supporting market mechanisms is a probable important obstacle in the medium phase of development. Regions in high stage of maturity development especially deal with barriers related to demand, stakeholder perception and investment. Literature showed also that there are several barriers that hamper development in all phases of BBE development. These are:

- Absence of clear and well elaborated bioeconomy strategy
- Lack of transparency and policy coherence
- Fragmentation of policy instruments
- Biomass availability
- Need for research and innovation that are required to design a bioeconomy that fits to the regional potentials
- Public awareness and stakeholder acceptance, and lack of demand-side policy.

7.2.6 Main characteristics of current BBE policies based on the longlist of policies compiled in the POWER4BIO regions.

This longlist inventory gave some main conclusions regarding the characteristics of BBE policy instruments that are currently implemented at national and regional levels.

1) Most of the relevant national and regional policy instrument were implemented in the last 10 years.
2) The type of policy instruments cover well the different type of instruments such as regulatory, financial, information and advisory instruments, networking and collaboration and volunatry instruments. But the type of policy instrument that supports the development of the bioeconomy is dominantly financial
3) Many of the policy instruments are oriented to the renewable energy value chain. This is mainly because many technologies are oriented to energy production in the low maturity phase of regions. Instruments that focus on the production part of the value chain mainly aim to mobilise biomass in a sustainable way. There are policy instruments specifically for biomass from waste, from forests, from agriculture.
4) Instruments focussing on the processing part aim to decrease investments costs and financial risks. It is also clear that there are not yet many instruments that aim to support consumption, apart from the renewable energy value chain. The instruments that relate to the 'end-of-life' are mainly waste management policy instruments.
5) Instruments that are focussing on the enabling environment of the bioeconomy transition are generic and can be applied on all types of value chains. There are many instruments focussing on research and innovation, mainly by providing financial support. And there are some instruments that provide long-term perspective, joint planning and collaboration.
6) The energy sector is clearly the sector that gains most of the support followed by agricultural, environment and the waste sector, the research and innovation sector, the forestry sector and the industry, enterprise and commerce sector. Sectors underrepresented in policy targeting are consumer sector, clustering/cooperation and networking sector, climate sector, chemical sector, development sector, support and advisory sector and fisheries sector.

The European policies that are mentioned to contribute to bioeconomy development at regional level are especially rural development policies, climate and energy policies, cohesion policies, in particular SMART specialisation policy, waste management policies and specific bioeconomy policies.

Many of the policy instruments are applicable in multiple maturity stages. In regions that are in the early stage (low to medium maturity) of bioeconomy development, we observe policy instruments that are often oriented to renewable energy and energy production from biomass and recycled waste.

Regions that are in medium to high maturity stage of bioeconomy development have often surmounted the stage of renewable energy production and are focussing on bio-based products of higher value like bio-based chemicals, bio-based materials.

However, there is also a whole range of policy instruments that can be applied in all stages of maturity and examples are in our long list of policies such as instruments to mobilize and regulate biomass, instruments for waste management, regulation and support instruments to safeguard the environment and prevent environmental impact, financing instruments for pilots, loans to help companies to finance bio-based, funding for research and research agenda, strategy for further bioeconomy and

circular economy development and instruments for monitoring progress of bioeconomy and circularity.

7.2.7 Characteristics of good policy examples

From the long list 10 good policy examples were selected, based on commonly agreed selection criteria which were also an outcome of consultation with the POWER4BIO region partners. Initial important criteria for selection were that the policy was following up or transposing EU-policy, the instrument has already proven to have a large impact, there is enough information available on it's impact and success (preferably it has been evaluatated/monitored) and it is general enough to replicate in other regions. The latter specifically applies to suitaility for replication in regions that are still in a low or intermediate state of development of bioeconomy.

In addition, an important criterion for the selection was that they represent different policy instruments, address different sectors included in the bioeconomy, address different stages in the biomass delivery chains and different end-products. Finally, we also choose examples that are either rather unique or that are more common policy instruments and are in place in several EU countries or regions. From our diverse selection we hoped to derive a lot of information on how good policy examples function in practice and what we can learn from them.

As to the integration with EU policies we see that good policies addressing different aspects in waste management and processing are clearly embedded in the EU waste policy framework. The policies facilitate the national translation of the EU's Waste Directive to reach its ambitions particularly on the waste hierarchy and the Polluters Pay principle, the disposal of waste requirements for landfilling and the principle in the Waste Directive that waste is to be recovered or disposed of without endangering the environment and groundwater.

We also observed that several of the national and regional good policy examples on waste were front runner policies. These forced the EU to take action to harmonization of rules on waste treatment and waste avoidance. In the last decade however, the EC can generally be seen as frontrunner in developing more ambitious waste policy targets while most EU MSs are mostly in the role of following these ambitions up in new policy measures at national and regional levels. The ambitions for circularity and the actions announced in the GD and the 2020 Circular Economy action plan will only strengthen this role of the EC further.

It is also interesting to see how the policy for the three renewable energy policy examples developed in time in line with the more ambitious EU wide targets set for reaching GHG mitigation. The examples show how regulation has shifted from overall wide support to bioenergy production without putting very strict requirements on efficiency and type of biomass use, toward stricter requirements for energy efficiency and higher feed-inn tariff support for the bioelectricity and heat produced from more sustainable biomass types, particularly those with no or low ILUC impacts.

Reasons why the selected examples are good policy examples are diverse, but generally one overlapping aspect is visible and that is that the policies have been successful in reaching their goals/objectives, if these were clearly formulated and related monitoring/evaluation methods were in place. On the other hand, we also saw for some of the examples selected that the goals were not clear and/or monitoring and evaluation results were not available.

Another aspect that makes them good examples is that they proved to be cost-effective in relation to the goals they aim to achieve such as increasing renewable energy targets, decreasing mixed unsorted waste amounts, avoiding landfilling, bringing GHG emissions down, etc.

SMART specialisation platforms are good examples in terms of number of clusters and research and innovation actions realised, amount of money spent, but what is also a good evaluation factor is the rewards received. The latter was seen for the Bavarian Cluster initiative that received numerous rewards of Bronze, Silver or Gold Labels of the European Cluster Excellence initiative.

Replicability of the good example policies depends on specific characteristics of the policy. Most of these policies could be implemented in all member states, but some policies require a higher level of knowledge and experience on the affected bioeconomy related fields. For example, to support cooperation between companies and research institutes in a particular field by cluster initiative there has to be a minimum number of companies and research institutes in the region on that field. Also, some policies should not be replicated in countries with high BBE development stage, because these countries have their own policies which were developed focusing on their own particular state and market by their own experiences from the last years or decades. Some policies are targeting unique fields and thereby they could be interesting only for a few regions. For example, the Andalusian Regulation of the use of residual biomass from olive oil industries.

In the ten good policy examples specific barriers were encountered. In the two SMART specialisation examples not surprisingly, collaboration challenges occur particularly in the first phase of the development. These relate to lack of central management at the initial stage that affect efficient communication and transfer of knowledge, communication of the importance of clusters and innovation to policy makers, lacking active participation by entrepreneurs in cluster activities due to strong focus on big industrial actors for energy and fuels. Initial interaction with entrepreneurs might be time consuming and required effort to communicate benefits of bio-based innovations. Difficulties were also encountered to access finances especially in the Smart specialisation clusters. The reason for this was the different State Aids rules applicable to industrial and agricultural activities that made it almost impossible to fund a complete regional value chain with a single fund. Secure private funding can also be a challenge in all BBE activities set-up.

Mention was also made of barriers like lack of training and knowledge among the crucial stakeholders to involve. Market barriers were also hampering some policies for reasons as complications with securing private funds during the initial stage of innovation development, commercialization of new bio-based products is a slow process which requires secure policy and financing conditions to minimize the investment risk, highly innovative products or components require long and consistent efforts for training, education and knowledge transfer to entrepreneurs prior to commercialization. In the bioenergy policies strong competition between bioenergy and fossil-based alternatives was a barrier, but not the only and main barrier overall.

How to turn barriers into opportunities was also seen in the good example policies. Difficult market competition is typically encountered in policies to bring landfilling down. If landfilling at low costs is possible and allowed, it is difficult to establish the infrastructure for a waste pre-treatment. Also, the landfill tax is a revenue raising mechanism. If it is introduced at a too high rate it will encounter a lot of opposition. The challenge is to get the rates right so that it does not encounter significant opposition.

Bringing waste being landfilled down, requires a diverse package of policy measures that both address the separation of waste at the source and the appropriate management of old and new landfills, incineration and further recycling and reusing of waste. Waste policy is therefore complex.

An important opportunity for almost all good policy examples was the presence of an EU regulation or stimulation framework. This EU framework provided a lot of guidance to set-up the policy instruments in the first place and/or to organise the instrument in such a way that it adapts to one of the several requirements EU policies impose on MSs. Beside regulation the provision of financial support through regional and structural development funds have also been very stimulating for developing certain instruments, particularly the SMART specialisation platforms. The new REDII has certainly been very guiding in the organization of the recent revisions in the renewable energy regulation and support systems in the examples presented here.

The role of political interest in bio-based development and reaching sustainability goals and/or new business opportunities, which can often be translated in several national and regional strategies can also be very supportive in the development of targeted policy instruments. This certainly played a role in the Dutch, German, Italian, Andalusian and Danish good policy examples.

As a last opportunity it should be mentioned that policy support instruments should leave enough room for competition between different technologies as this may accelerate technology development and results in lower market prices.

7.3 RECOMMENDATIONS

For regions that have the ambition the transform their economy to a more biobased economy including more circularity the EU in its Bioeconomy strategy recommends the developments of national and regional strategies and road maps. In the following we make recommendations, that are particularly relevant to regions that are still in an early phase of bioeconomy development. When regions have the ambition to develop a bioeconomy strategy and/or a SMART specialisation platform it is recommended to take as first steps the following:

1) Map and quantify well the different biomass resources in your regions that are present, their current uses, as well as unused biomass potentials;
2) Map and identify well the bioeconomy activities that are already covered in your region and that have a potential to develop in the near future and on the longer term. Using this information, make a precise overview of the players already involved in these activities and that need to be involved in the future activities;
3) Map and characterise accurately the policies of relevance that are already in place and identify the policy gaps following the bioeconomy system overview presented in chapter 2 of this deliverable. For the policies in place specify how they are further embedded in wider national and EU policies as presented in Chapter 4 of this report;
4) Identify whether the national and regional actions for EU policy implementation have all been followed up in your country and region, how they are followed up and where there are still gaps that may hamper the bioeconomy development base on all opportunities for bioeconomy activities to be developed in your region as mapped in step 2) above;

5) Map and quantify the current bioeconomy activities that already take place in your region in terms of economic value & employment.

Once the above 5 steps have been taken, use this information to:

6) Bring together all stakeholders identified in step 2) and work with them, in interactive sessions and in subgroups and working groups and if needed through involvement of experts and consultants on the following subjects while building on the factual information derived from the former steps 1 to 5:
    a. What are the most important goals the region may reach in the next 10 and next 20 years regarding bioeconomy development and its contribution to sustainable development such as reaching GHG mitigation, circularity in the economy, employment levels, economic growth, water, air, soil quality, etc.
    b. What are the main bioeconomy activities that are already developed and which can be further developed in the near future
    c. Identify and describe the bioeconomy developments that can be developed over the next 10 and 20 years
    d. Identify how the development of the different bioeconomy activities can best be made instrumental to the reaching of the specific goals formulated in step 6a for your region.
    e. Per identified bioeconomy development activity formulate:
        i. What biomass delivery chains need to be developed from biomass sourcing to end use and circularity
        ii. What stakeholders need to be involved
        iii. What policies are in place at local, national and EU level that already facilitate, regulate, constrain and/or support the chain implementations
        iv. What gaps exist in policy instruments, financial instruments that need to be developed

7) In the last step the information from former steps is translated in the roadmap that should specify action needed on the short and longer run to make the ambitions regarding goals for the region and the related instrumental bioeconomy activities develop. This will cover a wide range of concrete actions at the minimum covering aspects like:
    a. Policy development actions
    b. Collaboration needs also in terms of PPP involving actors covering all componenents of the bioeconomy system (see chapter 2)
    c. Finances and financial resources accessible
    d. Research development actions
    e. Skill and education development actions
    f. Infrastructural and logistical development options

LITERATURE

Aggestam, F., Winkel, G., Pülzl, H., & Sotirov, M. (2017). The EU policy framework. *Towards a Sustainable European Forest-Based Bioeconomy—Assessment and the Way Forward; EFI Series: What Science Can Tell Us*, *8*.

Banja, M.; Sikkema, R.; Jegard, M.; Motola, V & Dalleman, J-F (2019). Biomass for energy in the EU – The support framework. Energy Policy 131 (2019) 215–228

BBI JU (2018). *Examples of good practices reported by the BBI JU States Representatives Group*

Bell, J., Paula, L., Dodd, T., Németh, S., Nanou, C., Mega, V., & Campos, P. (2018). EU ambition to build the world's leading bioeconomy—Uncertain times demand innovative and sustainable solutions. *New biotechnology*, *40*, 25-30.

Bergeret, P.; Svedin, U.; Valceschini, E (eds). Bioeconomy challenges and implementation: th European research organisations' prspective. ISBN: 978-2-7592-2835-5

Berkum, S. van, Dengerink, J., & Ruben, R. (2018). *The food systems approach: sustainable solutions for a sufficient supply of healthy food* (No. 2018-064). Wageningen Economic Research.

Carus, M. (2017). Biobased economy and climate change—important links, pitfalls, and opportunities. *Industrial Biotechnology*, *13*(2), 41-51. DOI: 10.1089/ind.2017.29073.mca

Dees, M., Hohl, M., Datta, P., Forsell, N., Leduc, S., Fitzgerald, J., ... & Staritsky, I. G. (2017). *D1. 6 A spatial data base on sustainable biomass cost-supply of lignocellulosic biomass in Europe-methods & data sources: Issue: 1.2*. S2Biom.

DEFRA (2005) Agriculture and the economics base on farm regulation: A summary paper of Defra's economic evidence base on farm regulation –November 2005.

Diakosavvas, D., & Frezal, C. (2019). Bio-economy and the sustainability of the agriculture and food system: Opportunities and policy challenges. *OECD Food, Agriculture and Fisheries Papers, No. 136,* OECD Publishing, Paris. http://dx.doi.org/10.1787/d0ad045d-en

Directorate-General for Research and Innovation (2018). *A sustainable Bioeconomy for Europe: strengthening the connection between economy, society and the environment - Updated Bioeconomy Strategy.* doi:10.2777/792130

Dupont-Inglis, J., & Borg, A. (2018). Destination bioeconomy–The path towards a smarter, more sustainable future. *New biotechnology*, *40*, 140-143. https://doi.org/10.1016/j.nbt.2017.05.010

EC (2012). Innovating for Sustainable Growth: A Bioeconomy for Europe. Brussels, 13.2.2012. COM(2012) 60 final.

EC (2018). A sustainable Bioeconomy for Europe: Strengthening the connection between economy, society and the environment. Brussels, 11.10.2018. COM(2018) 673 final.

EC 2019. On the implementation of the Circular Economy Action Plan. Brussels, 4.3.2019 COM(2019) 190 final.

EC (2019). The European Green Deal. COM(2019) 640 final

EEA (2018). The circular economy and the bioeconomy. Partners in sustainability. EEA Report No 8/2018.

Gyalai-Korpos, M., Szabó, Z., Hollósy, M., Dávid, B., Pencz, K., Fehér, C., & Barta, Z. (2018). Bioeconomy Opportunities in the Danube Region. In *Towards a Sustainable Bioeconomy: Principles, Challenges and Perspectives* (pp. 99-116). Springer, Cham. https://doi.org/10.1007/978-3-319-73028-8

Green budget Europe (2015). The Danish Ecological Council. Successful environmental taxes in Denmark. https://green-budget.eu/wp-content/uploads/The-most-successful-environmental-taxes-in-Denmark-2_FINAL.pdf (*visited 1 May 2020*)

Hodgson, E., Ruiz-Molina, M. E., Marazza, D., Pogrebnyakova, E., Burns, C., Higson, A., ... & Noël, Y. (2016). Horizon scanning the European bio-based economy: a novel approach to the identification of barriers and key policy interventions from stakeholders in multiple sectors and regions. *Biofuels, Bioproducts and Biorefining*, *10*(5), 508-522.

IEA (2018), "Extended world energy balances", IEA World Energy Statistics and Balances (database), http://dx.doi.org/10.1787/data-00513-en. (accessed on 16 October 2018)

Jongeneel et al. (2007). Deliverable 2.3: Report describing the operationalisation of the first selection of indicators into impacts of Cross Compliance for the implementation in the first prototype of the analytical tool. CCAT project EC contract number 44423-CCAT.

José, M. L., González, M. Aguilar, A., Vela,C. (2018): Spanish strategy on bioeconomy: Towards a knowledge based sustainable innovation. In: *New biotechnology, Vol. 40*, Part A, 87-95 pp. https://doi.org/10.1016/j.nbt.2017.05.006

JRC (2019). Science for environmental sustainability. JRC thematic report. EUR 27498 EN

Kitney, R., Adeogun, M., Fujishima, Y., Goñi-Moreno, Á., Johnson, R., Maxon, M., ... & Philp, J. (2019). Enabling the Advanced Bioeconomy through Public Policy Supporting Biofoundries and Engineering Biology. *Trends in biotechnology*, *37*(9), 917-920. https://doi.org/10.1016/j.tibtech.2019.03.017

Lainez, M., González, J. M., Aguilar, A., & Vela, C. (2018). Spanish strategy on bioeconomy: Towards a knowledge based sustainable innovation. *New biotechnology*, *40*, 87-95. https://doi.org/10.1016/j.nbt.2017.05.006

Lewandowski, I. (2018). *Bioeconomy: Shaping the transition to a sustainable, biobased economy*. Springer Nature. https://doi.org/10.1007/978-3-319-68152-8

McCormick, K. & Kautto, N. (2013). The bioeconomy in Europe. An overview. ***Sustainability*** **2013**, ***5***(6), 2589-2608; **https://doi.org/10.3390/su5062589**

McNeill et al.,(2018) Inventory of opportunities and bottlenecks in policy to facilitate the adoption of soil-improving techniques. SoilCare deliverable D7.1. Report no. 09. www.soilcare-project.eu

Meyer, R. (2017). Bioeconomy strategies: contexts, visions, guiding implementation principles and resulting debates. *Sustainability*, *9*(6), 1031.

OECD (2018), Effective Carbon Rates 2018: Pricing Carbon Emissions Through Taxes and Emissions Trading, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264305304- en.

OECD (2019a). Taxing Energy Use 2019: Country Note – Denmark https://www.oecd.org/tax/tax-policy/taxing-energy-use-denmark.pdf

OECD (2019b). Taxing Energy Use 2019 USING TAXES FOR CLIMATE ACTION. https://www.oecd-ilibrary.org/docserver/058ca239-en.pdf?expires=1588503020&id=id&accname=guest&checksum=79BD1245ED84A36BE3EE85261F5B2B08

OECD (2018): *Meeting Policy Challenges for a Sustainable Bioeconomy*, OECD Publishing, Paris, DOI:https://dx.doi.org/10.1787/9789264292345-en

Pelkmans L., M. Van Dael, C. Panoutsou, E. Alakangas (2016): D6.3 Policy options to mobilize sustainable non-food biomass resources for the biobased economy, December 2016, S2BIOM Project Grant Agreement n°608622

Philp, J. (2018). The bioeconomy, the challenge of the century for policy makers. *New Biotechnology*, *40*, 11-19.

Ronzon, T., Piotrowski, S., M'Barek, R., & Carus, M. (2017). A systematic approach to understanding and quantifying the EU's bioeconomy. *Bio-based and Applied Economics Journal*, *6*(1050-2018-3682), 1-17. http:// dx.doi.org/10.13128/BAE-20567

Ronzon, T., & M'Barek, R. (2018). Socioeconomic Indicators to Monitor the EU's Bioeconomy in Transition. *Sustainability*, *10*(6), 1745. https://doi.org/10.3390/su10061745

Ronzon, T., Piotrowski, S., M'barek, R., Carus, M & Tamošiūnas, S. (2018): Jobs and wealth in the EU bioeconomy / JRC - Bioeconomics. European Commission, Joint Research Centre (JRC) [Dataset]

PID: http://data.europa.eu/89h/7d7d5481-2d02-4b36-8e79-697b04fa4278

Schieb, P. A., Lescieux-Katir, H., Thénot, M., & Clément-Larosière, B. (2015). Biorefinery 2030. *Springer Books*.

Schütte, G. (2018). What kind of innovation policy does the bioeconomy need?. *New Biotechnology*, *40*, 82-86.

Skou Andersen, Mikael (2017). Experiences with carbon taxation - Denmark, Sweden and Europe. Presentation at: Environmentally related taxes and other fiscal instruments Kirstenbosch Botanical Gardens, Cape Town 29/3/17. http://pure.au.dk/portal/files/111427005/CapeTown1_ANDERSEN.pdf

Spatial Foresight, SWECO, ÖIR, t33, Nordregio, Berman Group, Infyde (2017): *Bioeconomy development in EU regions. Mapping of EU Member States'/regions' Research and Innovation plans & Strategies for Smart Specialisation (RIS3) on Bioeconomy for 2014-2020*.

Ting, M. B., & Philp, J. (2018). Revitalisation of agricultural biomass for an industrial bio-economy, case studies on South Africa and Netherlands bio-economy. In *Towards a Sustainable Bioeconomy: Principles, Challenges and Perspectives* (pp. 279-305). Springer, Cham.

Toppinen, A., Korhonen, J., Hurmekoski, E., & Hansen, E. (2017). What makes a European forest-based bioeconomy competitive?. *Towards a sustainable European forest-based bioeconomy*, 101.

Viaggi, D. (2018). *The bioeconomy: delivering sustainable green growth*. CABI

Winkel, G. (Ed.). (2017). *Towards a sustainable European forest-based bioeconomy: Assessment and the way forward*. European Forest Institute (EFI).

Withana, S., ten Brink, P., Kretschmer, B., Mazza, L., Hjerp, P., Sauter, R., Malou, A., and Illes, A., (2013) Annexes to Final Report - Evaluation of environmental tax reforms: International experiences. A report by the Institute for European Environmental Policy (IEEP) for the State Secretariat for Economic Affairs (SECO) and the Federal Finance Administration (FFA) of Switzerland. Brussels. 2013.

World Bank & Ecofys (2014). State and Trends www.carbonfinance.org of Carbon Pricing. Washington DC, May 2014. Report 88284. DOI: 10.1596/978-1-4648-0268-3

ANNEXES

Annex I Literature review barriers and opportunities for bioeconomy development and policy

Literature Review: Barriers and Opportunities for Bioeconomy Development and Policy			
Barrier or opportunity	**Solutions for the barrier**	**Evidence for the issue**	**Source-**
Barrier for the BE development: Biomass availability			
Main bottlenecks in creating the bioeconomy and its biomass supply chains are related to **resource mobilization combined with financial constraints and uncertain policy framework**. An opportunity for Bioeconomy Opportunities in the Danube Region is the sustainable intensification of current farming practices.	There is a need to ensure continuity of policy in order to build investor confidence in bioeconomy, as well as to mobilize feedstock and human and financial resources, all of which are critical factors to working supply chains.	Biohorizons survey (Hodgson et al. 2016)	Gyalai-Korpos et al., 2018
All is dependent on sustainability of the feedstocks, the processes and the products of a bioeconomy if the mistakes of the past are not to be repeated in the future. **Biomass sustainability** as a policy subject is extremely complex and cannot be resolved without international – if not global – support.		Engagementwith the public and private sectors and workshops	OECD, 2018
Mobilization of biomass; barrier mismatch between demand for high quality biomass vs low quality biomass . Logistic systems for these low-quality materials have not been optimized.	Dedicated support, training and assistance in sustainable mobilization of biomass will be crucial Policy options: several regulations, financial measures and soft measures are proposed.		Pelkmans et al, 2016

Sustainability framework: One of the basic principles for the mobilization of biomass is that biomass production and harvests (in forests, agriculture or in nature management) should fit in the frame of long-term sustainability. A sustainability frame is to be applied to the management of forest or agriculture overall, independent of the end use of its products. The sustainability frame includes environmental, social and economic aspects (see GBEP sustainability indicators for bioenergy and UN SDGs).	Policy options: several regulations and financial measures and soft measures are proposed.		Pelkmans et al, 2016
Barrier for the BE development: Technical infrastructure in place			
Centralised systems which are not beneficial for the countryside, **lack of national and EU-legislation creating economic incentives** for a transition to a bioeconomy.	A common classification of the bioeconomy; coordinated support from the EU level and communication within an integrated EU strategy and policy framework; strategic planning and leadership for combined efforts on R&I; support on development of value chains; cross-border and interregional cooperation; support for traditional sectors and SMEs in conversion processes; support for transdisciplinary and specific bioeconomy competences and skills; synergies and coordination in funding and investments; activities to raise public awareness and acceptance; participatory approaches to develop solutions for potential conflicts at local and regional level.	Report	DG Research&Innovation,2018

To increase **wood supply on short and long term from European forests** the following measures can be implemented - constraints with respect to the sustainability of future forest biomass supply. **Constraints** can be technical (e.g. losses from harvesting and logging techniques, road infrastructure and logistics), social (e.g. forest owners' low willingness or interest to manage forests), economic (e.g. increase of wood price) and environmental (e.g. biodiversity, nutrient losses). Sustainable forest management is key in this respect.	To consider the multi-functionality in forests and stimulate further deployment of sustainable forest management (rules, guidelines, certification), also extending it to currently unmanaged forests Regulatory measures, financial measures and soft measures are proposed		Pelkmans et al., 2016
Barrier for the BE development: Finance and market mechanisms			
Many biorefnery models are emerging, but few have reached commercial maturity . They continue to represent **large risks for investors**. The private sector has been unwilling to finance biorefineries alone. The supply chains are not secured, the price competition from petrochemistry is fierce, and government policy uncertain." Fossil fuel consumption subsidies compose the largest global subsidy system.	Policy changes / Financial incentives - Carbon taxation and fossil fuel subsidy reform are a must for enabling the SDGs. Policies have to be stable and long-term so that the private sector has the confidence to invest in risky projects.	Expert analysis, review article	Philp, J., 2017
Direct support of one sector within the forest-based bioeconomy (e.g. energy subsidies) can have **adverse impacts on the competitiveness** of other sectors .	Indirect methods to create a level playing field such as a carbon tax and R&D support may encourage competition and innovation. A social license to operate from communities and countries where internationalised European-based companies operate becomes an increasingly important competitiveness factor (Toppinen et al, 2014)	Policy analysis	Aggestam, F., et al., 2017
Knowledge - high intellectual potential of researchers and several scientific discoveries. Answers to barrier: Polish inventions are very rarely available on the market and the number of national and international patent applications done by Polish scientists is very limited.	Infrastructure/ financial incentives by the state- In academic centers in Poland, several bio – "clusters" and "parks", dedicated to the transfer of academic achievements to industry, have been established.	Expert analysis	Wozniak & Twardowski, 2016

Mobilizing the required resources to support growth.	General conclusion: access to financial support and ensuring continuity of policy could be considered amongst the most important interventions overall. Specific: develop a skilled workforce; provide access to financial support; stabel feedstock supply; ensure competitive feedstock costs.	Survey of experts involved in bio-based research, industry, governance.	Hodgson et al., 2016
Risk perception is high in the bio-based economy and access to finance is an issue.	Governments can use tools to reduce financing risks: providing guarantees, low-interest loans. Support to develop knowledge and spreading knowledge through demonstrators and cooperation platforms. This helps reduce risk perception, which improves the investment climate.		Pelkmans et al., 2016
Current markets and systems are designed for fossil fuels, these are still the standard.	There may be ways to deal with the phasing out of fossil fuels, e.g.: introduction of a carbon tax, specific phasing out policies for fossil fuels, potential sustainability requirements for fossil fuels.		Pelkmans et al., 2016
Some advanced biofuels like DME, high ethanol blends (e.g. E85), or biomethane need **dedicated fuelling infrastructure and vehicle technology**.	Several financial measures and soft measure are proposed.		Pelkmans et al., 2016
Currently the **combustion of biomass over the value chain** is not included as it is considered carbon neutral.	A dedicated monitoring of energy use over the full value chain is needed.		Pelkmans et al., 2016
Barrier for the BE development: Public acceptance and consumer awareness			
Policy must take account of both supply- and demand-side measures, yet the latter, while a potential source of innovation, has tended to be overlooked by government.	Demand-side measures include public procurement, regulation, standards, consumer policies; user-led innovation initiatives; lead market initiatives to address market and system failures in areas with pressing social needs.	Engagementwith the public and private sectors and workshops	OECD, 2018

Weak market uptake and consumer confidence	A range of policy instruments, including provision of information on environmental footprint of bioeconomy products, public procurement, development of standards, and product labelling. Bio-economy policies must be clear and implemented for the long-term.	Analysis based on literature review and survey	Diakosavvas & Frezal, 2019
Establishing legitimacy of bio-based alternatives.	Build stakeholder consensus on bioeconomy development; implement green public procurement; champion utilisation of local resources; create conditions for niche markets.	Survey of experts involved in bio-based research, industry, governance.	Hodgson et al., 2016
A bio-based economy will be associated with a broad spectrum of societal impacts. Hence, it is a democratic imperative to base bioeconomy policy on broad societal debate, which **should also include overall visions and implementation pathways.** The developing bioeconomy involves new actors and new branches of economic activity. This process inherently creates **resistance from actors that have vested interests in the current system** and try to defend the status quo.	The development of the bioeconomy desired in the strategies could be restricted in the future, depending on the technological progress of alternatives, the momentum of alternative narratives and the setting of political framing conditions. There is susceptibility to a seesaw in the concrete arrangement of support policies, and investments are faced with high vulnerability.		Meyer, 2017
Resistance to change.	Ensure continuity of policy; build investor confidence in the bioeconomy; raise public awareness of bio-based products; ensure competitive feedstock costs.	Survey of experts involved in bio-based research, industry, governance.	Hodgson et al., 2016
Overall the **public image of biofuels and bioenergy** has worsened in the past years, which also extends to other applications of biomass.			Pelkmans et al., 2016
Market should be improved	Regulations and soft measures are proposed.		Pelkmans et al., 2016

Specifically for bio-based products, **acceptance by the public is crucial**	Communication campaigns; incentivising the uptake and development of bio-based products through public procurement policies. Regulations, financial measures and soft measures are proposed.		Pelkmans et al., 2016
Quality of products	Technical standards would be needed and preferably agreed at international level (ISO), including trade codes (CN codes) to monitor trade.		Pelkmans et al., 2016
Lack of commercial frameworks (e.g. incentives, taxation, market supports and product standards), lack of green public procurement and lack of bio-based public procurement.			Interreg project, 2019
Barrier for the BE development: Collaboration, research and education			
Inadequate diffusion, transparency and adoption of research and innovation.	Investing in innovative R&D; promoting collaboration between research institutions (academia) and industry; encourage the development of measures to promote targeted research and knowledge exchange; establish a long-term research and innovation agenda	Analysis based on literature review and survey	Diakosavvas & Frezal, 2019
New requirements for education and skills for stakeholders	Build up and expand the expertise necessary for a bio-economy by integrating dedicated curricula and training programmes in the higher education and vocational training systems	Analysis based on literature review and survey	Diakosavvas & Frezal, 2019
Insufficient knowledge exchange	Facilitate business to business collaboration; further academia to business collaboration; develop international networks or clusters; develop regional networks or clusters.	Survey of experts involved in bio-based research, industry, governance.	Hodgson et al., 2016
Lack of reproducibility and reliability in research.	Public–private partnerships are needed to focus on solving problems of reproducibility, reliability, and predictability. Create business confidence in public sector	Workshop	Kitney et al., 2019

	commitments for transitioning to new types of manufacturing in the bioeconomy and overcome current barriers for realizing the significant promise of engineering biology.		
Difficulty to connect to the chain.	Boost engagement with policy makers; institute standards and regulations for the bio-economy;stimulate industrial symbiosis; advocate use of standard lifecycle analysis	Survey of experts involved in bio-based research, industry, governance.	Hodgson et al., 2016
All too often **research success** is not accompanied by commercialisation. There are large skills gaps, and countries will continue to struggle with making and educating the bioproduction workforce.		Engagementwith the public and private sectors and workshops	OECD Report, 2018
Barrier for BE policies: Policy goals			
No single strategic document dedicated to bioeconomy.	The authorities placed bioeconomy as a smart specialisation strategy.	Expert analysis, review article	Wozniak & Twardowski, 2016
National bioeconomy strategies tend to demonstrate intent and commitment, but be **short on detail**, due in large part to the large range of related policy families, including tax, innovation, industry, agriculture, waste and trade.		Engagementwith the public and private sectors and workshops	OECD Report, 2018
Barrier for BE policies: Time frame			
Lack of continuity of policy. There is a need to ensure continuity of policy in order to build investor confidence in bioeconomy, as well as to mobilize feedstock and human and financial resources, all of which are critical factors to working supply chains.	In the Netherlands it was ensured that in the run-up to Horizon 2020 the research themes and other topics, such as SME participation, were formulated in a way that benefits Dutch interests.	Policy analysis	Ting & Philp, 2018

Policies are short-term and unstable	Bioeconomy policies have to be stable and long-term so that the private sector has the confidence to invest. Financial instruments for building public- private partnerships have to be attractive and not overly bureaucratic.	Engagementwith the public and private sectors and workshops	OECD Report, 2018
Long term strategies help to overcome uncertainties and interruption of investments. Policy needs to be consistent, but also dynamic to be effective (e.g. in case of price fluctuations). It is very important to have a long term policy vision. Timeframe for a vision should be 20 years and more (e.g. 2050); a policy framework needs to be clear for the next 10 to 20 years, as this is also the timeframe for investments.			Pelkmans et al., 2016
Barrier for BE policies: Policy implementation			
Complexity. The European forest-based bioeconomy is affected by a huge number of policy instruments. Diversification processes, as part of a cross-sectoral bioeconomy, increase this complexity. This raises the general question in how far policies can transform trade-offs into synergies.	The relationships between different policy frameworks, the forest-based bioeconomy and related market activities are ambivalent.	Policy analysis	Aggestam et al. , 2017
The **high degree of uncertainty** and the **diverse interests and political positions of stakeholders**, together with the high degree of political commitment towards the bioeconomy.		Expert analysis	Viaggi, 2018
Insufficient coherence and targeting of policy measures addressing the bio-economy.	Review existing domestic and trade policies and regulations which impact on the bio-economy and explore various innovative approaches.Ensure policy coherence in the design and implementation of a bio-economy strategy as well as among sectoral strategies. Remove fossil fuel subsidies, phase out biofuel subsidies, and apply the polluter pay and provider gets principles.Facilitate voluntary agreements.	Analysis based on literature review and survey	Diakosavvas & Frezal, 2019

The complexity of bioeconomy policy is partly due to the **multiple scales of action** required. These scales range from regional development (e.g. biorefinery deployment) through to national research and development (R&D) into synthetic biology, information technology (IT) convergence and automation to global issues of biomass and its sustainability.	The distributed bioeconomy manufacturing model calls for a "glocal" approach i.e. both global and local.	Engagementwith the public and private sectors and workshops	OECD Report, 2018
Lack of standards in enabling biotechnology. Standards in various forms are needed in engineering biology. The adoption of standards will accelerate the transition to a future advanced bioeconomy. Additionally, standards are required that enable companies to control their management systems or novel processes (...)	Important goals are working with experts in national and international standards organi zations, researchers, and the private sector to develop the necessary standards, technical and otherwise, in a cohesive manner	Workshop	Kitney et al., 2019
Biomass and developments in the biobased economy **link to different policy fields** (agriculture, forestry, environment, climate, energy, trade, economy …). It is important that there is consistency between these policy fields			Pelkmans et al., 2016
Opportunity for the BE development: Biomass supply - availability of biomass feedstock, residues			
Industrial residus	Several regulations are proposed		Pelkmans et al., 2016
Opportunity for the BE development: Conversion and distribution of biomass, end-use markets			
Commodities are fully tradable and compatible with storage facilities, shipping and conversion processes. This facilitates contracting, opens markets and provides easier access to finance.	Governments can facilitate this		Pelkmans et al., 2016
Opportunity for the BE development: Existing business opportunities			

Farmers' resilience. In terms of adaptation, bio-based economy, if implemented sustainably, can offer opportunities to farmers, since a more diverse production of crops for food, feed and industrial markets can provide more security and stability. Through the local production of feedstocks for bioenergy and bio-based products, farmers become more resilient and can adapt better to climate change, which is especially beneficial for the socio-economic development of rural areas.			Carus, 2017
Bio-economy could bring **new business opportunities, investment, and employment to rural areas; foster regional development; and support small to medium enterprises**			Carus, 2017
Opportunity for the BE development: Potential in research and education			
Innovation. The bio-based economy promises to introduce new chemicals, building blocks, and polymers with new functionalities; to develop new process technologies such as industrial biotechnology; to deliver solutions for green and sustainable chemistry and circular economy.			Carus, 2017
Opportunity for BE policies: General support on behalf of existing policy framework			
The active involvement of the private sector requires much more vigorous public policies. **Governments acting as intermediaries between the stakeholders.** They need to remain neutral concerning choices of technologies, but provide a stable regulatory framework, and above all a level playing field in terms of competition with existing technologies and sectors.	The Bazancourt-Pomacle biorefinery is the first operational integrated biorefinery with varied industrial facilities and production, an innovation platform and the operation of a genuine knowledge economy. The economies of scale or diversification made possible by this geographical proximity of the different players become key factors for competitiveness. The economic optimisation can be accompanied by environmental op-	Case study	Schieb et al., 2015

	timisation, when it includes reductions in waste, energy consumption and other inputs.		
Bioeconomy requires a **coherent policy.** In Germany, the bioeconomy is a matter for the entire Federal Government. This is particularly evident in the NFSB 2030.		Expert analysis	Schütte, G., 2018
The 2016 Action Plan for implementing the Spanish strategy on bioeconomy More than 250 people are trained in the concept of bioeconomy and its funding opportunities. It has been brought to different areas of society, both at national and European level.		Expert analysis	Lainez et al., 2017
"Only by tackling policy fragmentation, engaging with civil society and putting in place bioeconomy strategies throughout the member states and regions, can the EU deliver on the ambitious but achievable goals set out by its own bioeconomy strategy."		Expert analysis	Dupont-Inglis & Borg, 2017
There are many **policy options** to support engineering biology as an integral part of a bioeconomy.	We argue that getting more success stories in engineering biology can be accelerated through policy. Important goals are working with experts in national and international standards organizations, researchers, and the private sector to develop the necessary standards, technical and otherwise, in a cohesive manner; derisking private sector investments in biofoundries through public–private initiatives; supporting cross-disciplinary researchand education to embed CAB; and revisiting engineering biology approaches that might provide the breakthrough to cost-effective lignocellulose conversion, for example, inconsolidated bioprocessing (CBP).	Workshop	Kitney et al., 2019

Opportunity for BE policies: Synergies with other policy trends – systemic approach across sectors			
The Communique´ of the Global Bioeconomy Summit emphasizes the need to align the principles of a sustainable bioeconomy with the principles of a circular economy, which "would involve **systemic approaches across sectors** , particularly **innovation policy measures that aim at optimizing Bioeconomy value networks and minimizing waste and losses**".	Direct policy instruments, e.g. tariffs and subsidies on different (bio-based) products either domestically produced or traded, and indirect policy instruments, e.g. environmental taxes (carbon tax) or voluntary agreements.	Expert analysis	Lewandowski, 2018
The Directorate-General for Research and Innovation is in the process of developing a new research and innovation policy framework for food and nutrition security (FOOD 2030) with a view to structure, scale-up and boost research and innovation to future-proof our nutrition and food systems. FOOD 2030 will be tightly coupled with the R&I pillar of the Bioeconomy Strategy.		Expert analysis	Bell, 2017
Removing fossil fuel subsidies and pricing the environmental damage of those industries would put a completely different complexion on their economics, and would make arguments against green bioindustries much less convincing.	Objections to subsidising young technologies of any sort for climate change mitigation can be based on arguments around market distortion caused by subsidies. However, there is no such thing as a "level playing field" between the fossil industries and any of the green industries – including industrial biotechnology and engineering biology, which are foundational technologies of a bioeconomy. The fossil industries are over one century old and fossil fuels subsidies are still gargantuan: therefore the argument seems hollow.	Engagementwith the public and private sectors and workshops	OECD Report, 2018

The emergence of the bio- economy **blurs the distinction between agricultural, environmental, and energy policies**.	Assess the costs and benefits of implementing bio-economy and related policies in an integrated and joined-up manner, including through reform of institutional and governance structures. Adopt holistic and transparent crosscutting approaches and policies for consumer trust- building.	Analysis based on literature review and survey	Diakosavvas & Frezal, 2019
Link between bio-based economy and climate change. While bio-based economy can significantly contribute to climate change mitigation, it is not by default a climate-friendly concept.	According to McGlade and Ekins, one third of the global oil reserves, half of the gas reserves and over 80% of the currently known coal reserves need to remain unused between 2010 and 2050 in order to meet the 2°C target….sustainable sourcing and smart use of biomass can lead to the production of goods that are improved versions of traditional fossil-based alternatives or completely new items, and thus can contribute positively to savings in GHG emissions, toxicity, waste reduction, and a long-term shift away from finite resources.		Carus, 2017
Most of the countries reported that the existence of **networks, platforms, associations and clusters** supports the bio-based industrial sector and encourages/facilitates the involvement of national stakeholders in the BBI JU calls - it also helps to better prepare calls.		Several networks and clusters	Bio-based industries undertaking
Internal coordination between SRG members, Programme Committee members and National Contact Point of Societal Challenge 2-Horizon 2020			Pelkmans et al, 2016
In terms of greenhouse gas emissions, a minimum GHG saving performance compared to fossil fuels is included in the **sustainability criteria for biofuels**, and this will probably be extended to the application of solid and gaseous biomass for electricity and heat.			Pelkmans et al, 2016

Opportunity for BE policies: Existing funding		
A carbon price and carbon tax seem like the logical way to raise the large sums required to finance the public contributions of such projects. **Pricing carbon emissions through a carbon tax should be a powerful incentive** to invest in cleaner technologies and adopt greener industrial processes.	Engage-mentwith the public and private sectors and workshops	OECD Report, 2018
Existence of funding programmes available at national level, complements the BBI JU funding (even if not always specifically oriented to bio-based industries) and thus provides additional opportunities to deploy the technologies across Europe.	TRL 2-8, co-operative R&D projects on national level	Bio-based industries undertaking
Combination of different types of EU funding - mainly funding and instruments for economic growth have helped to deploy bio-based industries - other funding also like CAP etc.	Demonstrator regions	Bio-based industries undertaking

Annex II The EU Green Deal explained

The most recent EC strategy for sustainable development targetting strongly the bioeconomy development in the EU is the Green Deal that was published in December 2019. It is 'a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use (EC, 2019). The communication presents an initial roadmap of the key policies and measures needed to achieve the European Green Deal and it is foreseen that all EU actions and policies will have to contribute to the European Green Deal objectives. The Green Deal is also seen as an important component of the EC' strategy to implement the UN-2030

Figure 1 European Green Deal overview

Sustainable Development Goals (SDGs). Many of the policies and measures needed to achieve the GD ambitions will influence the development of the bioeconomy in the EU member States and that's why this GD is explained extensively here.

In Figure 1 the elements of the Green Deal are presented, and these are further explained in the next where per element of the Green Deal we discuss the future ambitions and already existing policy instruments in place and and new policy instruments announced in the Green Deal.

EU's climate ambitions

In the Green Deal (GD) the EC proposes to further increase the EU's climate ambition for 2030 and 2050 to achieve complete climate neutrality by 2050. How to achieve climate neutrality in the EU

economy was already worked out in the EC vision ' A clean planet for all'[21] which was already published in 2018. This vision provides a long-term strategy setting out the conditions for an effective and fair transition that is clear for investors and should ensure the irreversibility of the transition. A first concrete step to implement the vision is the proposal of the first European 'Climate Law' that is now open for public consultation (anno May 2020).This ensures that the 2050 climate neutrality is going to be anchored in legislation, also at national level.

Between 1990 and 2018, the European GHG emissions have reduced by 23% while the economy grew by 61%. If the EU succeeds in implementing current policies, the GHG emissions are expected to be reduced by 60% by 2050. The GD objective is to reach complete climate neutrality in the economy by 2050. This implies that current policies need to be adjusted. The revision process start in the summer of 2020, when the EC will present a new pathway to reduce GHG emissions by 2030 to at least 50% and towards 55% of the GHG emissions in 1990. In 2021, the EC will have reviewed all relevant-climate related policy instruments and will indicate how they can be revised to reach climate neutrality by 2050. This will also include the adoption of a new, more ambitious EU strategy on climate change adaptation, an adjustment in the **Emission Trading System** and of the Regulation on land use, land use change and forestry (LULUCF) and an update in the Climate law. The carbon pricing instrument is expected to be introduced throughout the economy. At the same time the Commission will propose a carbon border adjustment mechanism, for selected sectors, to reduce the risk of 'carbon leakage'. This implies that the price of imports need to be adjusted (through for example a carbon tax) to reflect more accurately the carbon content.

Supplying renewable, clean, affordable and secure energy

The production and use of energy accounts to 75% of EU's GHG emissions which makes it logical that decarbonisation of the energy system is a key priority in the EU and a key priority in the GD. This can be reached both through more efficient energy use and through a transition to more renewable energy sources. As for the later, bioenergy is one of these sources which makes up an important part of the existing bioeconomy.

Setting targets for renewable energy production and use in the EU started already in 2006 with the publication of the "Renewables roadmap" (CEC, 2006) which resulted in the approval of the Renewable Energy Directive (2009/28/EC) (RED). It required the EU to fulfil at least 20% of its total energy needs with renewables by 2020. In December 2018 an update of the RED entered into force (Renewable

[21] A Clean Planet for all - A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy COM (2018) 773

energy directive 2018/2001/EU), as part of the 'Clean energy for all Europeans' package, with new binding renewable energy targets for the EU for 2030 of at least 32%. How these directives and additional EU policy instruments were translated towards national actions is discussed in Chaptr 4 of this report. It is clear that the Green Deal ambitions for decarbonizing the energy sector build on policy instruments and targets which were already developed at EU level since the beginning of the 21st century.

In the GD the ambitions for clean energy will translate in a further adapted energy legislation by June 2021 which will consider the revised energy and action plans the EU MSs. These had to be submitted by the end of 2019 and the EC now started the process of reviewing the national plans. It will be particularly critical in relation to national plans that are not suffiently ambitious. In case the ambitions are too low and not in line with the increased climate ambitions for 2030, as mentioned in the former section, member states are to be forced to reflect these higher energy and climate ambitions in the National and Climate Plans (NCPs) that need to be re-submitted again in 2023, following the 2-yearly reporting obligation set out in the *Regulation on the governance of the Energy Union and Climate Action*[22].

Another important ambition in the GD is the setting up of smart infrastructure to support the access to clean energy at affordable prices. A Trans-European Networks – Energy Regulation (TEN-E) was even introduced for it in 2018. This TEN-E stimulates the cross-border coorperation to achieve the benefits of clean energy at affordable prices. It aims to enhance the deployment of innovative technologies and infrastructure that modernise and make the energy sector more efficient and particularly stimulate the introduction of more renewable energy sources.

A final ambition in the GD regarding energy is to solve the issue of energy poverty for households in certain regions that cannot afford key energy services needed to reach a mnimum standard of living.

Mobilising industry for a clean and circular economy

An important ambition presented in the GD is to transform the industry and all value chains into climate neutral and circular production systems. A key action plan developed to realise this ambition is the New Circular Economy Action plan '*For a Cleaner and more competetive Europe*' (COM(2020) 98 Final) published in March 2020. In this plan the EC has described how the 'EU can accelerate the transition towards a regenerative growth model that gives back to the planet more than it takes, advance towards keeping its resource consumption within planetary boundaries, and therefore strives to re-

[22] Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action

duce its consumption footprint and double its circular material use rate in the coming decade'. It provides 'a future oriented agenda achieving a cleaner and more competitive Europe in co-creation with economic actors, consumers, citizens and civil society organisations'.

Concrete actions in this plan are:

To decarbonize and modernise energy intensive sectors such as steel, chemicals and cement industries. A High Level Group of energy intensive industries worked on recommendations on how to achieve this and all industries need to commit to these. Finances can come from the EU Emissions Trading System Innovation Fund which will help to deploy large-scale innovative projects.

Action will also specifically focus on resource-intensive sectors such as textiles, construction, electronics and plastics. For plastics for example the Commission will follow up on the 2018 plastics strategy. Measures will be introduced to tackle intentionally added micro plastics and unintentional releases of plastics (e.g. from textiles and tyres). The measures also aim to provide a regulatory framework for biodegradable and bio-based plastics, and it will implement measures on single use plastics.

Requirements will also be introduced to ensure that all packaging in the EU market is reusable or recyclable by 2030.

The Commission will propose **a sustainable product policy legislative initiative** of which the core will be to widen the Ecodesign Directive[23] beyond energy-related products to make it applicable to the broadest possible range of products and make it deliver on circularity. In this legislation the following sustainability principles will also be regulated:

- improving product durability, reusability, upgradability and reparability,
- addressing the presence of hazardous chemicals in products, and increasing their energy and resource efficiency;
- increasing recycled content in products, while ensuring their performance and safety;
- enabling remanufacturing and high-quality recycling;
- reducing carbon and environmental footprints;
- restricting single-use and countering premature obsolescence;
- introducing a ban on the destruction of unsold durable goods;

[23] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products, OJ L 285, 31.10.2009, p. 10.

- incentivising product-as-a-service or other models where producers keep the ownership of the product or the responsibility for its performance throughout its lifecycle;
- mobilising the potential of digitalisation of product information, including solutions such as digital passports, tagging and watermarks;
- rewarding products based on their different sustainability performance, including by linking high performance levels to incentives.

Measures are to be expected from the EC to encourage businesses to offer, and to allow consumers to choose, reusable, durable and repairable products.

False green washing claims will be tackled and reduced through the introduction of standard methodologies to assess products impacts on the environment, digitalisation and information access on sustainable and circular characteristics of products (e.g. electronic product passport) and encourage public authorities to ensure their procurement is green through guidance and legislation on green public purchasing.

Beside the strategies and measures announced in the ne Circular Economy Strategy, the GD also aims to secure further the access to resources, particularly for critical raw materials necessary for clean technologies, digital, space and defence applications, by diversifying supply from both primary and secondary sources.

Finally, more promotion will come from the EC for new forms of collaboration with industry and investments in strategic value chains for example through large-scale pooling of resources, in Important Projects of Common European Interest.

Building and renovating in an energy efficient way

Since buildings account for 40% of the energy consumes in the EU, it makes sense to accelerate renovations to make buildingsmore energy efficient as this would significantly contribute to reaching the climate objectives. Therefore, the EC explains in the GD that it will ' rigorously **enforce the legislation related to the energy performance of buildings'**. There are already two existing EC regulations for which the implementation at national level will be reviewed carefully and are likely to be adapted.

Firstly, the Energy Perormance of Buildings Directive which prescribes the MSs need to develop long-term renovation strategies and these strategies will be carfully assessed in 2020 by the EC. Secondly, the EC will also review the existing Construction Products Regulation[24] wih the objective to ensure that the design of new and renovated buildings at all stages is in line with the needs of

[24] Regulation (EU) No 305/2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

the circular economy, and leads to increased digitalisation and climate-proofing of the building stock.

In parallel the EC will also take 2 additional actions. One is that it will launch work on the possibility of including emissions from buildings in the European emissions trading. This will contribute to the broader efforts to ensure that the relative prices of different energy sources stimulate more energy efficiency. The second action is to set up an open platform bringing together the buildings and construction sector, architects and engineers and local authorities to review the barriers to renovation. It will also include innovative financing schemes under *InvestEU*[25].

Sustainable and smart mobility

The GD spacifies the ambition to reduce the reduction in GHG emissions in transport by 90% by 2050. This covers transport by road, rail, air and water. For this the EC will **adopt a strategy for sustainable and smart mobility in 2020** to tackle all emission reduction. Several priorities will be addressed in this strategy. Firstly, a substantial part of the 75% of inland road freight will need to shift onto rail and inland waterways. For this an increase in the capacity of railways and inland waterways will be proposed by the EC by 2021. Secondly, the EC will also consider withdraw and presenting a new proposal to revise the Combined Transport Directive[26] . Thirdly, for aviation the EC work on adopting the EC's proposal on the ' Single European Sky' which is meant to help achieve significant reductions in aviation emissions. This will also address current tax exemptions for aviation (and maritime fuels).

Furthermore, the EC will propose to extend the European emissions trading to the maritime sector and to reduce the EU Emissions Trading System allowances for free to airlines. Beside this there will also be renewaed attention for achieving effective road pricing in the EU for which already in 2017 a proposal was launched[27] which needs to still be reviewed by the EP and the Council.

[25] InvestEU Programme builds on the successful model of the Investment Plan for Europe, the Juncker Plan. It will bring together, under one roof, the European Fund for Strategic Investments and 13 EU financial instruments currently available. Triggering at least €650 billion in additional investment, the Programme aims to give an additional boost to investment, innovation and job creation in Europe. See: https://ec.europa.eu/commission/priorities/jobs-growth-and-investment/investment-plan-europe-juncker-plan/whats-next-investeu-programme-2021-2027_en

[26] Proposal for a directive amending Directive 92/106/EEC on the establishment of common rules for certain types of combined transport of goods between Member States COM(2017) 648

[27] Called , the 'Eurovignette' Directive which is a proposal for a directive amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructure COM(2017) 275 .

Given the large shifts needed in fossil basec road transports to electric and other renewable sources the EC will also consider development stimulation and legislative options to build out the network (public) refuelling and recharging points, boost the production and uptake of sustainable alternative fuels for the different transport modes. The Commission will also review the Alternative Fuels Infrastructure Directive[28] and the TEN-T Regulation to accelerate the deployment of zero- and low-emission vehicles and vessels.

Trans-European Transport Network (TEN-T) policy supports the completion of 30 Priority Projects to develop a well-runing transport infrastructure in the whole EU. The development of the TEN-T network is supported through different programmes and projects in this network are eligible for EU grants to cofinance natonal initiatives in improving the transport network[29].

Finally, the EC will also address the pollution related to transport. More stringent air pollutant emissions standards for combustion-engine vehicles throuh a revised the legislation on CO_2 emission performance standards for cars and vans by June 2021. This will also involve a the pplication of European emissions trading to road transport. Finally, the polluting emissions in the maritime transport and improvements in air quality near airports will be addressed by the EC.

From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system

The aim of the EC as communicated throuh the GD is to improve further the sustainability of food production, declining emissions, pollutions and other negative impacts of natural resources further related to this food production. For this it is planned that the EC launches a 'Farm to Fork' Strategy in spring 2020 and a broad stakeholder debate. This will adress a wide number of ambitions for improving sustainability in agriculture and fisheries sector. At this moment the EC already proposes that for at least 40% of the new Common Agricultural Policy's (2021 to 2027) budget and at least 30% of the Maritime Fisheries Fund would contribute to climate action. Since the GD ambitions have been published only in December 2019 it is foreseen that the new CAP will be delayed (to beginning of 2022). This will enable the EC to review the strategic plans for agriculture developed by all MSs in the process of preparing the new CAP en to ensure that they also reflect the climate and wider environmental ambitions in the GD and the 'Farm to Fork' strategy. The plans need to enhance

[28] Directive 2014/94/EU on the deployment of alternative fuels infrastructure

[29] For more information see: https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/site/en/funding.html

further sustainable practices in agriculture, and the ones mentioned include precision agriculture, organic farming, agro-ecology, agro-forestry and stricter animal welfare standards. Through eco-schemes farmers should be rewarded for improved environmental and climate performance such as managing and storing carbon in the soil, and improved nutrient management to improve water quality and reduce emissions. The strategic plans also need to address the Farm to Fork ambition of reducing the use and risk of chemical pesticides, of fertilisers and antibiotics. Increasing circularity in agriculture to reduce the environmental impact of the food processing and retail sectors is also addressed by for example improving efficiency and resource efficiency in transport, storage, packaging and avoiding food waste, developing new innovative food and feed products and new sources of proteins. A last ambition in the Farm to Fork Strategy is to strive to stimulate sustainable food consumption and promote affordable healthy food for all. Several measures are announced of which one it to not allow imported food that does not comply with relevant EU environmental standards on EU markets.

Also for fisheries the EC will work with the MSs to develop sustainable seafood as a source of low-carbon food.

Preserving and restoring ecosystems and biodiversity

Currently the EU is not meeting some of its most important environmental objectives for 2020, such as the Aichi targets under the Convention on Biological Diversity and worldwide the IPBES 2019 Global assessment showed that loss of biodiversity continues at an alarming high rate. This while the EC acknowledges that Ecosystems provide essential services such as food, fresh water and clean air, and shelter. Therefore the EC will present a Biodiversity Strategy (expected March 2020), to be followed up by specific Action in 2021. The strategy will outline the EU's position at the Conference of the Parties to the Convention on Biological Diversity in Kunming, China, in October 2020. The strategy will present commitments to address the main causes of biodiversity loss in the EU which will be underpinned by measurable objectives that address the main causes of biodiversity loss. One concrete measure would for example be drafting a nature restoration plan and will look at how provide funding to help Member States to reach this aim. Also special attention will be for the EU's forested area which is under pressure of climate change and needs to improve, both in quality and quantity. Finally it is mentioned that also the blue economy needs to be supported as the role of oceans in mitigating and adapting to climate change is increasingly recognised.

A zero pollution ambition for a toxic-free environment

The last ambition in the GD is to create a toxic free environment. Masures need to focus on preventing pollution. To address these interlinked challenges, the Commission will adopt in 2021 a zero-pollution action plan for air, water and soil. Part of this plan will be to take measure to restore

the natural functions of ground and surface water. In this process the EC will also draw on the lessons learnt from the evaluation of the current air quality legislation[30], propose to strengthen provisions on monitoring, modelling and air quality plans to help local authorities achieve cleaner air. This will be followed by a revision in air quality standards to align morey with the World Health Organization recommendations. This will also go together with a review current EU measures to address pollution from large industrial installations. Lastly, a chemicals strategy for sustainability will be proposed that will both help to protect citizens and the environment better against hazardous chemicals and encourage innovation for the development of safe and sustainable alternatives.

[30] Fitness check of the Ambient Air Quality Directives SWD(2019) 427

Annex III Circular Economy Strategy 2020 explained

The new Action Plan announces initiatives for the entire life cycle of products, from design and manufacturing to consumption, repair, reuse, recycling, and bringing resources back into the economy. It introduces legislative and non-legislative measures and targets areas where action at the EU level brings added value. The Action Plan is at the core of the European Green Deal, the EU roadmap towards climate-neutrality. Half of total greenhouse gas emissions come from resource extraction and processing. It is not possible to achieve the climate-neutrality target by 2050 without transitioning to a fully circular economy.

The aim of the Action Plan is to reduce the EU's consumption footprint and double the EU's circular material use rate in the coming decade, while boosting economic growth. This will be done in full cooperation with stakeholders and business. Applying ambitious circular economy measures in Europe can increase EU's GDP by an additional 0.5% by 2030 and create around 700,000 new jobs.

1. MEASURES

1.1. for products:

At present, many products break down too quickly, cannot be reused, repaired or recycled, or can only be used once. This linear pattern of production and consumption ("take-make-use-dispose") does not give producers an incentive to make more sustainable products. The Sustainable Product Policy Framework aims to change this situation with actions to make green products more real and consumed. The rules will also aim to reward manufacturers of products based on their sustainability performance and link high performance levels to incentives.

A new Sustainable Product Policy Framework includes three main building blocks – actions on product design, on empowering consumers and on more sustainable production processes.

1.2. on design:

The Commission will launch a sustainable product legislative initiative (date tbc). This initiative will have at its core a proposal to widen the Ecodesign Directive beyond energy-related products. The approach is to make the Ecodesign framework applicable to the broadest possible range of products and make it deliver on circularity.

As part of this legislative initiative, and, where appropriate, through other instruments, the Commission will consider establishing sustainability principles. The new rules will in particular address the need to improve product durability, reusability, upgradability and reparability, addressing the presence of hazardous chemicals in products and increasing the recycled content in products. We will also aim at restricting single-use and countering premature obsolescence. Introducing a ban on the destruction of unsold durable goods will also be part of the measures.

The Commission will launch a European Circular Dataspace to mobilise the potential of digitalisation of product information, introducing for example digital product passports.

1.3. for consumers and public buyers:

The Commission will work towards strengthening the reparability of products. The aim is to embed a "right to repair" in the EU consumer and product policies by 2021.

The Plan foresees also actions to give consumers more reliable information about products at the point of sale, including on their lifespan and other environmental performance. The Commission will propose that companies substantiate their environmental claims by using Environmental Footprint methodologies. Stricter rules will be proposed to reduce greenwashing and practices such as planned obsolescence.

New measures will increase the uptake of green public procurement, such as introducing minimum mandatory green criteria or targets for public procurement.

2. TARGETS to contribute to climate-neutrality goals by 2050

Between 1970 and 2017, the global extraction and processing of materials, such as biomass, fossil fuels, metals and minerals tripled – and it continues to grow, causing greenhouse gas emissions, biodiversity loss and water stress.

The circular economy model where value and resources are maintained in the economy for as long as possible and waste generation is minimised, reduces pressures on natural resources.

The circular economy can make a decisive contribution to the decarbonisation of our economy. In the past few years only, several studies have shown the substantial potential of circularity as a tool for climate mitigation.

The Commission will step up the synergies between achieving circularity and climate neutrality. All actions in the Action Plan will contribute to reducing both EU's carbon and material footprint. In parallel, the Commission will work with Member State to promote circularity in future revisions of the National Energy and Climate Plans (NECP) and in other climate policies.

2.1. electronics and ICT

The Action Plan proposes setting up a 'Circular Electronics Initiative' to promote longer product lifetimes through reusability and reparability as well as upgradeability of components and software to avoid premature obsolescence.

The sector will be a priority area for implementing the 'right to repair'. The Commission is aiming to adopt new regulatory measures for mobile phones, tablets and laptops under the Ecodesign Directive, as well as new regulatory measures on chargers for mobile phones and similar devices. An EU-wide take back scheme to return or sell back old mobile phones, tablets and chargers will also be considered.

2.2. textiles

The Action Plan announces a policy framework which will aim to strengthen industrial competitiveness and innovation, boosting the EU market for sustainable and circular textiles, including the market for textile reuse, and driving new business models.

Textiles are the fourth highest-pressure category for the use of primary raw materials and water, and fifth for greenhouse gas emissions. This future strategy will boost the market for sustainable and circular textiles, including the market for textile reuse. It will support new consumption patterns and business models. The Commission will also provide guidance on separate collection of textile waste, which Member States have to ensure by 2025.

The Commission will work with the industry and market actors to identify bottlenecks in circularity for textiles and stimulate market innovation.

2.3. plastics

The Action Plan builds on the 2018 Plastics strategy, and focuses on increasing recycled plastic content. Mandatory requirements on recycled content will be suggested in areas such as packaging, construction materials and vehicles.

The Action Plan addresses also challenges related to microplastics and sourcing and use of bio-based plastics bio-based and biodegradable plastics. The latter focuses on assessing genuine environmental benefits, going beyond reduction in using fossil resources and the applications where such use can be beneficial to the environment, and of the criteria for such applications.

2.4. construction and buildings

The building sector consumes about 50% of all extracted material and is responsible for more than 35% of the Union's total waste generation.

The Commission will adopt a new comprehensive Strategy for a Sustainable Built Environment to promote circularity principles throughout the whole lifecycle of buildings. The Commission will propose to revise the Construction Product Regulation, which may include recycled content requirements for certain construction products.

2.5. packaging

The amount of materials used for packaging is continuously growing and in 2017 packaging waste in Europe reached 173 kg per inhabitant – the highest level ever.

The Commission will propose measures to ensure that the increase in the generation of packaging waste does not go against the CEIP principals, by means including by setting targets and other waste prevention measures.

The Commission's aim is to make all packaging placed on the EU market reusable or recyclable in an economically viable way by 2030. The Commission will propose to reinforce the mandatory essential requirements for all packaging placed on the EU market.

2.6. batteries and vehicles

The Commission will propose a new regulatory framework for batteries. It will include measures to improve the collection and recycling rates of all batteries and ensure the recovery of valuable materials, sustainability requirements for batteries, the level of recycled content in new batteries, and the provision of information to consumers.

The Commission will propose the revision of the rules on end-of-life vehicles in order to improve recycling efficiency, as well as rules to address the sustainable treatment of waste oils.

2.7. food

An estimated 20% of the total food produced is lost or wasted in the EU. The Commission will propose a target on food waste reduction as part of the EU Farm-to-Fork Strategy. That Strategy will address the entire food value chain to ensure the sustainability of the sector – strengthening efforts to tackle climate change, protect the environment and preserve biodiversity.

The Commission will launch analytical work to determine the scope of a legislative initiative on reuse to replace single-use food packaging, tableware and cutlery by reusable products in food services.

2.8. in production processes

Circularity is an essential part of a wider transformation of industry towards climate neutrality and long-term competitiveness. In synergy with the objectives laid out in the Industrial Strategy, the Commission will enable greater circularity in industry by:

- assessing options for further promoting circularity in industrial processes in the context of the review of the Industrial Emissions Directive,
- facilitating industrial symbiosis by developing an industry-led reporting and certification system, and enabling the implementation of industrial symbiosis;
- supporting the sustainable and circular bio-based sector through the implementation of the Bioeconomy Action Plan;
- promoting the use of digital technologies for tracking, tracing and mapping of resources;
- promoting the uptake of green technologies through a system of solid verification by registering the EU Environmental Technology Verification scheme as an EU certification mark.

3. HORIZONTAL ASPECTS

3.1. waste

Preventing waste from being created in the first place is key. Once waste has been created, it needs to be transformed into high-quality resources. The Commission will put forward waste reduction targets for more complex streams and enhance the implementation of the recently adopted requirements for Extended Producer Responsibility schemes, amongst other actions.

The Commission will continue modernising EU waste laws. Rules on waste shipments facilitating recycling or re-use within the EU will be reviewed. This will also aim to restrict exports of waste that cause negative environmental and health impacts in third countries by focusing on countries of destination, problematic waste streams and operations.

The Commission will also consider how to help citizens to sort their waste though an EU-wide harmonised model for separate collection of waste and labelling.

3.2. innovation and investments

Many EU funds will be mobilised to support the transition to a circular economy – from the EU Cohesion funds, the European Regional Development Fund and the LIFE programme. The Action Plan also includes actions to mobilise private financing in support of the circular economy through EU financial instruments such as InvestEU.

3.3. international level (beyond the EU borders)

The Action Plan proposes the launch of a Global Circular Economy Alliance to explore the definition of a 'Safe Operating Space', kick-starting a discussion on a possible international agreement on the management of natural resources. Moreover, the Commission will lead efforts at the international level to

reach a global agreement on plastics, and promote the uptake of the EU's circular economy approach on plastics.

3.4. creating a well-functioning EU market for secondary raw materials

Secondary raw materials face a number of challenges in competing with primary raw materials for reasons not only related to their safety, but also to their performance, availability and cost. A number of actions are foreseen in this Plan, notably introducing requirements for recycled content in products. The Commission will assess the scope to develop further EU-wide end-of-waste criteria for certain waste streams based on monitoring Member States' application of the revised rules on end-of-waste status and by-products, and support cross-border initiatives for cooperation to harmonise national end-of-waste and by-product criteria.

3.5. Circularity as a prerequisite for climate neutrality

In order to achieve climate neutrality, the synergies between circularity and reduction of greenhouse gas emissions need to be stepped up. The Commission will analyse how the impact of circularity on climate change mitigation and adaptation can be measured in a systematic way; improve modelling tools to capture the benefits of the circular economy on greenhouse gas emission reduction at EU and national levels; promote strengthening the role of circularity in future revisions of the National Energy and Climate Plans and, where appropriate, in other climate policies.

Also, the Commission will explore the development of a regulatory framework for certification of carbon removals based on robust and transparent carbon accounting to monitor and verify the authenticity of carbon removals.

3.6. Circularity in economic indicators

The Commission has already taken a series of initiatives in the EU Taxonomy Regulation, and carrying out preparatory work on EU Ecolabel criteria for financial products. The Circular Economy Finance Support Platform will continue to offer guidance to project promoters on circular incentives, capacity building and financial risk management. The Commission will: enhance disclosure of environmental data by companies in the upcoming review of the non-financial reporting directive; support a business led initiative to develop environmental accounting principles that complement financial data with circular economy performance data; encourage the integration of sustainability criteria into business strategies by improving the corporate governance framework; reflect objectives linked to the circular economy as part of the refocusing of the European Semester and in the context of the forthcoming revision of the State Aid Guidelines in the field of the environment and energy.

4. MONITORING

In 2021, the Commission will update the existing monitoring framework with indicators related to the current action plan and reflecting the interlinkages between circularity, climate neutrality and the zero pollution ambition. Indicators on resource use, including our consumption and material footprints will also be further developed. The Commission will also reinforce the monitoring of circular economy national plans and other national circular economy measures, including under the efforts to refocus the European Semester process towards integrating a stronger sustainability dimension.

Annex IV Long list of policies

ID	Country implemented	Policy instrument (name)	Describe main aim of the instrument
1	AT	Recycling of waste wood	This directive aims to efficiently recycle of old wood by the wood industry. The application of wood has the same environmental risks as the usage of primary wood materials.
2	AT	Austrian landfill tax, known as the 'Altlastensanierungsbeitrag' ('ALSAG')	Tax to fund the identification and clean-up of contaminated land and landfill sites stimulating treatment and recycling of waste and clean-up of contaminated (by landfill) sites. The tax was charged on 2 waste types: ATS 200 (EUR 14.53) per tonne for hazardous wastes and ATS 40 (EUR 2.91) per tonne for all other wastes (Umweltbundesamt, 2000). It also includes a landfill ban on waste with total organic carbon (TOC) content of over 5%, effectively banning all municipal solid waste (MSW) from being landfilled without pre-treatment.
3	AT	Appoint waste advisors	Municipal waste advisers are seen as one of the biggest success stories in public waste management.
4	BE	2010 Waste Management Plan of the Brussels-Capital Region included a proposal for putting waste adviser services at the disposal of businesses.	The Brussels Waste Network programme was created as a joint initiative of the environmental administration of the region (Bruxelles-Environnement) and the Brussels Enterprises Commerce and Industry in Brussels (BECI). The aim is to organise and coordinate a network of waste advisers that corresponds to the needs and challenges faced by businesses in the region.
5	BE	Tax regulation mechanism for biofuel producers from rapeseed oil	Biofuel from rapeseed oil produced by a natural or legal person who directly sells its production to the end consumer without intermediary can be exempted from excise duty.
6	BE, NL, LU	Pay as you Throw (PAYT) schemes	Local authorities in Belgium, the Netherlands and Luxembourg introduced PAYT to increase recycling and reduce residual waste collected from households.
7	BE-Flanders	Decision of the Flemish Government of 27 June 2003 on the recognition and subsidizing of forest groups and the way in which members of the ANB (Nature and Forest Agency) may participate in approved forest groups	The high requirements imposed on forest owners are compensated by different forms of subsidies and other simulative measures.
8	BE-Flanders	Generic R&D instruments	Companies and research institutes can apply for subsidies to conduct R&D. Subsidy percentages vary according to the maturity of the research.
9	BE-Flanders	Spearhead cluster policy	It is a network support structure for different sectors to create R&D consortia, and is linked with an earmarked R&D budget.
10	BE-Flanders	Moonshot policy	The moonshot programme wants to develop new technological solutions to enable Flemish industry to become carbon neutral in 2050. So long-term high risk research is needed.
11	BE-Flanders	Flanders Future Tech Fund	Non-bankable projects risk not to find funding at conventional institutes. So pilot installations do not find funding and are not built. The Flanders Future Tech Fund was created to bridge this gap. The FFTF funds pilots to industrialize these solutions. The business model of the plant has to be private and the income is generated not by sales, but by intellectual property and licensing of the developed solutions.

ID	Country implemented	Policy instrument (name)	Describe main aim of the instrument
12	BE-Wallonia	Subsidy (Subventions UREBA)	UREBA subsidies aim at supporting public bodies such as towns and provinces in their initiatives to reduce the energy consumption of their buildings. Projects using renewable energy sources are subsidized.
13	DE	Cluster Initiative Bavaria	The Bavarian Cluster Initiative concentrates on seventeen branches and technologies with high importance for the future of Bavaria. By promoting cooperation between companies and research institutions the Bavarian state government aims to create a dynamic and self organising process of growth and development.
14	DE	Bavarian Bioeconomy Council	Advising the Bavarian State on the further development of the bioeconomy. As an independent advisory body, it draws up recommendations and provides impetus for the development of a Bavarian bioeconomy strategy
15	DE	Funding Programme "BioKlima"	Bavaria wants to achieve significant reduction in energy-related CO2 emissions to 5.5 tonnes per capita by 2025. --> Support for investments in biomass heating plants (min 60 KW) for efficient energetic use of solid biomass Only natural wood and natural straw-like biomass may be used as fuels. Funding in form of non-repayable grants (project funding) as partial financing (30-40% of eligible costs)
16	DE	BayBIOTECH project network	Academic project network for resource conserving, application-oriented industrial biotechnology
17	DE	New materials in Bavaria	Research, development and testing of modern materials and new process technologies
18	DE	Bavarian Research Foundation	Funding guidelines: energy and environment
19	DE	Departmental research framework	Funding of innovative research and development projects, e.g. "Innovative renewable raw materials for energy and bioeconomy"
20	DE	Pay as you throw, Aschaffenburg, DE	The PAYT scheme with weight-based waste collection of residual waste and biowaste as well as separate collection of paper from all households, the operation of recycling facilities and composting/incineration of green cuttings in all bigger municipalities, the PAYT approach for collection, processing and disposal of bulky waste since 1999, disposal of the residual waste in an incineration plant according to BAT standards, anaerobic digestion of biowaste, subsidies for composting at the household level, for the use of reusable nappies
21	DE	Increase manure in biogas plants	DungG Increasing the manure amount going into biogas plants, so the amount of biogas produced from manure is stimulated to increase
22	DE	Ordinance on Electricity from Biomass (BiomasseV)	Regulates the generation of electricity from biomass
23	DE	2000, 2014 and 2017 Renewable Energy Sources Acts EEG	Law for the Priority of Renewable Energies. Small RES-E plants up to 100 kW are eligible for feed-in tariff. For most technologies, there is an annual degression. PV, wind onshore, wind offshore and biomass are the eligible renewable energy technologies for tenders. For each technology target corridors have been defined.

ID	Country implemented	Policy instrument (name)	Describe main aim of the instrument
24	DE	Renewable Energies Heat Act (EEWärmeG)	Under Renewable Energies Heat Act, builders of new buildings are required to generate a percentage of their heating requirements from renewable sources of energy, to undertake certain compensatory measures such as installing additional insulation, or to use combined heat and power systems or district heating.
25	DE	Market Incentive Program (MAP)	Market Incentive Program (MAP) supports installations of renewable heating and cooling technologies in existing industrial and commercial buildings. Both the German Development Bank (KfW) and the Federal Office of Economics and Export Control (BAFA) offer financial support for renovations of heating systems under the MAP.
26	DE	Support programme 'Use of biomass as an energy source'	It provides support to practically oriented solutions, of a demonstration-model and pilot-project type, that help to achieve greater flexibility in generating electricity and heating from biomass. It is primarily the potential of biomass residual matter and waste material that is to be opened up, to improve sustainable use for energy in the (coupled) activity areas of heating and electricity.
27	DE	Funding programme "Renewable raw materials"	Research, development and demonstration projects on renewable raw materials
28	DE	National Bioeconomy Strategy	Six strategic objectives are formulated: - Develop bio-economic solutions for the sustainability agenda - Recognize & develop the potential of bioeconomy within ecological limits - Expand and apply biological knowledge - Orienting the resource base of the economy towards sustainability - Develop Germany into the leading innovation location in the bio-economy - Involving society, intensifying national and international cooperation
29	DE	7th Energy Research Programme	Funding R&D, demonstration and testing of sustainable strategies and concepts for implementing energy and climate policy goals
30	DE	Funding programme "Energy efficiency in the economy"	Investment funding with the aim of increasing energy efficiency by industry and expanding the share of renewable energies for the provision of process heat
31	DE	Funding measure "KlimPro Industry"	Enable the German basic materials industry to develop processes that avoid greenhouse gases and to put them into practice in the medium to long term. To this end, new technologies or combinations of technologies are to be developed and applied on an exemplary basis that contribute as far as possible to the direct avoidance of greenhouse gases in industry.
32	DE	FONA[3]	Framework Programme to support research for sustainable development to implement the National Sustainability Strategy and the High-Tech Strategy of the Federal Government.
33	DE	Platform „Chemistry4Climate" + Roadmap Chemistry 2050	Expert group between the German Chemical Industry Association (VCI) and the Association of German Engineers (VDI). The aim is to develop proposals for solutions that will meet with a broad consensus.

ID	Country implemented	Policy instrument (name)	Describe main aim of the instrument
34	DE	Crops of the future	Application of molecular precision breeding in crops, conservation of local biodiversity, stabilization of crop yields, increasing performance potential of crops, improving resistance of plants (e.g. against heat/cold, drought)
35	DE	Circular Economy Act (KrWG) =German federal waste law	Conservation of natural resources and the safeguarding of environmentally compatible waste management
36	DE	Funding program "From material to innovation"	Funding of collaborative projects on material innovations, e.g. in the area of sustainable and efficient use of resources such as raw materials, materials and energy.
37	DE	Environmental innovation program	Funding of innovative large-scale pilot projects with a demonstrative character and environmental relief potential
38	DE	Biowaste regulation (BioAbfV)	Recycling of bio-waste on agricultural, forestry and horticultural soils -> restrictions for products made of compostable plastics
39	DE	Packaging law (VerpackG)	Avoiding and reducing the impact of packaging waste on the environment -> promoting the use of renewable raw materials provided the packaging is recyclable
40	DK	Act on the Carbon Dioxide Tax on Certain Energy Products	The Act on the Carbon Dioxide Tax on Certain Energy Products and the Act on the Energy Tax on Mineral Oil Products oblige companies producing, processing, possessing, receiving or dispatching energy products to pay a defined amount of tax (§ 1 Act 313/2012 and § 2 Act 321/2011). This amount is lower if the fuel is blended with biofuels (Annex 2 Act 313/2011). Biogas (for stationary engines >1000kW) also has a specific tax. Renewable energy sources are not subject to tax under this act.
41	ES	Orden 29/12/2011 regulating forest biomas use for energy	This regulation aims to regulate which forest biomass coming from different types of forest areas can be used as renewable resources for energetic use.
42	ES	Decree 4/2011 regulating use of effluents from olive oil industry as fertilizers	The objective of this decree is to stablish juridical status for the use as agricultural fertilizer of the biomass resulted from virgin olive oil extraction at the mills.
43	ES	Biomass for heating in buildings (BIOMCASA II)	The Biomcasa II and GIT programmes financed biomass projects for thermal use in buildings or industries through the Energy Service Companies (ESCOs). They are based on the design, execution, operation, maintenance, supply of fuel and billing of services by those businesses in line with the energy supplied.
44	ES	Regulation of Guarantees of Origin (GOs) of electricity produced from RES and high efficiency CHP generation plants	It regulates the Guarantees of Origin's contribution to the electricity produced from renewable energy sources and to be used as evidence for the final consumer that a certain amount of energy has been produced from such sources, as well as to simplify the electricity trade from renewable energy sources and high efficiency CHP power plants.
45	ES	RD 254/2016 regulatory bases for the concession of subsidies for projects for the sustainable supply of biomass between agents that receive or provide it, destined for the production of energy to be used in the transformation of agri-food products.	The purpose of this royal decree is to establish the regulatory bases for the concession of subsidies for the financial support of cooperation projects for the sustainable supply of biomass between agents that receive or provide it, destined for the production of energy to be used in the transformation of agri-food products. The cooperation will involve at least two of the following figures, a priority associative entity, a supra-autonomous agri-food SME or another natural or legal person, with

ID	Country implemented	Policy instrument (name)	Describe main aim of the instrument
			the participation of a priority associative entity or a supra-autonomous agri-food entity.
46	ES	RD 947/2015 to grant specific concessions to access the grid in the electricity distribution system in Spain for new installations	This royal decree aims to grant specific concessions to access the grid (in the electricity distribution system in the Iberian peninsula) for new installations for the production of electrical energy from biomass located in the peninsular electrical system and for installations of wind technology to systems/ electric energy generation plants using biomass and wind technology plants
47	FR	Crédit Impôt Recherche (CIR).	This credit on research expenditure that companies can rely on. 30% of R&D expenditure with a ceiling of 100 million euros.
48	HU	Government Decree No 279/2017. on sustainability requirements and certification of biofuels and bioliquids	Compliance with European Union law in Hungary in terms of sustainability requirements and certification of biofuels and bioliquids.
49	HU	Brown premium	Brown premium is the operating aid provided for biomass/biogas power plants after their green premium expired (15 years). This serves the maintenance of the biomass and biogas power plants' competitiveness by paying for plants the difference between fossil and alternative fuel based electricity production costs. “Alternative” brown premium is given to the plants which are able to use both fossil and alternative fuels. The goal is to encourage plants to use more alternative and less fossil fuels. It is a fix premium based on the difference between fossil and alternative fuel based electricity production costs.
50	HU	NFM (Ministry of National Development) decree 1/2012. (I. 20.) on the methodology for calculating the share of energy from renewable sources	Compliance with European Union law to produce renewable energy
51	HU	VP5-8.6.1-17 Investments in forestry technologies and processing and marketing of forest products - EAFRD funding	This is a call under the Hungarian Rural Development Programme focusing on purchase of forestry machinery and equipment, purchase of machinery for preparing wood products and development for processing or storing wild mushrooms, herbs and wild fruits - RDP Priority 5: Resource-efficient, Climate-resilient Economy, FA 5C: Facilitating the supply and use of renewable sources of energy
52	HU	VP3-4.2.1-4.2.2-18 Adding value to processing of agricultural products - EAFRD funding	The call covers among others the financing of the application of renewable energy strategies. Partial aim of the call: energy demand of food processing plants and wineries should be covered by renewable energy sources (e.g. biogas production, biomass based systems) - RDP Priority 5: Resource-efficient, Climate-resilient Economy, FA 5B: Increasing efficiency in energy use in agriculture and food processing

ID	Country implemented	Policy instrument (name)	Describe main aim of the instrument
53	HU	VP5-8.1.1-16 Supporting afforestation - EAFRD funding	It is a measure assisting afforestation. - RDP Priority 5: Resource-efficient, Climate-resilient Economy, FA 5E: Fostering carbon conservation and sequestration in agriculture and forestry.
54	HU	VP5-8.6.2-16 - Activities to mobilize forest production potential - EAFRD funding	A measure to mobilize forest production potential. A call contributing to RDP Priority 5: Resource-efficient, Climate-resilient Economy, FA 5C: Facilitating the supply and use of renewable sources of energy
55	IT	Renewable heat incentive	Price-based scheme (Conto Termico) is in place in Italy for small RES-H sources. Heat pumps (aerothermal, geothermal, hydrothermal), biomass and solar thermal are eligible technologies and the incentive is granted for a period varying between 2 and 5 years. Furthermore, a tax regulation system is currently in place for the promotion of RES-H. Conto Termico and Tax detractions can not be combined
56	IT	Biomethane Decree	Support bio-methane injection (into the gas network). - Support electricity from bio-methane. - Stimulate the use of biomethane in the transport sector.
57	**IT**	The policy document is the regional Smart Specialization Strategy, the specific instrument are Innovation Poles and Bioeconomy Technological Platform	S3 strategy aims to support the regional development. The bioeconomy area is present in the S3, and the main instruments adopted are the bioecnomy Technological Platform and the Innovation Poles described below.
58	**IT**	Bioeconomy Technological Platform (Smart Specialisaton Strategy)	Technological Platform aims at supporting industrial research and experimental development through collaborative projects by private and public actors, in order to foster the up taking of technologies and knowledge in the SMEs and BEs, with the active participation of research entities.
59	**IT**	Innovation Poles (Smart Specialization Strategy)	The poles are designed to make available facilities and services with high added value, and interpret the technological needs of companies. The beneficiaries may apply for regional co-financing.
60	**IT**	Regional energy environmental Plan	1. Support the development of energy production from renewable sources (among the actions included, there is "improve the efficiency in the use of solid biomasses and support the supply from short-value chain") 2. Lower the energy consumption (in public and private buildings, transport, industries) 3. Enforce the energy infrastructures (among the actions, "promote the adoption of tele-heating in urban areas, valorizing the heat coming from cogeneration processes of already existing plants using biomasses and wastes") 4. Promote the Green Economy on the regional territory (among the actions, "support the development of local energy value-chains (agriculture, manufacture, forestry, sustainable building)"; "promote initiatives of sustainable territorial development")
61	NL	SDE+ (Subsidie Duurzame Energie)	The SDE+ is an incentive scheme for the production of renewable energy in the Netherlands. It is an operating (feed-in-tariff) subsidy.
62	NL	Periodic monitoring of progress bioeconomy	The Dutch parliament had requested that the progress of the bio-based economy is monitored on a regular basis

ID	Country implemented	Policy instrument (name)	Describe main aim of the instrument
63	NL	Research agenda bio-based economy	The topsector bio-based economy has developed a research agenda 2015 - 2027 to guide research activities to support the bio-based economy
64	NL	Sustainability framework for biomass	To secure the sustainable use of biomass, the policymakers are developing a framework with guiding principles on the use of biomass
65	PL	Strategy for sustainable rural development, agriculture and fisheries 2030	On 15 October 2019 the Council of Ministers adopted a Resolution on the adoption of the "Strategy for Sustainable Rural Development, Agriculture and Fisheries 2030". It is a basic strategic document of the country's agricultural and rural development policy, presenting the objectives, directions of intervention and actions to be undertaken in the perspective of 2030.
66	PL	National Energy and Climate Plan for the years 2021-2030	Poland's National Energy and Climate Plan for the years 2021-2030 (NECP) has been developed in fulfilment of the obligation set out in Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action […] and was submitted to the European Commission in connection with Article 9 of this Regulation.
67	PL	Rural Development Programme for Poland	RDP inter alia promotes the sustainable management of natural resources (soils, water protection, traditional orchards and fruit tree varieties) and protecting valuable habitats, such as Natura 2000 sites, as well as moves to protect endangered traditional local livestock breeds and local crop varieties.
68	PL	Polish Circular Economy Roadmap	1. Sustainable industrial production a. Industrial waste b. Extended Producer Responsibility c. Environmental Footprint 2. Sustainable Consumption a. Municipal waste b. Food waste c. Education 3. Bioeconomy a. Ensuring framework conditions for bioeconomy development b. Building local value chains and a resource base c. Actions in the field of energy d. Actions in the field of industry 4. New business models
69	SK	National programme of utilization of wood potential in the Slovak Republic	The programme has 5 strategic priorities, including the achievement of increased use of forest biomass, as well as by-products in the processing of wood for energy purposes.
70	SK	Microloan programme	The programme, implemented since 1997, is intended to provide loans to small businesses. The microloan can be used for procuring movable and non-movable investment property, reconstruction of operating spaces as well as the purchase of necessary stocks, raw material or goods and other investment projects.
71	SK	Slovak Business Angels Network	First network of business angels (angel investors) in Slovakia, established in 2011. The network involves Slovak entrepreneurs and managers who are interested in investing their expertise, time and money into start-ups.
72	UA	Loan program for bioeconomy	Cheaper loans for businesses

Annex V: Policy factsheets for 10 good policy examples

Policy Factsheet 2&3: Austrian landfill tax, known as the 'Altlastensanierungsbeitrag' ('ALSAG') and *Waste Prevention Programmes*

1. **Title policy instrument**

   Two combined instruments: Austrian landfill tax, known as the 'Altlastensanierungsbeitrag' ('ALSAG') and the Abfallvermeidungsprogramm - *Waste Prevention Programmes*

2. **Main aim of the policy instrument (short)**

Enhance waste treatment and recycling, avoid landfill and clean contaminated sites. The waste prevention programme also aims at increasing separate collection rates, saving costs and generate new follow-up jobs.

3. **Country where it is implemented**

Austria

4. **Year of first implementation**

The tax was introduced in 1989 and levied from 1990. **Landfill Ordinance** was added in 1996.
Network of municipal waste advisers, an instrument of the Waste Prevention Program, was first established in the country in 1986.

5. **Is the policy still implemented? If not specify final year of implementation.**

Yes both instruments are still implemented.

6. **Type of instrument***

The Austrian landfill tax is a financial instrument - Environmental tax – waste tax. But organised in a rregulation (imposed by law).
The Waste Prevention Program is an information and advice sharing instruments - voluntary approaches (soft instrument).

7. **Biomass value chain position targeted****

Waste recycling, end of life. End products & uses.

8. **Description of the instrument (long)**

(*What is the instrument meant to bring about, how does the instrument work, who are targeted by the instrument*)
The Austrian **landfill tax** was introduced in 1989 through the Clean-Up of Contaminated Sites Act. The tax is set at a national level for all landfill sites with rates according to weight, type of waste and the standard of technology at the landfill site and on exports of waste for the purpose of landfill deposit abroad. (Previously the Water Act had dealt with most issues regarding contaminated land and landfill sites.)

The legislation states that the landfill tax is aimed at financing the containment and treatment of contaminated sites. The activities supported from the revenue gained from landfill taxes (Altsanierungsgesetz 1989) include: • The identification of sites • The administration of sites • The direct containment and clean-up of sites • The construction or improvement of waste treatment plants

as far they are required for the clean-up of sites • The development of new technologies for containment or treatment.

The **Landfill Ordinance** (1996) introduced the **TOC ban** (TOC=total organic carbon), that entered into force in January 1997. So, waste with a total organic carbon content of greater than 5% was banned from landfills. It means that municipal solid waste had to be pre-treated through incineration or mechanical-biological treatment. The deadline for the total compliance was set for the year 2004 and for certain federal states for 2008.

Since introduction the tax has undergone significant amendment, including regular rate increases.
In the years from 1997 to 2008, the rates for all types of waste and sites increased. The highest rate charged, for Municipal Solid Waste (MSW) landfilled in a lower standard technology site, was EUR 87 per tonne from 2006 to 2008, plus a surcharge of EUR 29 per tonne where there was no impermeable liner or no vertical enclosure and a further EUR 29 per tonne where there was no landfill gas capture and treatment system.

In 2006, the tax was expanded to **include an incineration tax** of EUR 7 per tonne, and in 2008, as all landfill sites were then 'state of the art', the tax was amended to its current form. Current rates (since 2012) are as follows: landfills for construction or inert waste and soil excavation: EUR 9.20 per tonne; residual waste landfills: EUR 20.60 per tonne; and mass or hazardous waste landfills, including output from MBT: EUR 29.80 per tonne.7 Untreated MSW that is stored or exported for disposal in a lower standard landfill is taxed at EUR 87 per tonne.8 The incineration tax is EUR 8 per tonne. Several material exemptions are currently in place, e.g. for animal by-products, explosive wastes (military), wastes with high biogenic fractions and radioactive waste. Furthermore, particular activities are also exempt, including repositioning of waste, landfilling of wastes from natural disasters and use of material as part of a restoration layer or as temporary surface cover.

The federal financial authorities (Bundesfinanzbehörden) are responsible for the collection of the tax, with provincial authorities reporting possible contaminated sites to the Ministry of the Environment. The Ministry then consults the Federal Environment Agency on further investigations and distributes funds for clean-up operations. The owner/operator of any landfill site is liable to pay the tax.

As to the **Waste Prevention Programme**, which already started earlier then the Austrian Landfill tax, aims at establishing a waste advisors network. The Austrian municipal waste adviser network was established in 1986 based on the regionally or locally waste authorities. They have been involved in several local or regional programmes, which raise separate collection rates, saving the costs and creating new environmental jobs. The main idea of employing waste advisors in the local/regional authorities was to minimize the environmental problems and reduce public expenses.

The advisors help to educate the households and enterprises in order to prevent and separate better the waste instead of paying extra fees or dispose the waste incorrectly. Their communication work is mainly focused on waste prevention, reuse, separate waste collection and sustainable consumption and lifestyles in general within the local/regional context although they cover other environmental-related areas too. They ensure the efficient link-up between regional/local waste management organization and population through dedicated service hotlines or electronic newsletters. They have been also contributing in planning and implementing collection schemes, and communication projects and campaigns as well as in developing waste management strategies and concepts.

They work as a representative of public entities at different levels. They are employed by municipalities/local authorities, provincial authorities, associations under public contract, cities or provincial au-

thorities. Since the beginning, the underlying idea of employing waste advisers was to use human resources prior to legal restrictions and industrial investments to minimise environmental problems and reduce public expenses ("prevention" instead of "end-of-pipe-treatment"). Waste advisers in Austria receive a dedicated training. During the years between 1986 and 1995, it was a six-month training programme. Partly due to shrinking public funding and saturation of the job market, this initial permanent training programme has progressively been substituted by shorter training courses and learning "on the job" (Dri et al., 2018).

For municipal waste advisers, their main focus is on awareness-raising, public education of the population and PR in the field of municipal waste management but may also cover other environment-related areas such as sustainability and consumption. So their communication work is focused on waste prevention, reuse, separate waste collection and sustainable consumption and lifestyles in general within the local/regional context. Their target groups are children from schools and kindergartens, private households and small and medium-sized enterprises in their region. Interaction can be either direct (personal) or via dedicated service hotlines or electronic newsletters. Additionally, they consult their regional waste management organisations in planning and implementing collection schemes, and communication projects and campaigns. They further cooperate with private waste management companies and provincial and federal authorities for the development of (innovative) waste management strategies and concepts ((Dri et al., 2018)).

It is clear that the combination of the waste prevention program with the landfill tax strengthens the effect of both policies.

9. **Is this instrument following up on EU policy? Either transposed policy to national/regional level or a policy to reach EU policy targets/ambitions? If yes, which policy and which EU targets and ambitions?**

Yes. but Austria already started with their waste prevention program in 1986 which was earlier then the waste directive created at EU level. Now the Austrian tax and waste prevention programs facilitate the national translation of the EU's waste management policies which are:

- **Landfill Directive** - Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste (Consolidated text: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:01999L0031-20180704&from=EN)
- **Waste Framework Directive** - Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (Consolidated text: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02008L0098-20180705)
- **Packaging Directive** - European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01994L0062-20180704)

10. Can you explain the impact of the policy in type, size, time and money spent? (*Should be based on evaluations)*

The primary environmental effect of the **ALSAG tax** was to help clean up contaminated site. Over the period 1991-2000 a total of 99 contaminated sites were funded.

The requirements of the Landfill Ordinance have resulted in improved technology and lower environmental impacts at landfill sites, including reducing greenhouse gas emissions from landfills by over 80% from 1990 to 2014.

The implementation of TOC ban has been successful: in the case of municipal waste, the share of waste sent untreated to landfills fell from 28.5 per cent in 1999 to 7.7 per cent in 2004, when the ban came into effect.

Total revenues from the tax for the period 1990-2014 were around EUR 1.229 billion, with annual revenues starting at EUR 10 million in 1990, increasing rapidly from 1996 to a peak of EUR 97 million in 2003, before falling due to the effects of the landfill ban and the structure of the tax. Since 2011, the revenue has been steady at around EUR 52 million per year.

The development of the waste advisors network through the waste prevention program has been extremely effective. Over a period of three decades since they were first created (in 1986) they have been contributing to raising separate collection rates (in some regions raising them from around zero to over 70 %), saving costs and generating new follow-up jobs.

11. Why can this policy be seen as a good policy example?

As for waste management Austria is among the top performers.

- The municipal waste landfilling rate is very low (2%) compared to the EU average that amounts to 24%.
- Austria is the only Member State where the revenue from the landfill tax (around EUR 1.2 billion in total up to 2014) is used exclusively to clean up contaminated sites.
- The municipal waste recycling rate (57.7 %, of which 32 % is composting) was well above the EU level in 2017. Austria has already met the EU 2020 recycling target for municipal waste.

The strength of this example is that several policy instruments are combined that both address the waste generation, prevention and separation behaviour of the waste producing sectors (households and economic sector) and the waste processing sector.

12. Would you recommend this policy instrument to be replicate in regions in low, medium, high BBE development stage? Explain why.

Yes to low and medium BBE development stage regions for sure.

- The combination of the landfill tax and ban, alongside several other waste management policies and regulations has helped to ensure that residual waste treatment has shifted significantly away from landfilling towards other treatment methods.
- Only 4 EU Member States do not have a landfill tax at this moment (CY, DE, HR, MT). – According to data in 2017. So the instrument of landfill tax is already broadly introduced. However, the system of waste advisors is less common and is a helpfull instrument in countries where education in waste reduction and separation at the source is still limited.

13. Are there similar policy instruments implemented in other EU countries/regions? If yes explain which ones.

Yes as to landfill tax:

- 24 EU Member States have a tax (AT, BE, BG, CZ, DK, EE, EL*, ES, FI, FR, HU, IE, IT, LT,LU**, LV, NL, PL, PT, RO, SE, SL, SK, UK), as well as Norway and Switzerland.

  *: the Greek landfill tax was suspended for 2017 **: a municipal tax is applied in Luxembourg
- Tax rates vary from 3€/t (LT) to more than 100€/t (BE).

Yes the system of waste advisors also exist in some regions in the EU, although much less common instrument then the tax:

- Germany (Nuremberg), UK (North London), Belgium (Brussels-Capital Region)
- Financing the costs of advisors is through the waste fees of households and small-enterprises. Tax rates vary where this type of policy is implemented.

14. Barriers and solutions encountered in the development and implementation of this policy instrument

As for **the landfill tax** the following barriers and solutions are typical:

Barriers:

The implementation of major changes in landfill tax in short periods of time without prior announcement can be problematic in a sector which is characterised by long lead times. As such, the implementation is phased over a period of years, depending upon the rate of tax already applied in the Member State concerned.

As long as landfilling at low costs is possible and allowed, it is difficult to establish the infrastructure for a waste pre-treatment.

Solutions:

The introduction of differentiated landfill tax rates for new and state of the art landfills and older, lower standard technology landfills is intended to address an imbalance between the costs associated with developing and operating the two types of landfill. However, if the tax differential for the two types of landfills is not substantial enough to offset the additional costs, it might be difficult for new sites to compete with old ones. Landfill tax creates the opportunity to supplement different approaches of national strategies to divert Biodegradable Municipal Waste from landfills. The approach might be separate collection policy supported by additional measures such as compost ordinance regulating the quality of compost produced of waste or landfill ban, as was the case in Austria. The landfill tax promotes speeding up the implementation process of the landfill ban, that might contribute to improved waste management i.e to strong decline in the rate of municipal solid waste (MSW).

There is a strong correlation between increasing landfill tax rates and decreasing rates of landfill for MSW. So, the landfill tax level can be decreased once a low level of MSW landfilling is reached.

The landfill tax can be differentiated. The differentiation is a clear incentive to modernise the landfills.

The landfill tax might give incentives to incinerate MSW if the incineration tax is much lower than the tax on landfilling.

In order to ensure that landfill taxes generate movement of waste into upper tiers of the hierarchy, it is suggested that a tax is implemented on incineration.

The landfill tax, together with the landfill ordinance encourages recycling and recovery of waste.

The landfill tax is a revenue raising mechanism. If it is introduced at a low rate, it does not encounter significant opposition.

As for the appointment of **waste advisors** the barriers and opportunities are:

Barriers:
The major change in development of network of waste advisor at any level is to find financial instruments, which finance the setting-up and operation of the network.
Solutions:
National/regional subsidies or financing through PROs (producer responsibility organisations) can contribute to the development of such networks. The latter can be on a voluntary or regulatory basis (Dri et al. 2018).

According to Dri et al. (2018) the involvement of waste advisers could be potentially more effective than the conventional communication activities in developing expertise in different topics, feedback and capacity-building among the team and transfer of the accumulated knowledge externally. An effective network of waste advisers provides best practices if the following points are addressed:

- ***Holistic approach:*** *Even if some campaigns have a specifically targeted focus, all materials and waste streams should be considered within a broader environmental strategy. Awareness-raising actions should be prioritised in line with the waste management hierarchy. Focus should be on prevention and reuse.*
- ***Cross-cutting issues:*** *The activities of waste advisers should not only tackle waste but should also make connections to other environmental issues (including energy, biodiversity, climate, etc.) in an effort to achieve a real and lasting change of mindsets. The target audience's interests should also be considered (for example promoting reduction of food waste to save money, promoting reuse to stimulate local employment, etc.).*
- ***Consistency*** *of the message delivered by waste advisers in the territory should be sought, making sure that it is in line with the national/regional policy framework and existing technical and logistical solutions.*
- ***Coordination*** *with other organisations with the same aim in order to find possible synergies and enhance the effect of the communication.*
- ***Capitalising on the knowledge*** *waste advisers gain through their direct contact and work with the citizens in order to boost the general communication strategy and to identify specific possibilities for improvement*

15. References used and more information available at:

- Bundesministerium für Nachhaltigkeit und Tourismus, Bundes-Abfallwirtschaftsplan 2017, Wien, Dezember 2017, ISBN: 978-3-903129-69-6
- CEWEP (2017): Landfill Taxes and Bans https://www.cewep.eu/wp-content/uploads/2017/12/Landfill-taxes-and-bans-overview.pdf
- DEFRA (2008): WR1202 "Landfill bans and restrictions in the EU and US" - Case Study Annex: Austria, http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=16103
- Dri M., Canfora P., Antonopoulos I. S., Gaudillat P., Best Environmental Management Practice for the Waste Management Sector, (2018) JRC Science for Policy Report, EUR

29136 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-80361-1, doi:10.2760/50247, JRC111059

- ECOTEC (2001): 10. Landfill taxes https://ec.europa.eu/environment/enveco/taxation/pdf/ch10_landfill.pdf In: Study on the economic and environmental implications of the use of environmental taxes and charges in the European Union and its Member States.
- EEA, Overview of national waste prevention programmes in Europe – Austria, Country fact sheet, EEA, 2016
- https://ec.europa.eu/environment/enveco/taxation/environmental_taxes.htm
- ETC/SCP (2013) Municipal Waste Management in Austria. European Environment Agency, Copenhagen. Accessible at http://www.eea.europa.eu/publications/managing-municipal-solid-waste/austria-country-paper-on-municipal
- Ettlinger, S.; Bapasola, A. (Eunomia)(2015): Landfill Tax, Incineration Tax and Landfill Ban in Austria, https://ieep.eu/uploads/articles/attachments/5bcba177-793e-4ed5-acbb- ffc8e0dc238f/AT%20Landfill%20Tax%20final.pdf?v=63680923242, IN: Mikael Skou Andersen (Arhus University), Tim Elliott, Dr Chris Sherrington, Thomas Vergunst, Sarah Ettlinger, Laurence Elliott and Joe Hudson (Eunomia), Patrick Ten Brink, Sirini Withana, Paulo Razzini, Peter Hjerp, Andrea Illes, Kristof Geeraerts and Alexandru Ghiurca (IEEP) (2015): Study on Environmental Fiscal Reform Potential in 14 EU Member States: Main Report No 07.0201/2014/685390/ENV.D.2 Final Report to DG Environment of the European Commission; file:///E:/ZSIL%20UTCA%203_5/2020/POWER4BIO/T4/DRAFTS_FROM_30032020/IEEP_EUNOMIA.pdf
- Federal Ministry Republic of Austria – Finance: Combating fraud https://www.bmf.gv.at/en/topics/combating-fraud.html
- Federal Ministry Republic of Austria – Finance: Altlastenbeitrag, https://www.bmf.gv.at/themen/zoll/fuer-unternehmen/altlastenbeitrag.html

Policy factsheet 6: Pay As You Throw (PAYT) scheme Dutch municipalities

1. **Title policy instrument**

Pay As You Throw (PAYT) schemes, the example of Dutch unit based pricing schemes in different Dutch municipalities.

2. **Main aim of the policy instrument (short)**

PAYT schemes are used by local authorities in order to increase recycling and reduce residual waste collected from households.

3. **Country where it is implemented**

Netherlands. But examples and experiences are with other PAYT schemes in other EU countries under point 13 in this factsheet.

4. **Year of first implementation**

In the Netherlands the first PAYT system was already introduced in the municipality Oostzaan in 1991. The review of PAYT scheme in the Netherlands presented here is based on data on PAYT schemes starting in 1998 until recent years.

5. **Is the policy still implemented? If not specify final year of implementation.**

Yes

6. **Type of instrument***

Financial instruments

7. **Biomass value chain position targeted****

End product/uses

Biomass (reuse of biowaste)

8. **Description of the instrument (long)**

(*What is the instrument meant to bring about, how does the instrument work, who are targeted by the instrument*)

In order to promote waste prevention and recycling, a number of municipalities in the Netherlands have introduced a unit-based pricing system. Citizens obtain an incentive to sort their waste and to change their consumer behaviour. Different Dutch municipalities have introduced different types of unit-based pricing systems.

Five different PAYT systems can be identified in Dutch municipalities:

1. Weight-based pricing (Per kg of waste offered)
2. Pricing based on volume (size of the bag/bin/container)

3. Pricing per bag
4. Pricing based on frequency of collection
5. Or combinations of the above

The schemes are also different in terms of the type of waste that is charged. In some municipalities it only applies to the residual (non-biological) waste, while in others it also applies to the collection of biowaste or recyclables. Usually for these last 2 categories the charges are much lower than for residual waste. Schemes are generally applied locally at the scale at which collection systems are organised (e.g. municipality, region) and may create large differences in waste collection within regions and countries.
PAYT schemes are not taxes but cost recovery mechanisms for waste management and financial incentives to adopt more environmentally sound behaviour.

Revenues raised from the PAYT are used for covering (part of) the cost of waste management. But since the revenues are variable in a PAYT scheme (the less you waste, the less you pay) waste management cannot strictly rely only on revenues from PAYT schemes.

Levies are raised in different ways in PAYT schemes either though purchasing sacks at a set price or by paying for bin collection by weight, frequency or size directly to the local authority (Card & Schweizer, 2017). The emptying of waste containers can also be designed so that they are not emptied for households that have not paid their fees.

9. **Is this instrument following up on EU policy?** *Either transposed policy to national/regional level or a policy to reach EU policy targets/ambitions? If yes, which policy and which EU targets and ambitions?*

At the time when the first PAYT schemes were introduced in the Netherlands there was not yet any EU wide legislation that dictated this. At the time they were a response to the growing amount of municipal waste and the challenge of managing it.

But soon with the introduction of the Packaging and Packaging Waste Directive (94/62/EC) in 1994 the introduction of PAYT schemes was further stimulated. This Directive was designed by the EC to harmonize national measures concerning the management of packaging and packaging waste and to prevent or reduce its impact on the environment and ensurethe functioning of the internal market by avoiding obstacles to trade and distortion and restriction of competition. In 2004, the Directive was amended to provide criteria clarifying the definition of the term 'packaging' and increase the targets for recovery and recycling of packaging waste. In 2005, the Directive was revised again to grant new Member States transitional periods for attaining the recovery and recycling targets. In 2013 Annex I of the Directive containing the list of illustrative examples of items that are or are not to be considered as packaging was revised. The latest revision of the Packaging and Packaging Waste Directive occurred on 29 April 2015 with the adoption of Directive (EU) 2015/720 amending Directive 94/62/EC as regards the consumption of lightweight plastic carrier bags.

In the Netherlands the EC Packaging and Packaging Waste Directive (94/62/EC) let to the extended producer responsibility (EPR) scheme Nedvang. Nedvang was founded for and by producers and importers who trade packaged products. They are legally obliged to ensure the recycling of packaging waste and are therefore involved in also managing waste collected in the PAYT schemes. The Packaging

Waste Fund Foundation has taken over this responsibility from them. Monitoring and stimulation of the collection and recycling of packaging waste has been outsourced to Nedvang by the Packaging Waste Fund. Nedvang works intensively with the Dutch municipalities, waste companies, recyclers and the organizations that represent them.

Other EU wide legislation driving the further management of waste including through PAYT schemes are:

- Waste Framework Directive (2008/98/EC),
- Landfill Directive (1999/31/EC)

Also objectives of the 7th Environment Action Programme, to which all EU countries have committed, include reducing waste generation, maximising recycling and reuse, limiting incineration and phasing out landfilling where alternatives exist.

10. Can you explain the impact of the policy in type, size, time and money spent? (*Should be based on evaluations)*

Dijkgraaf (2004) did an extensive evaluation of PAYT schemes in Dutch municipalities based on data collected by the Dutch Waste Management Council (AOO). The AOO-studies present data on the pricing systems used by Dutch municipalities and the quantities of paper, glass, textiles, compostable and unsorted waste collected. Dijkgraag (2004) did and evaluation of PAYT schemesIt was based on the AOO data collected for 1998, 1999 and 2000. The results showed there were 126 municipalities out of 538 municipalities that had some form of PAYT system. The evaluation of Dijkgraaf (2004) showed that large reductions in waste resulted from PAYT schemes according to different pricing methods:

1) Effect of pricing waste on the basis of weight:

- Reduces total waste by 38%. This effect differs for the underlying waste streams.
- Compostable waste diminishes by more than 60%. Many Dutch households started using a home composting method.
- Unsorted waste—the most environmentally unfriendly waste stream—reduced by nearly 50%. The explanationof this reduction is that the amount of recyclable waste increases when a weight-based system is applied so that higher efforts are put in recycling glass, paper and textiles (up 21%), for which no collection cost are charged. Given the cross-price effect, the net decrease in unsorted waste is 29%.

2) Effect of bag-based pricing for unsorted and compostable waste:

- Total waste diminishes by 36%.
- For municipalities that collect compostable waste by using a free collection bin, the reduction is only 14%. While the effects on unsorted waste are comparable for the two systems (−49% and −52%),
- Effects on the supply of compostable waste differ greatly. In municipalities with unpriced compostable waste collection, compostable waste increases (by 36%), while in the other municipalities (using a bag system for compostable waste as well as for unsorted waste), this waste decreases (by 61%).

- The effect on recyclable waste is also larger for municipalities that use the bag-based system for compostable waste. This suggests that in municipalities using a bag-based system only for unsorted waste, part of the recyclable waste is 'dumped' in the free compostable bins.

3) Effect of system based on frequency of collection:

- reduces the total amount of waste by 21%, due to a reduction in both unsorted waste (27%) and compostable waste (37%).
- As the effects on unsorted waste are less pronounced than in the weight- and bag-based systems, the stimulating effect on the collection of recyclable waste is smaller as well (up 10%).

4) Effects of system based only on the volume of collection:

- Total waste decreases by only 6%, mainly due to the effect on unsorted waste as the effects on compostable and recyclable waste are insignificant.

So the overall conclusion is that the effects of the bag-based system (that prices both unsorted and compostable waste) are comparable to those of the weight-based systems. Still weight-based schemes perform best, whilst schemes using sacks or based on frequency and volume of container are next best and broadly similar in performance. Schemes based only on choice of container size are the least effective. Recycling rates are highest for the sack-based scheme, but this is partly explained by the increase in the amount of waste available for recycling.

Overall, it is also clear that given the strong reduction in mixed waste and the increase in assorted waste (in recycle, compostable and unsorted fractions) also supports the divergence of waste becoming landfilled. PAYT schemes can therefore be seen as one of the several instruments needed to reach lower landfill levels.

As to the economic effects of PAYT schemes the study by Dijkgraaf (2004) for the 126 municipalities showed that only a part of the cost of waste management can be covered by PAYT schemes and that the revenues raised are variable and in principle even declining as the objective is to bring waste generation down. So, revenues need to be supplemented by charges raised from fixed rate fees for the whole waste management.

Dijkgraaf also evaluated the administrative cost of the different PAYT systems and concluded that the cost of the bag-based pricing system, which is also the most effective in bringing the mixed waste amount down, is the lowest as compared to the weight-, frequency and volume-based systems. Given the large reductions in unsorted waste, municipalities can also save a lot of money by introducing (especially) a bag-based pricing system.

11. Why can this policy be seen as a good policy example?

The PAYT scheme is clearly effective in bringing down the total amount of mixed waste and particularly of mixed waste per household. Given the long experience with different types of PAYT schemes they are good examples of policy instruments that can be implemented in very different ways with a diversity, but always, positive outcome. This instrument is effective, but not economically neutral. That is inherent to the PAYT scheme. The better the household performs inreducing and separating its waste, the less it will pay.

PAYT should be seen as part of a total waste management package also addressing the further waste treatment. It is also clear that given the strong reduction in mixed waste and the increase in assorted waste it is effective as a complementary instrument to reduce waste becoming landfilled. PAYT schemes can therefore be seen as one of the effective instruments needed to reach lower landfill levels.

12. Would you recommend this policy instrument to be replicate in regions in low, medium, high BBE development stage? Explain why.

Yes, low, medium and high. The PAYT scheme is clearly effective in bringing down the total amount of mixed waste and particularly of mixed waste per household. Given the long experience with different types of PAYT schemes they are good examples of policy instruments that can be implemented in countries/regions where waste separation and treatment is still lagging (far) behind.

PAYT schemes need to be adjusted after some time to stimulate households further to reduce and separate waste into recyclable parts.

13. Are there similar policy instruments implemented in other EU countries/regions? If yes explain which ones.

Beside the experience in the Netherlands also information on experience with PAYT schemes was presented for Luxembourg and Belgium in the factsheet by Card and Schweizer (2017).

In Luxembourg, Koerich and Kopstal piloted a scheme from 1994 to 1997; and in Belgium pilot schemes took place in Flanders in the early 1990s, before more widespread adoption from 1995. All schemes in these countries aim to disincentivise the use of containers for residual waste. For example, the Ghent regional PAYT system in Flanders relies in urban and suburban areas on the differential pricing of residual waste, recyclable and biowaste collection sacks. In more rural areas, the charge is applied via a system of charging residents per waste collection, with higher rates for residual waste than biowaste bins. The pilot system in Koerich and Kopstal in Luxembourg describes that charges varied based on the weight of the waste collected and volume of the residual waste container used, whilst dry recyclables were collected free of charge and similar schemes can be found across Luxembourg today.

In Flanders for example, PAYT schemes are partially regulated by the regional government, which sets (amongst other parameters) minimum and maximum tariffs that local authorities may charge for the collection of residual waste. The PAYT measures were introduced to reduce the ever growing issue of waste management and to prevent further the establishment of new landfills. As to the economics it was shown in Flanders that the funds raised by PAYT amounted to around 50% of the funds required for waste management.

The regional focus also allowed several local authorities to adopt the new system simultaneously, increasing harmonization across the area. In Wallonia, several municipalities introduced PAYT schemes as a means to ensure that they were not required to pay a levy on excess residual waste, which was to apply to those municipalities where residual waste per inhabitant exceeded a specific quota.

The PAYT schemes of the Benelux countries all showed a reduction of overall waste generated, and in particular lower rates of residual waste disposed. However, not all schemes perform in the same way,

and their impact depends also on the scheme that was in place prior to the implementation of PAYT. Schemes based solely on bin capacity do not bring about the same level of benefits as those based on weight or frequency of collection.

An important outcome of the BENELUX schemes was that once the bin choice has been made, the household has little incentive to reduce waste generation further. Card and Schweizer (2017) recommend that frequent revision of choice of bin size is important to allow households to choose and that sack based schemes provide a greater incentive to reduce residual waste, because only full sacks need to be set out and the household is free to purchase any number of sacks.

Another recommendation made by Card and Schweizer (2017) based on the BENELUX PAYT experience is that if there is no frequency component to the charge scheme, the logistics can be inefficient if vehicles collect bins that are relatively empty at a fixed frequency. A combination of frequency and weight-based charging is therefore a good option to generate a continuous incentive through the weight-based element, whilst reducing the frequency of set-out and improving logistical efficiency.

14. Barriers and solutions encountered in the development and implementation of this policy instrument

Factsheet PAYT in Benelux countries (Card & Schweitzer, 2017)

In some areas, especially where regional co-ordination has been less strong than can be seen in Flanders, there have been more barriers to the implementation of PAYT. One element of this is a perceived rise in the illegal disposal of waste (Fullerton and Kinnaman, 1996), although other studies have found that this effect is over-stated (Hogg et al., 2006; Dijkgraag, 2004). Analysis of the behaviour of Dutch citizens in bij Dijkgraaf (2004) shows that there is no evidence that surrounding municipalities without unit-based pricing systems in fact collect part of the waste produced in municipalities with unit-based pricing systems. Fullerton and Kinnaman (1996) estimate that illegal dumping constitutes 28% of the total reduction in waste collected at the curb. Hong (1999) shows that dumping was substantial after the adoption of the unit-based pricing system in Korea.

Other barriers have included the avoidance of charges by individuals travelling to areas not implementing a PAYT scheme to waste disposal, although again the scale of this behaviour is small compared to the overall positive impact of PAYT (Linderhof et al., 2001). There can also be disagreement over the regulation of PAYT between national and regional authorities. For example, in Luxembourg, there were disagreements over the introduction of legislation transposing the revised EU Waste Framework Directive (2008/98/EC) regarding waste charges. Syvicol (who represent Luxembourgish cities and communes) disagreed with the Government's intention to introduce new regulations mandating differential tariffs for waste management (Europaforum, 2011). Syvicol was concerned that the costs, to both Local Authorities and households, had not been considered properly in drawing up the legislation, and also objected to the introduction of a model of charging from central government. Nevertheless, the transposing legislation was passed, bringing in stricter rules on the basis for PAYT in Luxembourg, which stated that the 'charges placed on households must contain at least one variable component calculated according to the weight and/or volume of residual waste produced' (Journal Officiel du Grand-Duché de Luxembourg, 2012).

Some have argued that PAYT represents a regressive tax that has a disproportionate impact on lower-income households, as an unvaried charge across all households, unable to distinguish and allow for low-income households (Hogg et al., 2006), although the same paper cites an example of a specific scheme in Leuven, Belgium working to combat this issue by providing low income households with 20 free sacks each year. Others, such as the Luxembourg Chambre des Salariés, have raised concerns that the charges have a disproportionate impact on large families or households regardless of their efforts to sort waste (Chambre des deputes, 2011). Generally, it might be assumed that although charging schemes can be designed to take account of social factors, it might be preferable to maintain the incentive of the variable element of the fee and to address distributional issues by lowering the fixed component of the fee, or through more general approaches to addressing social inequality.

15. References used and more information available at:

Card, Daniel & Schweizer, Jean-Pierre (2017). Pay-As-You-Throw schemes in the Benelux countries. Case study report. Capacity building, programmatic development and communication in the field of environmental taxation and budgetary reform. Final report (2017). Report prepared for the EC- Directorate-General for Environment Directorate F — Global Sustainable Development Unit F.1 — Sustainable Development Goals Green Finance & Economic Analysis.

Chambre des deputes (2011). No 62884: CHAMBRE DES DEPUTES: Session ordinaire 2011-2012. Accessible at http://www.chd.lu/wps/PA_RoleEtendu/FTSByteServingServletImpl/?path=/export/exped/sexpdata/Mag/146/077/104756.pdf

Dijkgraaf, E and Gradus, R (2004) Cost savings of unit-based pricing of household waste: The case of the Netherlands. University of Rotterdam.

Emma Watkins, Patrick ten Brink, Sirini Withana, Daniela Russi, Andrea Illes, and Konar Mutafoglu of the Institute for European Environmental Policy, IEEP; Sarah Ettlinger of Eunomia; and Mikael Skou Andersen and Anders Branth Pedersen of Aarhus University. Capacity building, programmatic development and communication in the field of environmental taxation and budgetary reform. Final report (2017). Report prepared for the EC- Directorate-General for Environment Directorate F — Global Sustainable Development Unit F.1 — Sustainable Development Goals Green Finance & Economic Analysis.

Europaforum (2011). La transposition de la directive "déchets" commence à déclencher un débat sur ses conséquences sur l'autonomie, les finances et les taxes communales. Available at (http://www.europaforum.public.lu/fr/actualites/2011/10/syvicol-directive-dechets/)

Journal Officiel du Grand-Duché de Luxembourg (2012). Loi du 21 mars 2012 relative à la gestion des déchets. Accessible at http://www.chd.lu/wps/PA_RoleEtendu/FTSByteServingServletImpl/?path=/export/exped/sexpdata/Mag/195/076/109745.pdf

Linderhof, V; Kooreman, P; Allers, M and Wiersma, D (2001). Weight-based pricing in the collection of household waste: the Oostzaan case. University of Groningen.

OECD (2015). Environmental Performance Reviews: The Netherlands 2015. OECD Publishing, pp207-208

Oosterhuis, F; Bartelings, H; Linderhof, V and van Beukering, P (2009). Economic instruments and waste policies in the Netherlands. Inventory and options for extended use. Ministry of Housing, Physical Planning and the Environment (VROM).

Policy factsheet 13: Cluster Initiative Bavaria

1. **Title policy instrument**

The Bavarian Cluster Initiative, the example of a German regional collaboration model to drive the bioeconomy development.

2. **Main aim of the policy instrument (short)**

The Bavarian Cluster Initiative is a policy instrument that aim **to foster collaboration for innovation** between companies and research institutes in seventeen cluster platforms that are connected to high potential sectors and technologies to drive bioeconomy transition in the Bavarian region. Examples of branches and technologies are:

- energy, including energy and environmental technologies,
- mobility, including aerospace, automotive and railway technology,
- digitalization, including information and communication, mechatronics & automation, power electronics and sensor technology,
- health, including biotechnology, food and medical technology,
- materials, including chemistry, forestry and wood, MAI carbon, nanotechnology and new materials.

Mainly the fields of environmental technology, biotechnology/nutrition, forestry and wood, chemistry as well as new materials, include bioeconomic topics. The collaboration is promoted by the state government with the **aims to improve the competitiveness** and to be a dynamic and self organizing process of creating growth and development within these fields.

3. **Country where it is implemented**

Germany, more specifically in the Bavarian region, but cluster initiatives can also be found in other EU countries.

4. **Year of first implementation**

In Bavarian cluster initiative was launched in 2006.

5. **Is the policy still implemented? If not specify final year of implementation.**

Yes

6. **Type of instrument***

Financial instruments; Information and advice sharing instruments; voluntary approach

7. **Biomass value chain position targeted****

No specific position

8. **Description of the instrument (long)**

(*What is the instrument meant to bring about, how does the instrument work, who are targeted by the instrument*)

This policy instrument was initiated in 2006 by The Bavarian State Government in the scope of its economic policy. The aim is to increase competitiveness in sectors that play an important role in bioeconomy. The 'Bavarian Cluster Campaign' was first launched to promote networking. The targets of the policy instrument are Bavaria's small and medium-sized enterprises, large companies and knowledge institutes, while focusing on 19 high-potential branches and technologies. This campaign was a state-aided network projects for top achievements on innovation and research in these 19 branches and technologies. At the moment, there are 17 cluster platforms. Each cluster platform has a professional cluster management team. These management teams help to position the platforms as hubs for information, communication, coordination, knowledge transfer and innovation. The platforms are led by cluster spokespersons who lead the process to develop cluster strategies. These spokespersons have outstanding personalities and good personal network of relationships. Next, there are also advisory boards and working groups that have the role to identify topics that provide added value. These topics are often the basis for new collaboration and R&D projects and collaborations between research and industry emerge, in particular also for companies that by themselves are not able to invest in R&D. Events are organized to strengthen relation between small and medium size enterprises and knowledge partners and to strengthen the relation between the actors in the respective value chain. Activities that are organized by the cluster management team are:

- Organizing dialog between cluster players, develop key topics, present wide variety of industry-specific events like conferences and workshops to make sure business can meet the right partners
- Providing information on market trends, research findings, technologies, funding opportunities
- Coordinate acquisition of national and international financial assistance
- Initiate and accompany national and international research and development projects
- Facilitate contacts to national and international networks, organize joint trade fair stands and establish access to foreign markets

This cluster initiative has the benefit of providing concrete support to platform members like targeted information and networking opportunities as well as integration of research competence in industry, new partnerships and innovation projects. The emerging innovations provide new business opportunities, expanding markets and results in new jobs. The platforms provide support that makes companies more innovations, dynamic and really support their growth.

9. **Is this instrument following up on EU policy?** Either transposed policy to national/regional level or a policy to reach EU policy targets/ambitions? If yes, which policy and which EU targets and ambitions?

Bavarian Cluster Initiative exists since 2006 and was launched by The Bavarian State Government in the scope of the economic policy. However, the cluster initiative is instrumental to reach the EU objectives with regard to the smart specialization policy that was initiated by the EU in 2011. Smart specialization is a place-based policy concept promoting regional economic transformation and investment through innovative activities in selected domains. This strategy aims to contribute to the Europe 2020 ambitions: 350.000 new jobs, 140.000 start-ups and 15.000 new products on the market are to

be expected. For Bavaria, the introduction of the EU smart specialization was not new but rather a confirmation of the implemented instruments. It has been helpful to get better access to EU funds.

10. **Can you explain the impact of the policy in type, size, time and money spent? (*Should be based on evaluations)***

The Bavarian Cluster Initiative has started in 2006 and is still running. It is difficult to say how long the Cluster Initiative will remain in place. Crucial is continuity in basic funding to allow the cluster secretariats to provide a certain amount of support services. The Bavarian State Government has recently funded the third phase of the Bavarian Cluster Initiative. The government has invested 63 million euro in the cluster initiative since 2006.

The impact of the Bavarian Cluster Initiative is described in their reporting documents. By April 2017, over 10,000 events were organized, in which 562,000 participants took part. 1,500 projects were initiated and 9,900 participants collaborated in these projects. More than 248 million euro federal funds were acquired and this was added with over 39 million euro of EU funding. The clusters have proven to be effective in national cluster competitions and have received Bronze, Silver or Gold Label of the European Cluster Excellence initiative.

11. **Why can this policy be seen as a good policy example?**

This instrument is a good policy example because it plays an important role in driving bioeconomy development. It has already been proven in the Bavarian case how effective it has been in boosting the bioeconomy through the tremendous increase in clusters and collaboration projects in innovation and knowledge development. Furthermore, the high quality of the clusters set-up in Bavaria was confirmed by the several received Bronze, Silver or Gold Label of the European Cluster Excellence initiative.

The instrument is mainly oriented to fostering collaboration between science and business and is focused on matchmaking between organisations that can jointly research, innovate and develop net bio-based applications. These joint initiatives are eligible for funding. The instrument also supports the marketing and branding of a region, therefore attracting new companies to the regions and setting up international collaborations. The result of the policy instrument are collaborations and joint projects that contribute to new products that are sold on the market. It is an instrument that is easy replicable in different types of regions. Therefore, this instrument plays an important role to drive regions to more mature bio-based development stages.

12. **Would you recommend this policy instrument to be replicate in regions in low, medium, high BBE development stage? Explain why.**

Yes, mainly in low and medium regions because these regions have still a large potential to grow via innovations. The instrument is also suitable for regions in high BBE stage, but the expectations are that these regions have already opted for other mechanisms to foster innovation and growth.

13. **Are there similar policy instruments implemented in other EU countries/regions? If yes explain which ones.**

There are many regions that make use of the cluster approach to foster innovation. They are listed on the website: https://www.clustercollaboration.eu/cluster-list. The cluster approach is also used for

other economic developments, apart from bio-based sectors. Examples are Bio-based Delta in the Netherlands, BioVale in the UK, IAR in France.

14. Barriers and solutions encountered in the development and implementation of this policy instrument

Barriers and enabling factors of implementing cluster approaches for bioeconomy development have been analyzed in the EU project BERST. These barriers and enabling factors are coming from experiences of several regions that have applied cluster approach.

Barriers can be:

In initial stage

- Lack of central management at the initial stage that affect efficient communication and transfer of knowledge
- Communicating the importance of clusters and innovation to policy makers remains a challenge, especially when it is initiated by the academic sector.
- Lacking active participation by entrepreneurs in cluster activities due to strong focus on big industrial actors for energy and fuels. Initial interaction with entrepreneurs may be time consuming and required effort to communicate benefits of bio-based innovations.
- Private funds can be difficult to secure during the initial stage as the cross sector transfers, respective methods and products were not yet developed

In medium stage

- Lack of secure funding for cluster management prohibits the full time employment of personnel in developing the cluster's activities, as they also have to secure funding from other sources.
- Adoption of EU legislation at local and regional levels required long term and consistent efforts form the cluster management. Slow development of start-up companies as the activities are developed within large industries.Highly innovative products or components require long and consistent efforts for training, education and knowledge transfer to entrepreneurs prior to commercialization. Commercialization of new bio-based products is a slow process which requires secure policy and financing conditions to minimize the investment risk

Enabling factors:

In initial stage

- Interest in cluster approach from public authorities
- Possibility for funding of research and infrastructure through national and regional funding
- Consistent participation of large industrial actors and good cross sector collaboration on projects among primary and end-use sectors.
- Knowledge providers with strong capability provided a successful start to the cluster through research projects;
- Strong central organization that is operated full time.

In medium stage

- Increasing consumer demand for products that can be recycled or composted strengthens the role of biotechnology and bio-based products
- Good cooperation between the cluster management and frequent information exchange between knowledge institutes and business support/cluster management.
- Strong and consistent political commitment towards the development of all aspects of the cluster.
- Increased access to public funding for research, development and demonstration activities provided opportunities for entrepreneurs and for increased innovation in end products.
- Strong commitment of individuals that lead the cluster organization
- Strong collaboration with industry, R&D and regional partners in several EU funded projects
- EU funding for large demonstration facilities in project contexts
- Efficient process of financing start-up companies.

15. References used and more information available at:

https://ec.europa.eu/regional_policy/en/newsroom/news/2017/01/26-01-2017-smart-stories-smart-specialisation-in-practice

https://www.invest-in-bavaria.com/en/blog/post/bavaria-continues-to-focus-on-networking-cluster-initiative-is-being-extended.html

https://www.cluster-bayern.de/fileadmin/user_upload/stmwi/Publikationen/2017/2017-09-28_Cluster_Initiative_Bavaria-Eng.pdf

https://www.slideshare.net/Invest_in_Bavaria/investorsguide-bavaria-2014

https://www.alpine-space.eu/projects/alplinkbioeco/regional-policy-inventory/d.t1.1.1-inventory-of-policy-instruments-bavaria.pdf

https://www.bio-basedpress.eu/nl/2015/10/3bi-bemiddeling-voor-bio-based-innovatie/

https://www.wecr.wur.nl/BerstPublications/D3.1%20GoodPracticesInSelectedBioeconomySectors_8June15.pdf

Policy factsheet 61: Stimulation of Sustainable Energy Production - Stimulering Duurzame Energieproductie (SDE+)

1. **Title policy instrument**

Stimulation of Sustainable Energy Production - Stimulering Duurzame Energieproductie (SDE+)
Link to full text of legal source (original language): https://wetten.overheid.nl/BWBR0022735/2012-03-13

2. **Main aim of the policy instrument (short)**

Energy producers can receive financial compensation for the renewable energy they generate by this tendering procedures based feed-in premium (FIP) system.

3. **Country where it is implemented**

The Netherlands

4. **Year of first implementation**

2011

5. **Is the policy still implemented? If not specify final year of implementation.**

Yes

6. **Type of instrument***

Financial instruments

7. **Biomass value chain position targeted****

Processing & conversion of biomass
Market retail & distribution

8. **Description of the instrument (long)**

(*What is the instrument meant to bring about, how does the instrument work, who are targeted by the instrument*)

The SDE+ scheme was established in 2011 and involves the government providing both guarantees and risk reductions to renewable energy developers via subsidies through a tendering scheme. This scheme does not prescribe the technology the renewable energy is generated by; in general, all technologies can compete, so that the most cost-effective renewable energy mix will be developed.

The main goal of the SDE+ policy is to encourage renewable energy generation in the Netherlands. The policy aims to generate as much renewable energy at the lowest costs possible and thereby be in line with the various goals of the government and the EU Directive.

Through the SDE+ policy, the government provides compensation to renewable energy producers in cases where their income generated per kilowatt hour (kWh) is lower than the costs of production. The Dutch tendering scheme is designed to target any company and institution that generates renewable electricity and has the ability to realize the size of projects tendered by the government.

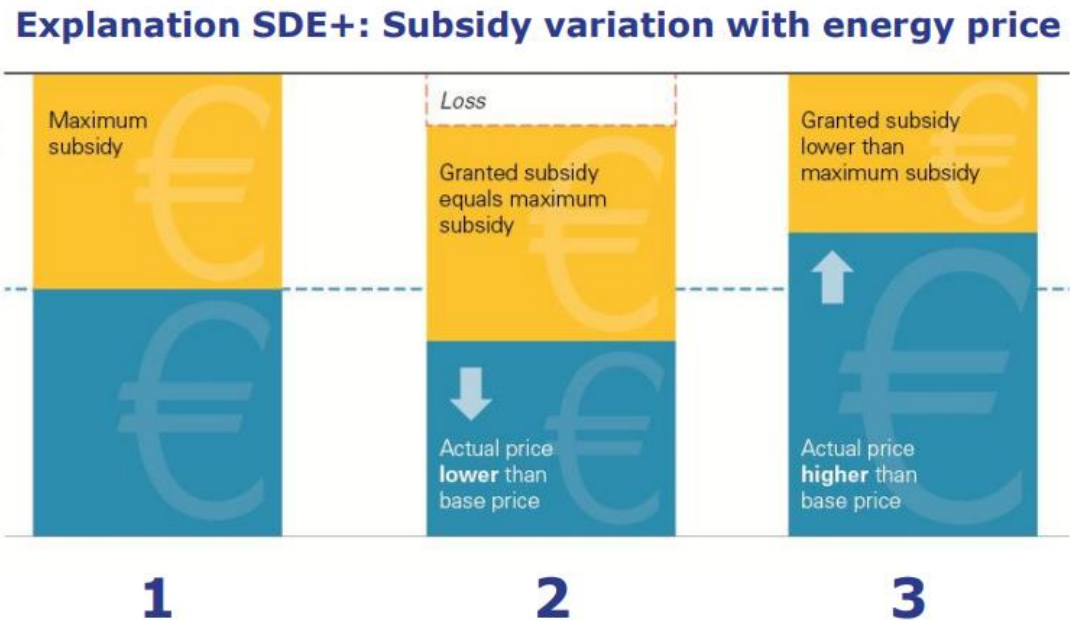


Figure 1. Explanation SDE+: Subsidy variation with energy price[31]

The SDE+ tendering scheme offers to compensate electricity generation companies for the difference in price between the market price and the costs of renewable energy generation over a period of 8, 12 or 15 years, depending on the type of technology used. This means that producers will sell their generated electricity at the current market price and receive a premium for the difference between this price and a predetermined price per kWh, also called the strike price.[32] Support in SDE+ is only received for a fixed amount of full load hours per year. This maximum is technology specific, e. g. an all-purpose fermentation CHP plant which won support in spring 2019 can only receive subsidies for 7,622 full load

[31] https://www.eurosaiwgea.org/meetings/Documents/SS%20Energy/Energy_SS_Kroezen_Roelofs_Netherlands.pdf

[32] https://es.catapult.org.uk/wp-content/uploads/2018/10/Netherlands-RES-Support-Case-Study-FINAL.pdf

hours and a solar PV plant with a capacity between 15kWp and 1MWp capacity for 950 full load hours per year.[33]

Recently some contracted projects have not been delivered, after which the government has decided to make some adjustments in the SDE+. Non-realisation can lead to significant delays in delivery, as new bidding rounds for the allocated subsidy need to be organised. The new adjustments follow the principle that a strict monitoring and control mechanism is necessary to ensure that projects that have won the auction will also be developed and will deliver expected energy generation. This will avoid high costs for the government that would be incurred when it needs to source the required electricity from elsewhere. The Dutch government creates a budget plan annually that includes the available funding for tendering schemes that will be opened in that year. This budget is created from a levy on energy bills called "opslag duurzame energie" (ODE). The levy is a fixed rate that does not vary with the amount consumed. The Dutch government aims to open two tendering schemes per year. The tendering scheme is categorised as a 'floating premium determination' mechanism. This means that the premium depends on the level of the electricity price. By receiving a higher premium when electricity prices are lower, generators will not be exposed to the risk of the price fluctuations in the electricity market. The scheme consists of sequential bidding rounds where the government defines a base amount with predetermined prices and producers can offer a respective volume. [1]

9. **Is this instrument following up on EU policy?** Either transposed policy to national/regional level or a policy to reach EU policy targets/ambitions? If yes, which policy and which EU targets and ambitions?

This instrument follows the instructions of the European Union's *Guidelines on State aid for environmental protection and energy 2014-2020* (2014/C 200/01) [34] , the *European Commission guidance for the design of renewables support schemes*[35] (2013) and helps the realization of the EU's Revised Renewable Energy Directive[36].

[33] Aures II Project (European Union's Horizon 2020 research and innovation programme under grant agreement No 817619) *D2.1-NL, December 2019, Auctions for the support of renewable energy in the Netherlands* (http://aures2project.eu/wp-content/uploads/2019/12/AURES_II_case_study_Netherlands.pdf)

[34] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52014XC0628%2801%29

[35] https://ec.europa.eu/energy/sites/ener/files/com_2013_public_intervention_swd04_en.pdf

[36] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC

10. **Can you explain the impact of the policy in type, size, time and money spent?**

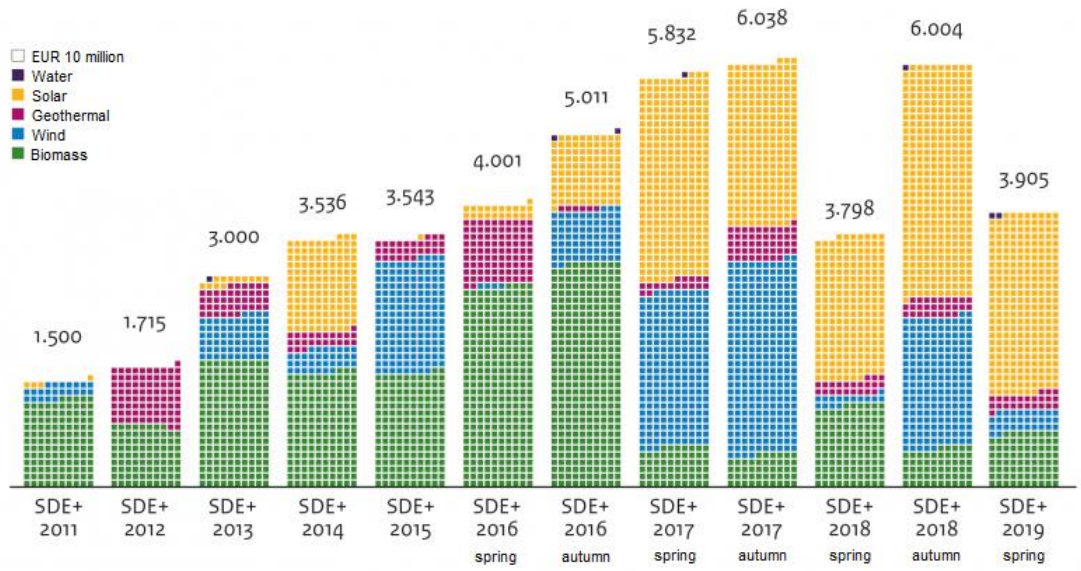


Figure 2. Commitment budget per technology in the various SDE + rounds[37]

In total, up to January 1st 2018 the SDE+ has realized approximately 5,823.6 MW of new installed energy capacity (including electricity and heat) with 3,185.2 MW for electricity[1]. In a study commissioned by the Ministry of Economic Affairs, the cost-effectiveness of the SDE+ from 2011 to 2015 was reviewed[38] . It concluded that without funding from the SDE+, most projects under the scheme would not have been realized. This conclusion is based on a study of financial data and investment plans of individual projects under SDE+. It states that the rates used for compensation of producers are broadly in line with market values, thereby minimising the number of free riders in the system. The study estimates that the system includes around 5-15% free riders in total, which is considered low compared to the rate of free riders related to energy policies in other EU countries. The review also concluded that the administrative costs of managing the scheme were seen as reasonable in comparison with the

[37] https://www.rvo.nl/subsidie-en-financieringswijzer/stimulering-duurzame-energieproductie-sde/feiten-en-cijfers/feiten-en-cijfers-sde-algemeen

[38] Blom, M., Schep, E., Vergeer, R., Wielders, L. (2016). Review of the Dutch SDE plus Renewable Energy Scheme. CE Delft and SEO Economisch Onderzoek. Delft, the Netherlands

amount in EUR of subsidies provided. The realization rate of projects under SDE+ has in general been low as has the utilisation of the budget. In general, around 20-25% of the SDE+ budget has not been utilised per year. [1]

The 2020 SDE+ spring tender round has a budget of €4 billion. [39]

11. Why can this policy be seen as a good policy example?

The goal of the SDE+ is to increase renewable energy generation at the lowest possible cost. To this end it was introduced as the first technology neutral subsidy scheme in Europe and is open for renewable electricity, renewable gas and renewable heat or a combination thereof. Eligible technologies are biomass, geothermal, hydro, solar photovoltaics, solar thermal, and onshore wind energy, which all compete for the same budget. [2] This system gives opportunity to develop a competitive renewable energy sector which focuses on real market aspects (cost efficiency, sale of energy at the time interval of higher prices) while in the same time optimises expenditures of the government by supporting the most cost effective solutions.

12. Would you recommend this policy instrument to be replicate in regions in low, medium, high BBE development stage? Explain why.

This instrument can be used in regions with different BBE development level, since it is a multiple times revised and optimized policy. It probably won't fit perfectly for all EU countries but since they have similar goals, with minor changes taking into account particular economic factors (biomass price, electricity price, available financial sources from the government) this instrument could help to develop similar policies in almost every EU countries. In countries with low and medium BBE development phase it could serve as a base or a starting point, and by the experience gained in the last decade, even in countries with high development level could SDE+ be used to develop further their current policy.

13. Are there similar policy instruments implemented in other EU countries/regions? If yes explain which ones.

Nowadays most of the EU countries follow *European Commission guidance for the design of renewables support schemes* (2013). Before the mentioned guidelines there were feed-in tariff systems in almost every member countries. It gave a good investment opportunity and a big push for the sector,

[39] https://english.rvo.nl/subsidies-programmes/sde

but it was not efficient on long-term, it was not development and innovation oriented and gave opportunity for many free riders. Countries mostly modified the way how support levels are being determined, which shows a move from administratively determined tariffs to support levels being determined in competitive (tendering) procedures. FIT schemes and investment grants set through administrative procedures often remain in place for smaller installations (e.g. RES plants < 30 kW in Croatia, < 100 kW in Germany or < 500 kW in France), while FIP schemes set through competitive procedures are becoming mandatory for new larger installations. It can further be observed that in most of the member states, two or more support systems co-exist, often combining FIT and FIP schemes. [40]

For example in Germany the revision of the EEG in 2017 has induced a paradigm shift for the support of renewable electricity generation. In principle, support for electricity from RES is no longer allocated on the basis of administratively-set feed-in tariffs. Instead, sliding feed-in premiums are competitively determined in auctions for installed generation capacity (kW). The successful participation in an auction is a pre-condition to receive support payments and the premium is paid per generated electricity unit (in ct/kWh) and financed by the electricity consumers via a surcharge on their electricity bills. Administratively-set FIT support payments remain possible in exceptional cases only, e.g. installations below de-minimis thresholds or pilot installations. [41]

Another example for combining schemes is Hungary, where the so-called “Brown Premium” is part of the premium tariff system, which comprises of the market referential price and a certain subsidy, the premium. The brown premium is provided to the solid biomass and biogas plants with expired green premium(FIP) or FIT to maintain their competitiveness. “Alternative Brown Premium” given to the plants which are able to use both fossil and alternative fuels. The goal is to encourage plants to use more alternative and less fossil fuels. It is a fix premium based on the difference between fossil and alternative fuel based electricity production costs.

[40] Council of European Energy Regulators: *Status Review of Renewable Support Schemes in Europe for 2016 and 2017*(https://www.ceer.eu/documents/104400/-/-/80ff3127-8328-52c3-4d01-0acbdb2d3bed)

[41] Aures II Project (European Union's Horizon 2020 research and innovation programme under grant agreement No 817619) *D2.1-DE, December 2019, Auctions for the support of renewable energy in Germany* (http://aures2project.eu/wp-content/uploads/2020/02/AURES_II_case_study_Germany.pdf)

14. Barriers and solutions encountered in the development and implementation of this policy instrument

The current support scheme Stimulation of Sustainable Energy Production (Stimulering Duurzame Energie, SDE+) will be replaced by the Sustainable Energy Transition Incentive Scheme (Stimuleringsregeling Duurzame Energietransitie SDE++) in 2020. In this new scheme the focus will be on reduction of CO_2 (instead of generation of renewable energy) and it will also allow CO_2 reducing industrial technologies to participate.

SDE+ was the main tool of the Dutch government to achieve its 2020 renewables targets. From this point of view, SDE+ was "too little too late" because of two reasons:

- realization rates at the beginning of SDE+ were low;
- the budget was increased too late, so that a significant part of new installations will only become operational around or after 2020.

Up until 2014 almost 50% of the auctioned volume was not realized due to delays or when banks refused loans as subsidies turned out to be not sufficient to support the project. This started to change from 2014 onwards, when measures were implemented to reduce the share of non-realisation. These measures included the submission of a feasibility study and stricter permitting rules. This resulted so far an increase in realization rates, which are for 2012 and 2013 close to 50%. Only around 10% of project capacity in 2015 was not realized. Final assessment on the effectiveness of the introduced measures can only be made once all realization periods are over, which is currently not yet the case. [2]

In a previous phase of the SDE+, when technologies were separated in terms of budgets, there was an aggressive lobby taking place of different parties to significantly increase the available budget under SDE+ for their specific technology. This has led to a change in design for the current SDE+, so that now all technologies are bundled in one budget plan. Technologies can compete among themselves for this budget, which leads to significant price reductions and thereby a more cost-effective policy. [1]

15. References used and more information available at:

1. https://es.catapult.org.uk/wp-content/uploads/2018/10/Netherlands-RES-Support-Case-Study-FINAL.pdf
2. Aures II Project (European Union's Horizon 2020 research and innovation programme under grant agreement No 817619) D2.1-NL, December 2019, Auctions for the support of renewable energy in the Netherlands (http://aures2project.eu/wp-content/uploads/2019/12/AURES_II_case_study_Netherlands.pdf)
3. https://www.eurosaiwgea.org/meetings/Documents/SS%20Energy/Energy_SS_Kroezen_Roelofs_Netherlands.pdf
4. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52014XC0628%2801%29
5. https://ec.europa.eu/energy/sites/ener/files/com_2013_public_intervention_swd04_en.pdf
6. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC
7. Blom, M., Schep, E., Vergeer, R., Wielders, L. (2016). Review of the Dutch SDE plus Renewable Energy Scheme. CE Delft and SEO Economisch Onderzoek. Delft, the Netherlands

8. https://english.rvo.nl/subsidies-programmes/sde
9. https://www.rvo.nl/subsidie-en-financieringswijzer/stimulering-duurzame-energieproductie-sde/feiten-en-cijfers/feiten-en-cijfers-sde-algemeen
10. Council of European Energy Regulators: Status Review of Renewable Support Schemes in Europe for 2016 and 2017(https://www.ceer.eu/documents/104400/-/-/80ff3127-8328-52c3-4d01-0acbdb2d3bed)
11. Aures II Project (European Union's Horizon 2020 research and innovation programme under grant agreement No 817619) *D2.1-DE, December 2019, Auctions for the support of renewable energy in Germany* (http://aures2project.eu/wp-content/uploads/2020/02/AURES_II_case_study_Germany.pdf)

Policy factsheet 22: Ordinance on the Generation of Electricity from Biomass (Biomass Ordinance - BiomasseV)

1. **Title policy instrument**

Ordinance on the Generation of Electricity from Biomass (Biomass Ordinance - BiomasseV)

Link to full text of legal source: http://www.gesetze-im-internet.de/biomassev/BiomasseV.pdf

2. **Main aim of the policy instrument (short)**

Regulates which substances are classed as biomass and how the related substance-based tariffs for electricity generated are calculated.

3. **Country where it is implemented**

Germany

4. **Year of first implementation**

2001, amended multiple times, the last amendment was in 2017

5. **Is the policy still implemented? If not specify final year of implementation.**

Yes

6. **Type of instrument***

Regulation (imposed by law)

7. **Biomass value chain position targeted****

Biomass

Processing & conversion of biomass

8. **Description of the instrument (long)**

(*What is the instrument meant to bring about, how does the instrument work, who are targeted by the instrument*)

The target of this instrument is the energy sector[42]. This Ordinance is the base of the biomass based energy production in Germany, because it determines which feedstock and technologies are included in this sector. It was part of the policy package which resulted in the biogas plant boom in Germany. This instrument determined which plants were able to apply for specific feed-in tariffs and feed-in premiums.

For the scope of application of the Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz), this Ordinance regulates:

- **Which substances are classed as biomass:** plants and parts of plants; energy sources derived from plants or parts of plants; waste and by-products of plant or animal origin from the agricultural, forestry or fishing industry; biowaste; gas produced from biomass through gasification or pyrolysis and secondary and by-products derived therefrom; alcohols produced from biomass whose components, intermediate, secondary and by-products were generated from biomass; flotsam from water management or management of lake and river banks;
- **The substances for which an additional substance-based tariff may be claimed:** two substance-based tariff groups have been determined. Substance tariff class I includes energy crops (such as maize and sugar beets). The tariffs for substance class II were set higher than those for substance class I in order to create an incentive to use substances from the substance tariff class II. From a sustainability standpoint, substance tariff class II contains particularly valuable substances (such as liquid pig manure and wildflower growth). The tariff paid for substances from substance tariff class I (including maize and cereal grain kernels) was lowered to counter the problem of the excessive use of maize and cereal grain kernels and having and indirect land use change effect. The exact tariffs are determined by The Renewable Energy Sources Act.
- **Which energy-related reference values are to be used to calculate substance-based tariff and how it is to be calculated:** the document includes three annexes which determine the energy yield of substances e.g. in case of sugar beet the system calculates with 75 m^3 methane yield per tonne of fresh mass. For each substance used, its share in the total electricity generated is calculated by multiplying the quantity of such substance used by the energy yield according to Annex 1, Annex 2 or Annex 3 to this Ordinance. In order to calculate the percentage share of a substance tariff class in the total electricity generation, the shares of the substances of a substance tariff class in the total electricity generation are added and

[42] https://www.bmu.de/fileadmin/bmu-import/files/english/pdf/application/pdf/biomasse_verordnung_en_bf.pdf

placed in proportion to the total shares of all substances used in the total electricity generated. The share in the total electricity generated, for which the tariff to which the substance tariff class entitles is paid, is calculated by multiplying the percentage share of the substances of a substance tariff class by the total quantity of electricity generated. Annex 1 includes substances that do not entitle to payment of a substance-based tariff, Annex 2 includes substances for substance tariff class I while Annex 3 includes Substances for substance tariff class II.

- **Which technical procedures for electricity generation from biomass fall within the scope of application of the Act:** combustion installations in combination with steam turbine, steam engine, Stirling engine and gas turbine processes, including Organic Rankine Cycle (ORC) processes; combustion engine installations; gas turbine installations; fuel cell installations; other installations that are operated with respect to the goal of climate and environmental protection.
- **Which environmental requirements must be met in generating electricity from biomass:** In order to avoid and reduce environmental pollution, to protect against and to act as a precaution against harmful environmental impacts, to avert risks and to protect resources, and to ensure environmentally sound management of waste, the public law provisions applicable for the respective technical processes and for the use of the relevant substances shall be complied with.

9. **Is this instrument following up on EU policy? Either transposed policy to national/regional level or a policy to reach EU policy targets/ambitions?** *If yes, which policy and which EU targets and ambitions?*

This instrument is part of a larger package, which helps Germany to reach its environment, climate, energy and bioeconomy related goals.

On the short term, Germany has a national target of 18% share of renewable energy in the gross final energy consumption by 2020 which has been set in EU's Revised Renewable Energy Directive (RED) [43] in 2009 and in National Renewable Energy Action Plan (NREAP) in 2010. The contribution from each of

[43] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC

the sectors heating and cooling, electricity and transportation is displayed in the table below.

Sector	Targets set in the RED and NREAP (Share in gross final energy consumption per sector)
Heating and cooling	14%
Electricity	30%
Transport	10%
Overall target	18%

Table 1: Germany´s 2020 renewable energy targets

On the long term Germany has the following targets by 2050:

- 60% of the gross final energy consumption from renewable energy sources ,
- 80% of the gross electricity consumption from renewable energy sources,
- 40% reduction in gross final energy consumption in the transport sector (year of reference 2005),
- 50% reduction in the total primary energy consumption (year of reference 2008),
- 80-95% reduction in GHG-emissions (year of reference 1990). [44]

This ordinance (BiomasseV)helps Germany to reach these targets by regulating the generation of electricity from biomass taking into the account both environmental and technological aspects.

This BiomasseV regulation does not stand alone. It is complementary to the *Renewable Energy Sources Act (EEG)*, which was last updated in 2017. This EEG 2017 specifies that small RES-E plants up to 100 kW are eligible for feed-in tariff. The tariff payment period is 20 years from the day of commissioning. For most technologies, there is an annual degression. The level of the feed-in tariff is defined by this EEG law and varies according to specificities of the technologies. From 2017 onwards, funding rates for renewable electricity systems with an installed capacity larger than 1 MW will no longer be fixed by government but will be determined via a market based auction scheme. PV, wind onshore, wind offshore and biomass are the eligible renewable energy technologies for tenders. For each technology

[44] https://www.ieabioenergy.com/wp-content/uploads/2018/10/CountryReport2018_Germany_final.pdf

target corridors have been defined. For biomass the annual capacity addition is 100 MW. These auction processes are carried out by the relevant appointed regulatory authority (Bundesnetzagentur).

Support to renewable heating and cooling is regulated by two separate regulations which are the *Renewable Energies Heat Act* (EEWärmeG), the *Market Incentive Programme* (MAP) governed by the Federal Office of Economics and Export Control (BAFA). Under Renewable Energies Heat Act, builders of new buildings are required to generate a percentage of their heating requirements from renewable sources of energy, to undertake certain compensatory measures such as installing additional insulation, or to use combined heat and power systems or district heating. In addition to the Renewable Energies Heat Act, the Federal Government uses the Market Incentive Programme (MAP) to increase the proportion of heat generated from renewable sources. This MAP supports installations of renewable heating and cooling technologies in existing industrial and commercial buildings and thus complements the Renewable Energy Heat Act, which considers only new buildings (residential and non-residential). Both the German Development Bank (KfW) and the Federal Office of Economics and Export Control (BAFA) offer financial support for renovations of heating systems under the MAP.

10. **Can you explain the impact of the policy in type, size, time and money spent?** (*Should be based on evaluations)*

This ordinance gives a stable basis to biomass based energy production from technological, environmental and economical side. Although this instrument has no direct financial effect, it helped Germany's biogas plant boom in the last two decades. The number of biogas installations rose from 1,050 in 2000 to 8,856 (with an installed capacity of 4,018 MW) in 2015. [45]. This 2017 revision is aimed to support the reaching of the much more ambitious 2050 targets for decrease in gross final energy consumption in the different energy sectors and for the significant GHG emission reduction.

11. **Why can this policy be seen as a good policy example?**

Many countries in lower bioeconomy development stage have no such ordinance, which makes their development harder. Without appropriate, stable and long term focused policies the biomass based electricity production sector can't develop, because private sectors do not invest in uncertain fields. Thereby a similar ordinance would gain the biomass based energy sector regulative and economic stability as well.

[45] https://www.cleanenergywire.org/dossiers/bioenergy-germany

This instrument also helps food security and biodiversity by classifying energy crops (such as maize and sugar beets) in the group of substances with lower tariff thereby stimulating the processing of non-food substances.

Finally it is very informative to understand how the German renewable energy regulation developed in time. It shows how regulation has shifted from overall wide support to bioenergy production without putting very strict requirements on efficiency and type of biomass use, toward (since 2017) more strict requirements for energy efficiency and higher feed-inn tariff support for the bioelectricity and heat produced from more sustainable biomass types, particularly those with no or low ILUC impacts.

12. **Would you recommend this policy instrument to be replicate in regions in low, medium, high BBE development stage? Explain why.**

Countries and regions in low, medium and high BBE development stage could use this regulation history as an inspiring example of how to create their own regulation system for bioenergy production stimulation and regulation. Although it is a developed and multiple times amended instrument, other member states should use this policy with some changes taking into the account their own feedstock options. The experience in Germany is also informative in that it will help avoid the ' early adopters mistakes' made in Germany investing large amounts of financial resources in bioenergy systems which were less GHG efficient and had more adverse effects on environment than initially expected when the support system was introduced. The example of Germany therefore helps other countries to stimulate bioenergy production systems through feed-in tariff systems that may have a higher GHG efficiency and lower risk for adverse impacts on the environment.

13. **Are there similar policy instruments implemented in other EU countries/regions? If yes explain which ones.**

As we mentioned before, this ordinance is part of a larger package. Some related German instruments:

- Renewable Energies Heat Act (EEWärmeG): The new Renewable Energies Heat Act entered into force on 1 January 2009. It stipulates that owners of new buildings must cover a certain quota of their heat supply with renewable energies. [46]

[46] https://www.buildup.eu/en/practices/publications/german-renewable-energies-heat-act-eewarmeg

- Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz – EEG): It has been adopted as a feed-in tariff (FIT) system in 2000. With the latest amendment in 2017 an auction system has been introduced implying public tender procedures for onshore wind, offshore wind, solar and biomass projects in the country's efforts to shift from FIT support renewable energy deployment to a market orientated price finding mechanism. With that, projects will no longer be eligible for statuary feed-in tariff remuneration but will have to bid for it in public auction organised and monitored by the Federal Network Agency (Bundesnetzagentur). The amendment stipulates capacity thresholds for technology deployment in order to control capacity volumes commissioned each year. [3]
- Biomass Electricity – Sustainable Development Ordinance (Biomassestrom-Nachhaltigkeitsverordnung – BioSt-NachV): lays down provisions relating to sustainable production of electric energy from liquid biomass. [47]

Some other EU member states have also their own energy sector related biomass policy. Italy focuses on the use of biomethane in the transport sector. They distinguish basic and advanced biomethane production. Advanced biomethane is made from non-food biomass, mainly from different residues. In this way Italy wants to help food security and biodiversity and boost the biomethane sector simultaneously.

Experience from countries like Germany indicate that dedicated energy crops are the least sustainable feedstock, due to potential indirect land use changes (ILUC) and competition with fodder and food production. In Denmark to avoid significant ILUC impacts National Danish agreements and legislation[48] stipulate that use of energy crops as feedstock for biogas should decrease significantly as these are not considered to effectively contribute to reducing GHG emissions. For this reason, from 2015 there is a strict limitation on the use of energy crops to a maximum of 25% of the feedstock mass and from 2018 this rate was decreased to 12% up to 2021. [49]

14. Barriers and solutions encountered in the development and implementation of this policy instrument

[47] http://www.fao.org/faolex/results/details/en/c/LEX-FAOC089130

[48] BEK nr 301 af 25/03/2015 (Gældende) - Bekendtgørelse om bæredygtig produktion af biogas (Executive Order on Sustainable Biogas Production)

[49] https://www.ieabioenergy.com/wp-content/uploads/2018/07/environmental-sustainability_web.pdf

In the 1990's biomass based energy sector was seen as a valve for agricultural overproduction. In the 21st century priorities changed and environment related targets like the reduction of the demand for fossil fuels, the saving of greenhouse gases and the securing of energy supplies were given more weight which led to new approaches. As a result new bioenergy related policies have been developed including this ordinance, which was the base of the upcoming policies in the last two decades. To follow the new ecological standards and technological trends the policy was amended multiple times, last time in 2017.

As mentioned above the ambitious targets of Germany for decarbonizing their energy system has made Germany an early adopter. Early adopters have a higher chance of making sub-optional policies because of lacking knowledge and experience. In Germany this lead to huge financial investments in biogas installations that were less GHG efficient, and still make up a large amount of the bioelectricity and heat system. This large increase in biogas installations in the past also had more adverse effects on environment, indirect land use changes and loss of permanent grasslands, than initially expected when the support system was introduced. Other countries that are not early adapters can learn from the German experience.

15. References used and more information available at:

https://www.bmu.de/fileadmin/bmu-import/files/english/pdf/application/pdf/biomasse_verordnung_en_bf.pdf

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC

https://www.buildup.eu/en/practices/publications/german-renewable-energies-heat-act-eewarmeg

https://www.ieabioenergy.com/wp-content/uploads/2018/10/CountryReport2018_Germany_final.pdf

http://www.fao.org/faolex/results/details/en/c/LEX-FAOC089130

https://www.cleanenergywire.org/dossiers/bioenergy-germany

BEK nr 301 af 25/03/2015 (Gældende) - Bekendtgørelse om bæredygtig produktion af biogas (Executive Order on Sustainable Biogas Production)

https://www.ieabioenergy.com/wp-content/uploads/2018/07/environmental-sustainability_web.pdf

Policy factsheet 40: Act on the Carbon Dioxide Tax on Certain Energy Products

1. **Title policy instrument**

Carbon Tax (*CO2-afgift*)

2. **Main aim of the policy instrument (short)**

The objective of the policy is to put a tax on CO_2 to stimulate households and the business sector to reduce CO_2 emissions.

3. **Country where it is implemented**

Denmark

4. **Year of first implementation**

Since 1992

5. **Is the policy still implemented? If not specify final year of implementation.**

Yes

6. **Type of instrument***

Financial instrument

7. **Biomass value chain position targeted****

End use (energy consumption) and conversion (energy production). This instrument is not actually targetting a biomass value chain, but rather the competing alternative of it which is the fossil energy delivery chain.

8. **Description of the instrument (long)**

(*What is the instrument meant to bring about, how does the instrument work, who are targeted by the instrument*)

Denmark was one of the first and still is one of the leading countries in implementing CO_2 taxation on energy. In 1977, a fossil fuel (oil products, coal and electricity consumption) tax was introduced as a response to the oil crisis in the 1970s. This tax was the predecessor of the Carbon Tax.

At this moment (as at 1 July 2018), the main tax on CO_2 in Denmark is arranged through the Carbon Tax (*CO2-afgift*), with a nominal rate of DKK 173 (around 23 €) per tonne of CO_2.

The current CO_2 tax was introduced in two phases: in May 1992 it was applied to energy products consumed by households and in January 1993 a carbon tax on businesses was prepared which became into force as of 1996.

Beside the taxation of CO_2 there is also a whole package of energy taxes in Denmark:

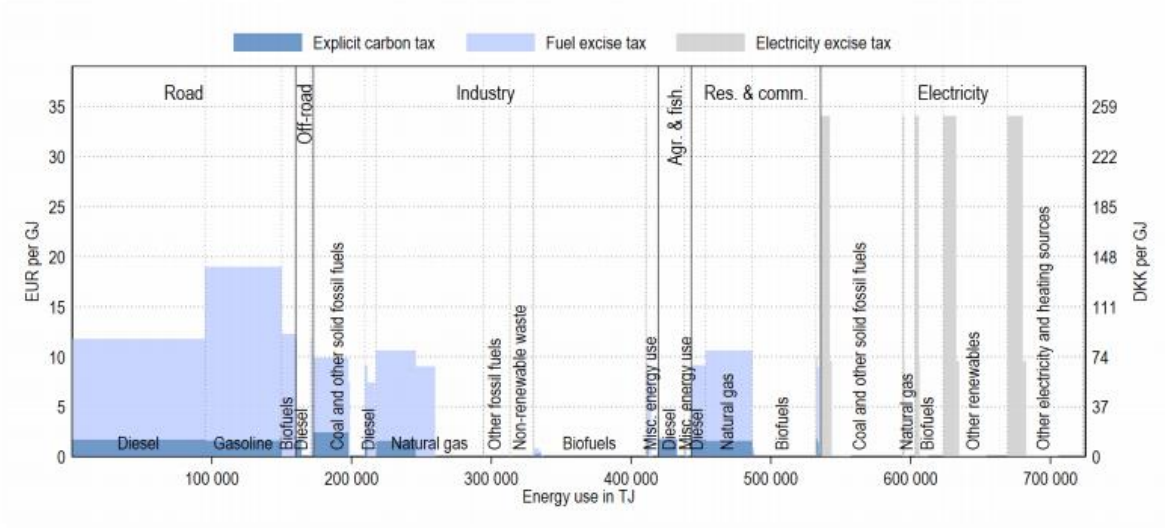
- The Mineral Oil Tax (*Mineralolieafgift*)
- The Gas Tax (*Gasafgift*)
- The Coal Tax (*Kulafgift*)
- The Electricity Tax (*Elafgift*)

The CO_2 tax system did change in time in Denmark. At the beginning when it was introduced for industries the carbon tax payment was highest on the energy for room heating and room cooling. It was lower for so-called "light processes", including light industrial processes and including electricity used for lighting and office equipment in the business sector. This was because a bigger part of the tax payment was reimbursed and because of basic allowance. The energy-intensive processes, including industrial processes and horticulture, were specified in the regulation. The energy-intensive industries had a further reimbursement option, if they signed an energy efficiency agreement with the Danish Energy Agency and invested in energy saving equipment.

As from 2013, the socialist government and the Parliament decided to remove the carbon tax on the business sector and introduce a payment of energy taxes on the EU minimum level. Now, the business sector only pays a CO_2 tax on energy for room heating and cooling. The household sector continues to pay a CO_2 tax on energy consumption. This carbon tax removal in certain industries of course has to do with the fact that Denmark also participates in the EU emissions trading system (ETS). Facilities that are covered by the ETS (power and energy intensive industries) do not pay the carbon tax (or receive a full refund). Heat inputs into district heating plants are, however, subject to the CO_2 tax, irrespective of whether they are also covered by the EU ETS (see Chapter 3, Section 3).

From the overview in Figure 1 it becomes clear that in the current Danish energy tax system:

1) In the road sector, on the fossil based diesel and gasoline a fixed carbon tax applies, while biogasoline and biodiesel are exempted from carbon tax. Also for gasoline the fuel excise tax is higher rate than for diesel fuel.
2) In the off-road transport sector, diesel is taxed at the standard rate for propellant purposes. Diesel used for railway operations is only subject to the CO_2 Tax. Diesel motor fuels for marine and domestic commercial aviation are untaxed. All EU ETS-covered companies benefit from a full refund on the CO_2 Tax paid.



Note: Tax rates applicable on 1 July 2018. Energy use data is for 2016 and adapted from IEA (2018[21]), *World Energy Statistics and Balances*. Energy categories (labelled at the bottom) that represent less than 1% of a country's energy consumption are grouped into "misc. energy use" and may not be labelled.

Figure 1 Effective tax rates on energy use, including the carbon tax, in Denmark for the industry sector (source: https://www.oecd.org/tax/tax-policy/taxing-energy-use-denmark.pdf)

3) In the industry sector, including all primary energy use associated with district heating and fossil fuels are taxed with a CO_2 tax (either national CO_2 tax or ETS). This includes the heat inputs into CHP plants as well. ETS industries benefit from a full refund on the CO_2 tax paid, except for district heating plants. However, these fossil fuels are generally not taxed when used: for energy transformation processes other than heating (e.g. coking coal to coke); mineralogical and metallurgical processes and energy as inputs in auto-producer electricity plants. Biofuels used in industry are untaxed. The same applies to energy from non-renewable waste.
4) In the agriculture and fisheries sector there is an explicit CO_2 tax on fossil-based diesel use. On the other hand diesel and other motor fuels consumed in the agriculture sector benefit from a reduced fuel excise tax (with the exception of gasoline use). Fishing fuels and solid biofuels are untaxed (applies both to CO_2 and fuel excise tax). For the small 2.1% of the agricultural and fishing sector that falls under the EU-ETS companies benefit from a full refund on the CO_2 tax paid.
5) In the residential and commercial sector, fossil fuels and biogases are taxed, both by a carbon and the fuel excise tax. Like in other sectors solid biofuels are not taxed.
6) In the electricity sector all energy sources are untaxed. This is compensated by the fact that electricity consumption of households is taxed as of businesses. This is usually taxed by both carbon and electricity excise tax, as described in the former. However, one exception occurs

as electricity for own use in the industry is not taxed, and neither are electricity exports, which may, however, be subject to electricity taxes in other countries.

9. **Is this instrument following up on EU policy? Either transposed policy to national/regional level or a policy to reach EU policy targets/ambitions? If yes, which policy and which EU targets and ambitions?**

Carbon and energy taxes in Denmark are levied within the framework of the **2003 European Union (EU) Energy Tax Directive**, which sets minimum rates for the taxation of energy products in EU member states.

Furthermore, the CO_2 and energy taxing systems in Denmark have been integrated with the **EU ETS** so that industries do not pay double carbon taxes (or receive a full refund).

10. **Can you explain the impact of the policy in type, size, time and money spent? (*Should be based on evaluations)***

There have been several studies on Carbon tax effects in Denmark and in other countries, particularly by OECD.

In a study by Green Budget Europe (2015) it was reported that when the carbon tax was introduced at the end of the 1990s it was first calculated in an ex-ante study, that the carbon tax in the business sector should reduce the CO_2 emissions by 4.6 % and that 1.8 % reduction should come from the energy efficiency agreements and investment grants. Two inter departmental evaluations concluded later, that the carbon tax influenced the CO_2 emissions as predicted, and that macro-economic negative effects of the carbon taxation were extremely limited . It was also shown by the Danish Energy Agency that the rising energy taxes (in household sector) and the carbon taxation, introduced in households in 1993, reduced the overall energy consumption per square meter immediately (see Figure 2).

The Green Budget Europe (2015) also claim that since the business sector until recently have had the energy taxes fully reimbursed, the carbon taxation (and the Emission Trading System) are the main reasons for the energy efficiency development in the Danish industrial sector (See Figure 3).

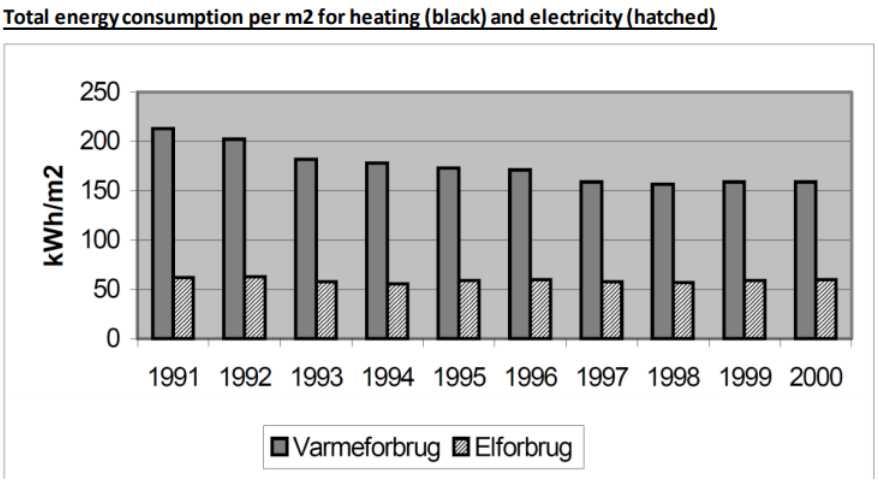


Figure 2 Development of total energy consumption for heating and electricity in Denmark (source: Green Budget Europe (2015) (https://green-budget.eu/wp-content/uploads/The-most-successful-environmental-taxes-in-Denmark-2_FINAL.pdf)

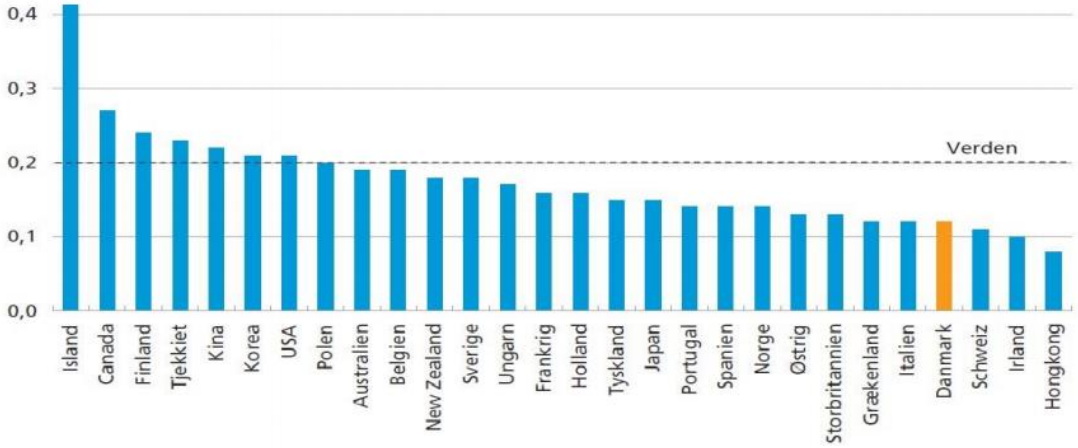


Figure 3 Energy intensity per unit produced in industrial countries, Denmark compared (source: Green Budget Europe (2015) (https://green-budget.eu/wp-content/uploads/The-most-successful-environmental-taxes-in-Denmark-2_FINAL.pdf)

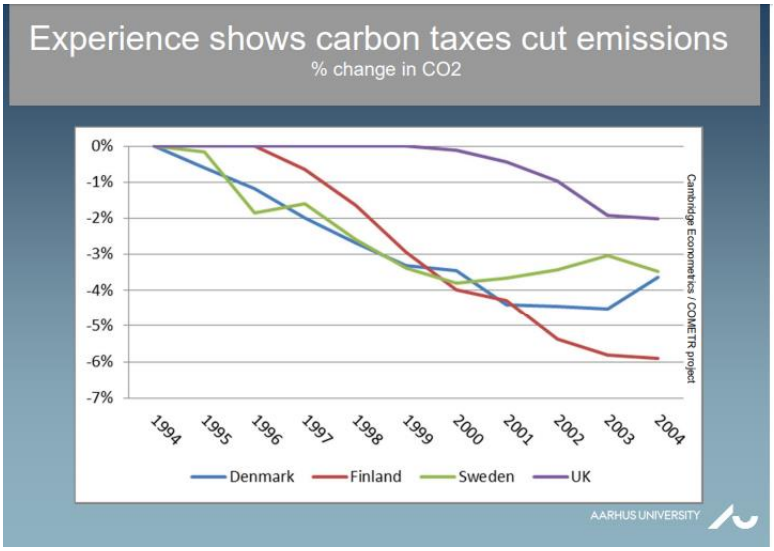


Figure 4 Changes in CO_2 emissions since introduction of carbon taxes (source: (Skou Andersen, 2017)

Also experiences in other Nordic countries show that carbon taxes lead to lower GHG emissions (see Figure 4).

A World Bank report (World Bank & Ecofys, 2014) showed for Denmark that primary energy intensity declined by 26% from 1990 to 2010 and CO_2 emissions were reduced by 25% per produced unit from 1993 to 2000. However, it is not clear to what degree this can be attributed to the carbon taxes. A goal was to avoid increasing the overall tax burden, so the energy tax was lowered with introduction of the carbon tax. The same study also concluded that the impact on GDP and employment was evaluated as generally positive as several measures that had an impact on, amongst others, income tax were introduced alongside the carbon tax.

11. Why can this policy be seen as a good policy example?

In the first place the carbon taxation turned out to indeed deliver to the objective of reducing GHG emissions. This did not hamper economic growth as was also seen in all Nordic countries. The way it was implemented in Denmark delivered declines in GHG emissions in both the households and economic sectors.

Another reason to call this a good policy example is because the policy was evaluated well and adjustments were made to the policy to integrate it with new EU policy developments such as the EU ETS and with market developments and energy taxing systems. So for example to keep the efficient tax rate, the government decreased energy tax level when carbon tax was established. But, it was increased in 2005 as carbon tax was decreased. Also the carbon tax revenues were not for the government budget but instead 40% of this tax revenue was used for environmental subsidies and 60% was returned to industry. These returned taxes were used to invest in for example industrial restructuring. The Danish government also offers 25% reduction of the tax to the companies that sign an energy savings agreement with the Ministry of Transportation and Energy. So, the positive aspect of this policy is that it is dynamic and that it keeps on encouraging companies to further increase energy savings and reduce GHG emissions.

According to Cindy Bae (https://blogs.ubc.ca/cindybae/2013/02/07/denmarks-carbon-tax-policy/) Denmark's carbon policy is successful and cost-effective. This is because the tax policy is easy and incurs low cost for Danish firms to switch to use alternative energy source which can reduce carbon emission. Policy makers provide firms a subsidy for environmental innovation and huge investments in renewable energy by using carbon tax revenue. The effect is also large because the tax covers many sectors ranging from of natural gas, coal, electricity and light and heavy fuel oil.

As a result household carbon emission levels were reduced by 25% and industrial carbon emissions dropped by 23% between 1990 and 2005. High benefits have been created with relatively low carbon tax cost.

12. Would you recommend this policy instrument to be replicate in regions in low, medium, high BBE development stage? Explain why.

This tax can be introduced in all countries as it is generally proven as an effective measure to bring GHG emissions down both in households and in economic sectors. When introducing carbon taxes, it should be well integrated with all taxation measures in place. In Denmark in time many adaptations

were made in the system in both the carbon taxing and the energy taxing with the introduction of the EU ETS and with the changes in carbon prices. The effectiveness was also very much determined by the fact that earnings from the carbon tax were reinvested in economic sectors to introduce innovations which lead to higher energy efficiency and lower emissions in production processes.

13. **Are there similar policy instruments implemented in other EU countries/regions? If yes explain which ones**.

There are already several countries in the EU that levy national carbon taxes (see Figure 5). In this respect Denmark is no exception.

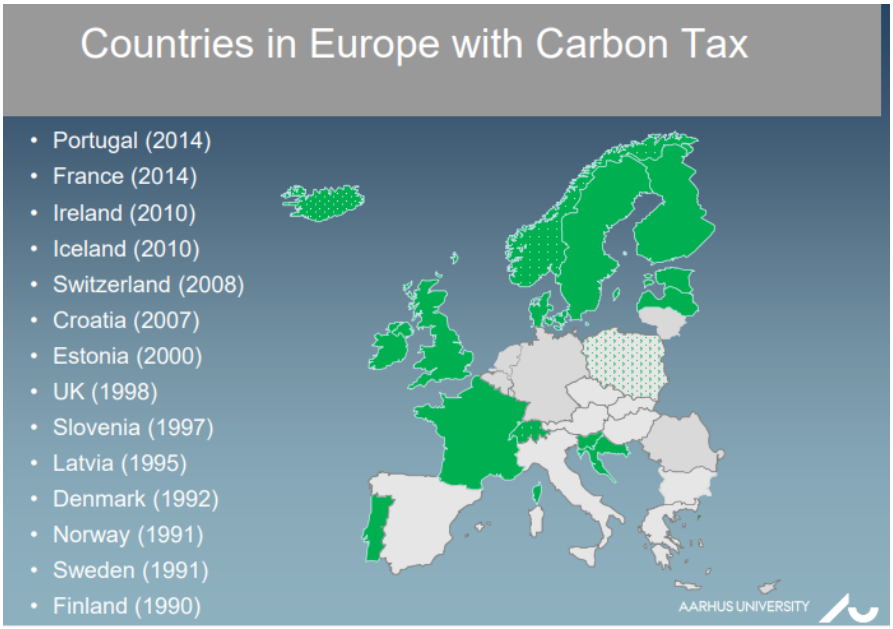


Figure 5 Overview of European countries with a national carbon tax (Skou Andersen, 2017)

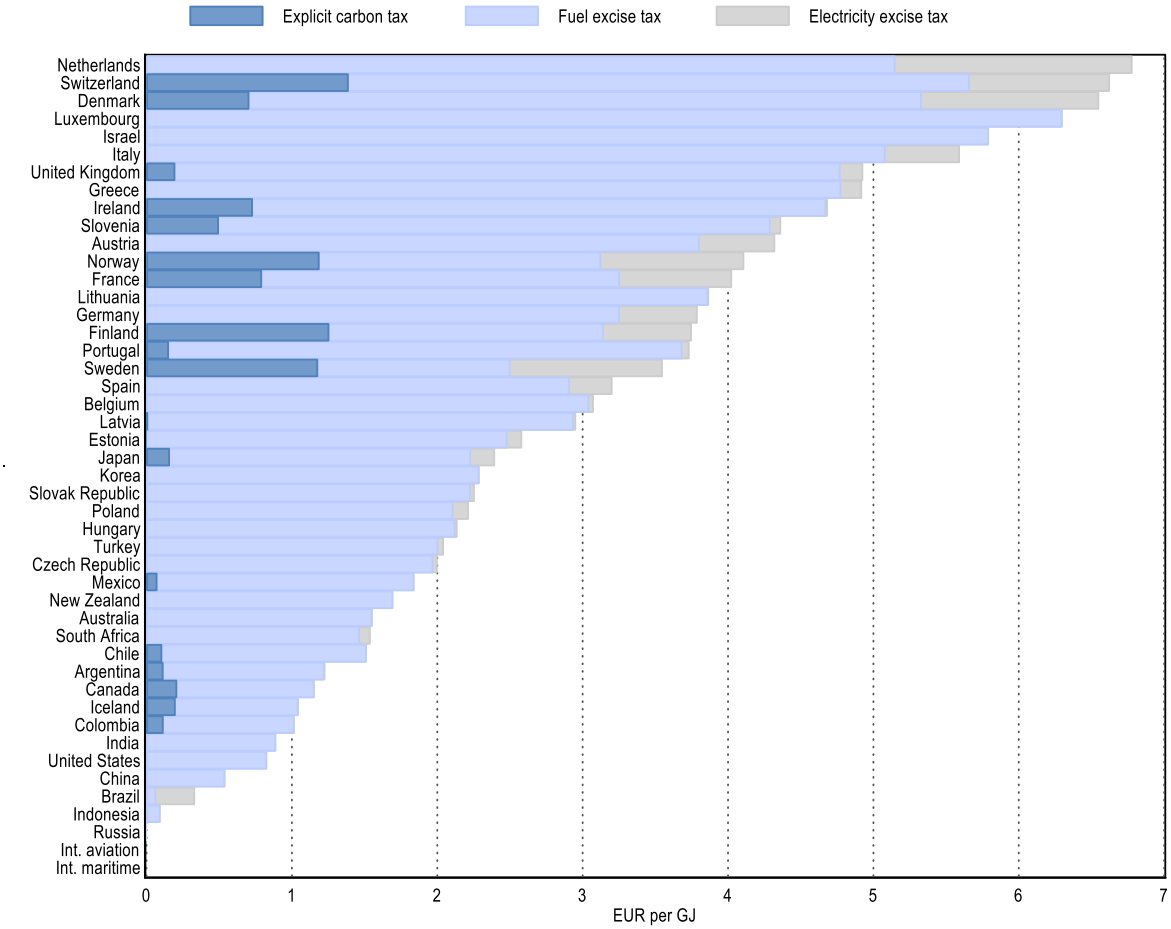


Figure 6 Average effective CO_2 and energy tax rates in OECD countries (Source: StatLink 2https://doi.org/10.1787/888934008057 and OECD (2019b)

Also, outside Europe there are countries with a carbon tax system (see Figure 6). It becomes clear that carbon taxes in Denmark are not amongst the highest. Switzerland, Norway, Finland, Sweden and France levy higher carbon tax rates as expressed in € per GJ. However, if we look at the total tax levied on energy, Denmark is among the top 3 countries with highest tax rates on energy.

So in comparison to other EU countries Denmark chooses carbon tax as one of the tax types for energy, but overall taxes on energy are higher. Denmark even has the 2nd highest tax rate on energy on an economy-wide basis, at EUR 5.95 per GJ, compared with EUR 2.7 per GJ on a simple-average basis across the 34 OECD and 7 partner economies.

A country like the Netherlands does not use carbon taxes so far, but levies very high fuel and electricity excise taxes. In Norway, Sweden and Finland the carbon taxes are amongst the highest of all countries, but fuel and electricity excise taxes are much lower. Switzerland has the highest overall taxes on energy.

14. Barriers and solutions encountered in the development and implementation of this policy instrument

There were several barriers encountered in the implementation.

Firstly, there was concern that the introduction of the carbon tax was to adversely influence the relative competitive position of Danish companies and that it would lead to lower GDP development and loss of jobs. Ex-ante evaluations and also ex-post evaluations helped to address this concern and make the policy more effective.

Secondly, adjustments were made in the policy in time with the changes made in EU policy such as through the introduction of the EU ETS and developments in carbon markets which lead to changes in carbon prices. This leads to adjustments in the policy which could have created uncertainty to economic actors. On the other hand, by creating flexible policy frameworks adjustments can be made in time.

15. References used and more information available at:

Green budget Europe (2015). The Danish Ecological Council. Successful environmental taxes in Denmark. https://green-budget.eu/wp-content/uploads/The-most-successful-environmental-taxes-in-Denmark-2_FINAL.pdf (*visited 1 May 2020*)

IEA (2018), "Extended world energy balances", IEA World Energy Statistics and Balances (database), http://dx.doi.org/10.1787/data-00513-en. (accessed on 16 October 2018)

OECD (2018), Effective Carbon Rates 2018: Pricing Carbon Emissions Through Taxes and Emissions Trading, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264305304- en.

OECD (2019a). Taxing Energy Use 2019: Country Note – Denmark https://www.oecd.org/tax/tax-policy/taxing-energy-use-denmark.pdf

OECD (2019b). Taxing Energy Use 2019 USING TAXES FOR CLIMATE ACTION. https://www.oecd-ilibrary.org/docserver/058ca239-en.pdf?expires=1588503020&id=id&accname=guest&checksum=79BD1245ED84A36BE3EE85261F5B2B08

Skou Andersen, Mikael (2017). Experiences with carbon taxation - Denmark, Sweden and Europe. Presentation at: Environmentally related taxes and other fiscal instruments Kirstenbosch Botanical Gardens, Cape Town 29/3/17. http://pure.au.dk/portal/files/111427005/CapeTown1_ANDERSEN.pdf

Withana, S., ten Brink, P., Kretschmer, B., Mazza, L., Hjerp, P., Sauter, R., Malou, A., and Illes, A., (2013) Annexes to Final Report - Evaluation of environmental tax reforms: International experiences. A report by the Institute for European Environmental Policy (IEEP) for the State Secretariat for Economic Affairs (SECO) and the Federal Finance Administration (FFA) of Switzerland. Brussels. 2013.

World Bank & Ecofys (2014). State and Trends www.carbonfinance.org of Carbon Pricing. Washington DC, May 2014. Report 88284. DOI: 10.1596/978-1-4648-0268-3

Policy factsheet 41: Regulation on the use of biomass from forest for energy (Orden 29/12/2011)

1. Title policy instrument

Regulation on forest biomass use for energetic purposes

Link to full text of legal source (original language):

https://juntadeAndalusia.es/boja/2012/12/d3.pdf

2. Main aim of the policy instrument (short)

This regulation aims to regulate which forest biomass coming from different types of forest areas can be used as renewable resources for energetic use.

3. Country where it is implemented

Spain, Andalusia

4. Year of first implementation

2011

5. Is the policy still implemented? If not specify final year of implementation.

Yes

6. Type of instrument*

Regulation (imposed by law)

7. Biomass value chain position targeted**

Biomass

Processing & conversion of biomass

8. Description of the instrument (long)

(*What is the instrument meant to bring about, how does the instrument work, who are targeted by the instrument*)

The purpose is to regulate the use of woody biomass coming from mountains or forest lands in Andalucía as a renewable feedstock for use in energy generation. The focus is entirely on forest biomass

from vegetation that covers the mountains and/or forest lands of Andalusia[50]. When the regulation was designed the draft of this regulation was first presented to the Forest Committee of the Andalusian Council for Biodiversity and then, to the whole Andalusian Council for Biodiversity. Finally, it was approved by the Parliament of Andalusia.

The regulation specifies that the following forest biomass can be used for energy generation:

1) Biomass obtained from forest areas that have specifically been planted with the objective to produce biomass for energetic uses. The status of this land as energy forest needs to be approved by the Andalusian government (Junta) based on a technical plan submitted. The production in this forest has to follow the rules of sustainable forest management as specified in laws[51]as well as the natural resource management plans and the rest of planning or regulatory instrumentsincluding principles of sustainability and stability of the forest ecosystems[52]. It is also specifically specified that on the same surface where wood for energy is produced, other non-timber producing activities are also allowed such as for example production of cork, fruits, honey, pastures, hunting, inland fishing, recreational use.
2) In forest areas not directly dedicated to biomass or energy, biomass harvesting for energetic use is still allowed for the following types:
    a. Primary residues from logging activities
    b. Biomass that is removed for the creation and maintenance of firebreaks for the prevention of forest fires.

For the establishment of a forest with a purpose of biomass based energy generation a technical plan has to be submitted and approved. In this plan the following information needs to be included:

1) Surface of the plantation
2) Type of ecosystems present where it is to be located
3) Soil type
4) Productivity of the forest
5) Species used, fast growing species are allowed

[50] as defined the article 5 of Law 43/2003, of November 21, de Montes, and in article 1 of Law 2/1992, of June 15, Forest of Andalusia.

[51]Law 43/2003, of 21 November and Law 2/1992 of 15 of June.

[52] Regulated in Law 42/2007, December 13 on Natural Heritage and Biodiversity and in Law 8/2003 on Wild Flora and Fauna of Andalusia

6) In case of the use of an invasive species, it needs to be specified what measures are taken to control the invasive effects
7) Rotation period
8) Plantation framework and design
9) Soil preparation measures taken
10) Type of phytosanitary treatments (pesticides, herbicides) needed in the plantation
11) Need for irrigation or fertilization, and where appropriate, availability of water use concessions
12) An energy and GHG balance of the plantation during the production cycle of the plantation

The forest plantations on private and public lands that were already in existence before this regulation was approved, also needed to submit these technical plans, but these were treated with priority.

Finally, the regulation promotes the certification of woody biomass going to energy. However, this is not an obligation.

9. **Is this instrument following up on EU policy? Either transposed policy to national/regional level or a policy to reach EU policy targets/ambitions?** If yes, which policy and which EU targets and ambitions?

This regulation was one of the instruments to stimulate the domestic biomass availability for the production of bioheat and bioelectricity to reach the sustainable energy targets that were specified in the Spanish National renewable Action plan 2011-2020 (Plan de Acción Nacional de Energías Renovables de España (PANER) 2011-2020) and the Royal Directive 661/2007 (Real Decreto 661/2007)[53] that establishes a system of economic premiums for the use of forest biomass as the main fuel for energy production in Spain.

This instrument helps Spain and the region of Andalusia, to reach the goals of the first (RED) and Revised Renewable Energy Directive (REDII) related to reaching renewable energy targets.[54]

Furthermore this regulation also follows up on the Analusia plan for sustainability in energy (*Plan Andaluz de Sostenibilidad Energética 2007-2013* (PASENER)[55]). The target set in PASENER is to increase

[53] **https://www.idae.es/tecnologias/energias-renovables/plan-de-energias-renovables-2011-2020**

[54] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC

[55] **https://juntadeandalucia.es/organismos/empleoformacionytrabajoautonomo/consejeria/sobre-consejeria/planes/detalle/13207.html**

the renewable energy share in the primary energy production to 18.3% in 2013 with a ratio of 39.1% of the electric power production coming from renewables. This means that the CO_2 emissions avoided will rise to 11 million tons and emissions CO_2 per unit of electricity generation will be reduced by around 20%.

10. **Can you explain the impact of the policy in type, size, time and money spent?** (*Should be based on evaluations)*

So far no impacts have been systematically studied.

However, what we do see is that bioelectricity production in Andalusia increased considerably between 2010 and 2019 from 210 MW to 274 MW[56]. The main biomass sources are secondary residues from the olive oil industry and also wood from dedicated forest biomass production, particularly eucalyptus.

The heat production based on biomass has also increased strongly since 2010 to 1776 MW per year in 2019. Wood biomass is an important source used. As for biomass installations for thermal uses, as of 31/12/2019 Andalusia has 27,579 biomass installations for thermal uses including stoves, boilers, dryers, hot air generators, etc., which represents an installed thermal power of 1,775.65MW.

11. **Why can this policy be seen as a good policy example?**

Because it is generally not common that the use of forest biomass is regulated by regions. In this respect the regulation is quite unique because it provides clear guidance on which forest biomass can be used for energy production. This stimulates the use of forest biomass and is also providing some guidance on the sustainable production of biomass in forests planted especially for providing biomass for energy.

The regulation also specifies that primary residues from forest can be used for energy generation and the same applies to wood harvested from forests to maintain fire breaks. This instrument is therefore not only focused on enhancing the residual woody biomass supply for energy, but particularly couples biomass provisioning with landscape fire risk reduction.

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[56] https://www.agenciaandaluzadelaenergia.es/sites/default/files/Documentos/informe_andaluz_miea_2019_12_31.pdf

12. **Would you recommend this policy instrument to be replicate in regions in low, medium, high BBE development stage? Explain why.**

Yes, in countries regions that have important sources of biomass from forests. Regulation can ensure:

1) The exploitation of unused biomass
2) The sustainable and resource efficient exploitation
3) May prevent deforestation practices
4) May help to better manage forest and bring forest fire risk down

13. **Are there similar policy instruments implemented in other EU countries/regions? If yes explain which ones.**

Yes, but not many. In Wallonia there is policy regulating which forest residues can be used for energy.

Other more general examples are for UK. The UK has introduced specific sustainable land use criteria (e.g. no harvest of wood from carbon rich forests or from high biodiverse forests) and requires certification when sourcing woody biomass from forests (for both home produced and imported biomass).

According to Banja et al (2016) ' some EU countries have prohibited the use of certain biomass feedstocks for bioenergy, like Belgium, Finland, and the Netherlands. Belgium and Hungary explicitly aim to ensure that the use for energy is the last step in the use hierarchy of biomass feedstocks. This is being referred to as the 'cascading principle' and is derived from EU's Waste Framework Directive (Directive, 2008/98/EC).

14. **Barriers and solutions encountered in the development and implementation of this policy instrument**

So far no systematic monitoring of this policy instrument has been made.

Regarding the bioeconomy, from a regulatory point of view, the Renewable Energy Plan (PER) 2011-2020, approved by Agreement of the Minister's Council on November 11, 2011, includes an excellent analysis of the situation of the forest biomass sector, a good evaluation of potential, but neglects all support measures and development of bioeconomy strategies.

Rural development and environmental legislation is not coordinated with energy legislation, which hinders many investment opportunities and difficulties in financing business projects.

It could conclude that little coordination can be identified between the public administrations in charge of forest and energy management, and at the same time, of controls with local entities, which makes it difficult to launch public initiatives.

There is a lack of an institutional communication strategy for the promotion and valorization of forest biomass to obtain energy and the environmental improvement of our forests, due to the lack of discourse, which hinders the transmission of this message to society.

Cooperation agreements between farmers or forest managers, agribusiness and the bio-based industry are extremely important to promote a sustainable bioeconomy in Andalusia. More specifically,

these agreements will help increase the knowledge and skills of biomass producers and specifically an adequate participation of all stakeholders in the value chain in the final income.

15. References used and more information available at:

Junta de Andalusia (2013). Marco de referencia para el aprovechamiento de la biomasa de pinares en Andalucía. https://www.juntadeAndalusia.es/medioambiente/portal_web/web/temas_ambientales/montes/usos_y_aprov/jornadas_biomasa/Publicaciones/Biomasa%201%20Capitulos/12_aprovechamiento_biomasa1.pdf

Consejería de Medio Ambiente . Orden de 29 de diciembre de 2011, por la que se regula el aprovechamiento de la biomasa forestal con destino energético. https://www.juntadeAndalusia.es/boja/2012/12/3

Francisco Bas Jiménez (2013). JORNADA SOBRE EL USO DE LA BIOMASA FORESTAL EN ANDALUCÍA. Situación actual del uso de la biomasa en el contexto de las energías renovables. Dor. de Planificación y Gestión Energética en la Administración Pública. Sevilla, 21 de marzo de 2013.

Sebastian, F, Dr J. Royo, Ms M. Díaz, Mr D. García-Galindo, Ms M. Gómez, Ms E. López, Mr D. Maraver, Ms A. Rezeau, Mr S. Sala and Ms A. Sin (2011). The Spanish case of biomass utilization for energy purposes. Conference Paper · June 2011 DOI: 10.13140/RG.2.1.4671.4726

https://www.agenciaandaluzadelaenergia.es/sites/default/files/Documentos/informe_andaluz_miea_2019_12_31.pdf.

Policy factsheet 42: Regulation of the use of residual biomass from olive oil industries (D 4/2011)

1. **Title policy instrument**

Regulation on use of olive mill waste waters (effluents) from olive oil industry as fertilisers on agricultural soils (*DECRETO 4/2011, de 11 de enero, por el que se regula el régimen del uso de efluentes de extracción de almazara como fertilizante agrícola*).

Link to full text of legal source (original language):

https://www.juntadeAndalusia.es/boja/2011/14/d1.pdf

2. **Main aim of the policy instrument (short)**

The objective of this decree is to establish the legal status for the use of the olive mill waste waters(*efluente de almazara*) produced in the virgin olive oil extraction mills as agricultural fertilizer.

3. **Country where it is implemented**

Spain, Andalusia

4. **Year of first implementation**

2011

5. **Is the policy still implemented? If not specify final year of implementation.**

Yes

6. **Type of instrument***

Regulation (imposed by law)

7. **Biomass value chain position targeted****

Biomass

End use

8. **Description of the instrument (long)**

(*What is the instrument meant to bring about, how does the instrument work, who are targeted by the instrument*)

The purpose is to regulate the use of waste water/effects of olive oil extraction activity and return it to the olive fields as fertilizer in the agricultural soils, restoring some of the nutrient extractions caused by the crop. According to Ouzounidou et al. (2010) olive mill wastewater possesses considerable amounts of mineral nutrients such as potassium (K2O: 2.4-10.8 g/l) and phosphorus (P2O5: 0.3-1.5 g/l), and a wide-range of micronutrients. On the other hand, olive oil effluents applied on land may

also have adverse environmental effects such as soil contamination, underground seepage, water-bodies pollution and foul odor emissions (Ouzounidou et al. (2010), IPPC BREF, 2006). Regulation of the use of these residues as fertilisers is therefore necessary.

In general terms there is a SWOT analysis done by Galanakis (2017) on the direct application of olive mill waste waters on soils (see Figure 1).

Table 5.2 The Main Strengths, Weaknesses, Threats, and Opportunities Related to the Reuse of OMW as Soil Amendment

Strengths	Weakness
• Spreading is regulated and permitted by specific laws in different countries. • Timely disposal of the waste. • Simple equipment and technology are required. • Low costs. • Agronomic and environmental advantages documented, including the storage of C (with potential possibility of acquisition of "C credits").	• Environmental risks if conducted in unsuitable conditions and using irrational techniques. • Need of suitable agricultural soils. • Poor fertilizer value of OMWW and not composted pomace and agronomic short-term effect for OMWW. • Possible phytotoxic actions by irrational spreading of OMWW. • Spreading logistics are complicated due to the low accessibility of fields in some periods of the year.
Threats	Opportunities
• Environmental pollution with irrational spreading.	• Increase in agronomic benefits with composting. • Valorization of compost derived from pomace in nurseries after a partial or total replacement of the peat. • Accounting of "C credits".

Fuente: GALANAKIS C.M. (editor) 2017.

Figure 1: SWOT analysis of direct application of olive mill waste waters on soils

Effluents are produced in two phases of the olive oil extraction process. In the first phase before the oil extraction, the whole olives are washed with water and this water ends up as effluent. After the oil extraction in the second phase, the resulting oil needs to be washed again with water. Again, effluents consisting of this washing water result.

The use of these effluents in agricultural soils has many advantages. They replace the input from nutrient and water resources outside the system, which have costs, cause additional energy consumption and GHG emissions and are largely fossil-based. Avoiding external inputs through the use of effluents from the olive mills in the olive production systems has therefore many environmental and economic advantages. Furthermore, in most olive oil mills a modernisation of the process took place in recent years that led to a reduction of the pollutants occurring in the effluents from the washing of the olives and the olive oil. The risk of accumulation of hazardous substances in the effluents has therefore declined. Using the effluents as fertilisers in olive production requires a legal basis that organises the amount used, the location where it is used and the compositional characteristics of the effluent allowed to be applied on soil. These aspects need to be made consistent with the prescriptions in other laws. Such as the Laws that regulate water quality (*Ley de Aguas Real Decreto Legislativo 1/2001 & Ley de Aguas de Andalucía (Ley 9/2010)*) and the law that regulates the integrated management of environmental quality in agriculture (*Gestión Integrada de la Calidad Ambiental, artículo 84 de la Ley 7/2007*). These laws prescribe that the use of effluents in agricultural soils can only be allowed if this does not create any risk for water, air or soil quality and for flora and fauna. Also the updated law regulating water quality (*Ley de Aguas Real Decreto Legislativo artículo 5 de la Directiva 2008/98/CE*) already gives specifications on the use of effluents from industry as fertilisers. It regulates precisely on what type of land and soils the types of effluents can be used, the land application mechanisms, the

commitments of the mills, consent of the holders of the receiving parcels and the managers of the irrigation systems through which the effluent is applied and the required analytical controls to be made. Despite this, this new law on use of effluents from olive oil mills as fertilisers is essential as it regulates some additional issues specifically for olive mill effluents. These additional issues are:

1) The confirmation that olive oil effluents are produced as an integral part of the virgin olive oil production process and therefore comply with the EU waste law 2008/98/EC declaring that these residues are indeed considered by-products and not wastes.
2) The requirement for asking permission for the use of effluents as fertilisers in agriculture. This can be asked by owners of olive oil mills or of purchase centers of effluents or, holders of the tanks containing the olive oil mill effluents, which are intended to used fertilizer in agriculture. The entity wanting to use the effluent as fertiliser must get the permission from the Regional Ministry of Agriculture of the Junta de Andalucía. The request for authorization needs to be accompanied by an 'Effluent Management Plan'.
3) The effluent management plan will need to be approved by the Ministry responsible for agriculture in every Andalusian province which has 6 months for this decision.
4) The 'Effluent Management Plan' should specify:
    a. Technical and analytical characteristics of the effluents
    b. Characteristics of the soils it is to be applied on
    c. Method and period of application of the effluent to the soil
    d. The plan must be signed by a competent person working in the company that applies for the permission
5) When the effluent is applied to soil the following requirements need to be complied with:
    a. A written consent of the land-holder it is applied to
    b. A written consent of the managers of the irrigation systems through which the effluent is applied
    c. After application of effluent to soil, indicate the identification of the *piece of land* (each parcela or piece of land, ie the area of the land has a identification number which must be indicated in the form sheet document as well as the volume of effluent applied.
    d. At the end of the annual effluent application period (before November 30 of each year) the person responsible for the Effluent Management Plan must submit an annual report specifying the volumes and the fertilized surfaces applied. The annual report needs to be approved by the competent authority at provincial level.
    e. Document to be submitted after each application and then annually with the total effluent data.
6) The application of effluent as fertiliser needs to comply with the following specific rules:
    a. The amount applied cannot exceed more than 50 M3 per hectare per year
    b. Applications must be made in such a way that it does not produce surface runoff, leaching, or lead to groundwater table increases
    c. Effluents, when NOT applied through ferti-irrigation with drip application, cannot be spread within 500 m of urban areas, within 100 m of drink water protection areas (as

defined in the Regulation for Public Water, approved by Royal Decree 849/1986) and within 100 m of a terrestrial maritime public area (as defined in the Law on Coasts 22/1988)

7) How control on following the requirements of this law is done and what consequences are to be applied in case of breaches.

9. Is this instrument following up on EU policy? Either transposed policy to national/regional level or a policy to reach EU policy targets/ambitions? If yes, which policy and which EU targets and ambitions?

Yes, it follows on the EU Waste Directive 2008/98 / EC. This directive establishes in article 5, paragraph 1, the conditions that must be met for a substance resulting from a production process that can be considered as a by-product and therefore not as a waste. This directive prescribes that effluents from industries can be used as fertilisers if:

1) They are produced as an integral part of the olive oil production process,
2) without any further transformation other than normal industrial practice and
3) the substance must meet all the relevant requirements that ensure that it will not cause any adverse effects on the environment or on human health.

The Andalusian Law is therefore a further specification of complementary requirements applying specifically to olive oil mill effluents. After all, the EU Waste Directive applies to effluents in general but there is no EU legislation regulating olive mill waste management, and standards are left to be set by individual countries.

10.* Can you explain the impact of the policy in type, size, time and money spent? (*Should be based on evaluations)

The number of submitted and approved Effluent Management Plans and the amount of applied olive mill effluent is regularly monitored by the Junta de Andalusia. Underneath the monitoring results of the 2016/2017 olive oil harvest campaign are presented[57]. The pie chart indicates the management plans that have been authorized in each of the provinces for both mills and purchasing centers that have requested such use of effluents and have had the necessary management plan approved for the reuse of such effluents.

[57] Source: https://www.juntadeAndalusia.es/organismos/agriculturaganaderiapescaydesarrollosostenible/areas/agricultura/produccion-agricola/paginas/efluentes.html

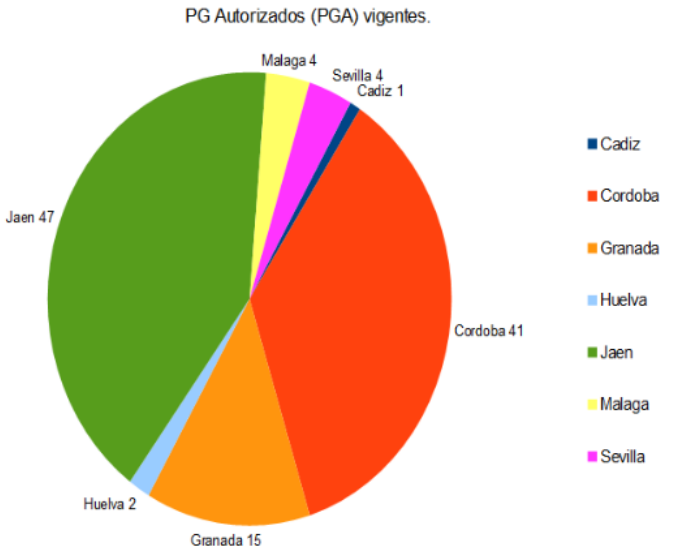

Figure 2: Number of approved Effluent Management Plans in 2016/2017 in Andalucía per province

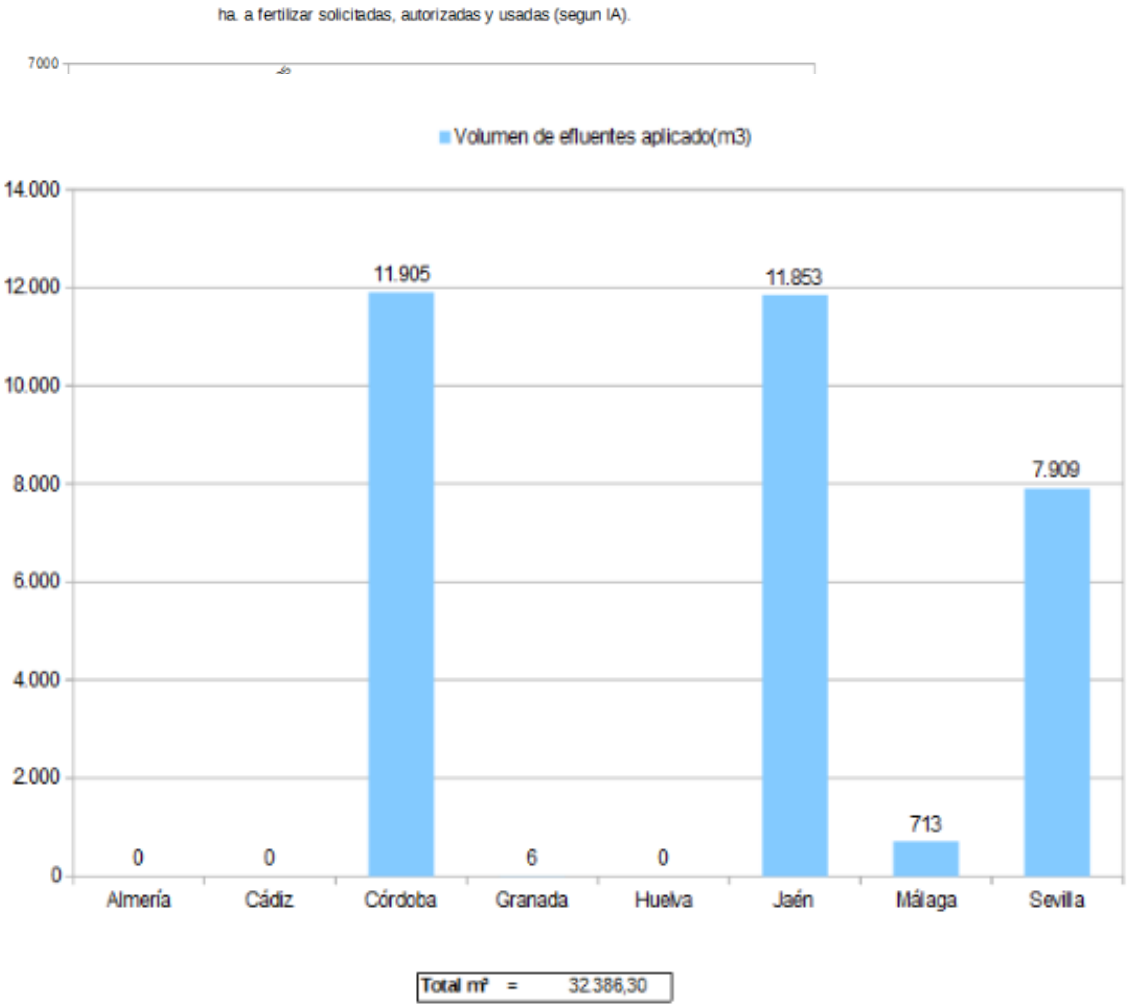

Figure 3: Number of hectares for which authorization was applied (green), for which authorization was granted (orange) and to which fertilisation with effluents was also applied (purple) in Andalucía 2016/2017.

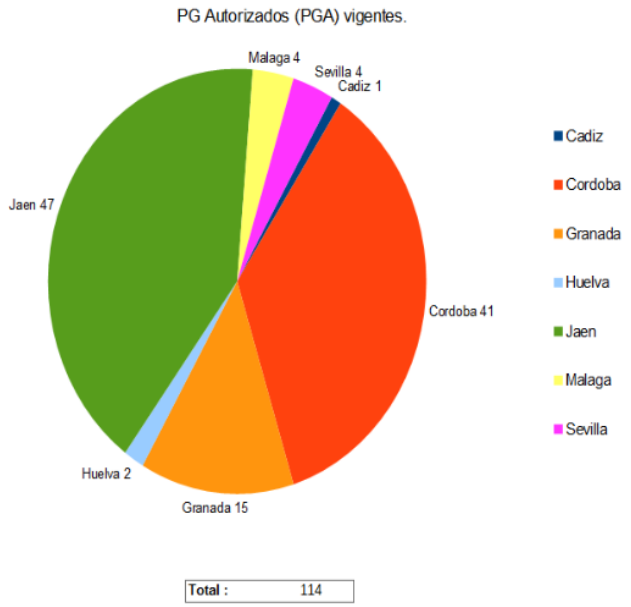

Figure 4: Amount of m3 of effluents applied to lands in 2016/2017 in Andalucía

At national level a study was done in 2019 on whether one of the effluents from the olive oil mills (' *orujo graso húmedo'*) can be regarded as by-products instead of waste according to the EU Waste Directive 2008/98 /EC. It showed that 96% of the effluents produced in the mills are also reused in or outside the mills. It was also concluded that the volumes of this production residue have increased considerably in recent years. The report concludes that although the production is large and increasing the olive oil industry can manage the processing of the residue, including for fertilisation use. With respect to the protection of human health and the protection of the environment, it is concluded that no general adverse impacts are expected. Consequently, it was concluded that all four conditions defined in EU Waste Law 22/2011 are met and that the effluents from the olive oil mills in Spain can be declared by-products.

11. Why can this policy be seen as a good policy example?

It is generally not common that the use of olive oil mills effluents are regulated in a way that they can be declared by-products according to the EU Waste Law. This legal arrangement supports the more circular use of these olive oil residues and supports both the environmental and economic sustainability of the olive oil sector. In countries and regions where this is not arranged, the options to create a more circular olive oil production system are more limited.

12. Would you recommend this policy instrument to be replicate in regions in low, medium, high BBE development stage? Explain why.

Yes, in countries /regions that have important olive oil production. Regulation can ensure:

5) The exploitation of unused biomass
6) The sustainable and resource efficient exploitation
7) May prevent unsustainable dumping of the effluents
8) May help to make the olive oil sector more circular and bring down GHG emissions through exchanges part of the fossil-based fertilisers with olive oil mill effluents.

13. **Are there similar policy instruments implemented in other EU countries/regions? If yes explain which ones**.

Within Spain, beside Andalucía, the autonomic regions of Cataluña (since 2015) and Valencia (since 2018) have regulated the use of effluents from the olive oil mills as fertilisers on land.

Olive oil waste regulations exist in Italy, Greece, Spain, Cyprus and Portugal. Specification of these regulations are, however. often different with respect to several rules (as was reviewed by Inglezakis et al., (2012).

14. Barriers and solutions encountered in the development and implementation of this policy instrument

Difference in the way the policy is implemented in Spain and also between EU countries.

15. References used and more information available at:

Inglezakis, V.J, Moreno J.L. & Doula M. (2012). Olive oil waste management EU legislation: Current situation and policy recommendations. www.journal-ijcees.com ISSN: 0976-3716 (print) IJCEES Vol 3(2):65-77, 2012.

IPPC BREF, 2006. Integrated Pollution Prevention and Control, Reference Document on Best Available Techniques in the, Food, Drink and Milk Industries, European Commission.

Ouzounidou, G., Zervakis, G.I. and Gaitis, F., 2010. Raw and Microbiologically Detoxified Olive Mill Waste and their Impact on Plant Growth, Terrestrial and Aquatic Environmental Toxicology. Global Science Books.

Policy factsheet 56: Biomethane Decree Italy

1. Title policy instrument

Biomethane Decree

Link to the full text of the legal source (original language): https://www.mise.gov.it/images/stories/normativa/DM-biometano-2-marzo_2018_FINALE.pdf

2. Main aim of the policy instrument (short)

The goal of the instrument is to support bio-methane injection (into the gas network) and electricity production from bio-methane and to stimulate the use of bio-methane in the transport sector.

3. Country where it is implemented

Italy

4. Year of first implementation

2013, amended in 2018

5. Is the policy still implemented? If not specify final year of implementation.

Yes

6. Type of instrument*

Financial instrument

7. Biomass value chain position targeted**

Processing & conversion of biomass

Market retail & distribution

8. Description of the instrument (long)

(*What is the instrument meant to bring about, how does the instrument work, who are targeted by the instrument*)

The years 2008-2012 have been characterized by a rapid growth of biogas plants built in Italy. The sector grew considerably, exceeding one thousand plants with an installed capacity of around 900 MW, thanks to a feed in tariff ("tariffa onnicomprensiva") system that guaranteed really interesting subsidies (0,28 €/KWh) for the production of renewable electric energy.

From January 2013 to December 2017, the Italian biogas support scheme substantially changed and was considered less profitable by the investors. Compared to the past, the subsidies have decreased and have been extended from 15 to 20 years and related to the size of the plant (the smaller the biogas plant is, the higher is the subsidy) and to the feedstock (the more by-products or organic waste you use, the higher is the subsidy). They also introduced a ranking system for the new biogas plants ("registri") and a special bonus for the enhancement of the thermal energy and for the reduction of the nitrogen content in the digestate. At the end of 2017 in Italy there were 1,555 operating plants, with a total installed capacity of 1,345 MW. According to these numbers, Italy was the second biogas market in Europe after Germany and the fourth in the world after Germany, China and USA.

Despite the excellent starting conditions (large number of biogas plants and natural gas vehicles, extension of the natural gas grids) in Italy there were only a few biomethane plants in production. There was only a large plant that is injecting around 3,750 m^3/h into the natural gas grid and seven other small pilot plants. The largest one, near Milan, entered into operation in June 2017 and it is fed by organic fraction of municipal solid waste.[58]

With the biomethane sector not fully developed, a new decree for biomethane production was published by Italy's Economic Development Ministry (MISE) in March 2018. The decree provides for 4.7 billion € of incentives dedicated to plants, operating between 2018 and 2022. As advanced biofuels and biomethane have higher production costs than traditional fuels, the decree seeks to support biomethane producers with a premium to fill the cost gap. The incentives apply up to 1.1 billion m^3 biomethane per year. Transport fuel retailers have the obligation to sell a minimum amount of biofuel.

This obligation can be satisfied by getting the requested amount of CIC* (Certificati di Immissione in Consumo di biocarburanti - Certificate of Emission of Biofuel in Consumption) in two ways, namely:

(i) through selling the prescribed amount of biofuel in return for a corresponding amount of CICs, or

(ii) through purchasing the obligation share of biofuels not injected into the market from producers or other obliged entities with a CIC surplus.

[58] Maggioni, L., Pieroni, C., Pezzaglia, M. The biogas and biomethane market in Italy

* A CIC is issued for each 10 GCal of produced biomethane; considering that 1m^3 CH_4 is equal to 8121 kcal, a CIC corresponds to about 1231 m^3 CH_4. This calculation assumes that 1m^3 CH_4 equals 0.68 kg under normal conditions (standard temperature of 273.15 K and pressure of 101.325 kPa).[2]

The biomethane is considered advanced if it is derived from particular biomass:

- Algae if grown on land in ponds or photobioreactors
- Organic waste from domestic collection and subject to separate collection
- Biomass fraction corresponding to industrial waste not appropriate to use in the human or animal food chain, including material from retail and wholesale trade and from the agri-food, fisheries and aquaculture industry
- Straw
- Animal manure and sewage sludge
- Effluent from palm oil mill and empty palm fruit bunches
- Talloil pitch
- Crude glycerine
- Bagasse
- Grape marc and wine lees
- Shell
- Husk
- Cobs cleaned of kernels of corn
- Biomass fraction corresponding to waste and residues from the forestry activity and industry such as bark, branches, pre-commercial thinning products, leaves, needles, foliage, sawdust, splinters, black lye, brown slurry, fiber sludge, lignin and tall oil
- Agro-industrial residues and by-products different from other categories, with higher concentrations of pure cellulose and hemicellulose as specified in the definition in the Article 2 of the policy.
- Energy crops with a low starch content (p.e. ryegrass, switchgrass, miscanthus, common reed) and cover crops preceding the main crops and following them. The following crops are included in the definition of cover crops, grown both in purity and in mixture, and with the condition that they are in rotation as previous or subsequent to the main crops: – Field bean (Vicia faba minor) – Alfalfa (Medicago sativa L.) – Facelia (Phacelia spp.) – Loiessa (Lolium spp.) – Winter turnip (Brassica rapa L.) – Ethiopian mustard (Brassica carinata L.) – Sorghum (Sorghum spp.) – Tobacco (Nicotiana tabacum L.) – Clover (Trifolium spp) – Triticale (Triticum secalotriticum) – Sulla (Hedysarum coronarium L.) – Veccia (Vicia sativa L.)[1]

The revenues for advanced biomethane are generated from two main sources, namely:

1. The payment of 375 € for a 10-year CIC; after this time, producers are only entitled to receive CICs at a price defined by the market. In addition, advanced biomethane, obtained by the substrates listed above), entitles producers to receive one CIC per 5 GCal (double counting).

2. Selling produced biomethane at the average price, weighted against the quantities registered in the virtual trading point (PTV) during the month of the sale, reduced by 5%.

An additional premium is offered when the producer is also the distributor of the methane. In fact, in this scenario, the value of the guaranteed CICs is increased by 20%.[59] This premium encourages the producer to sell the biomethane locally.

The Decree provides for the introduction of guarantees of origin (GoG) system which, according to the purpose of the legislator, serves to prove to the consumer the origin of renewable gas used.

To support the development of the biomethane system the decree introduces an additional amount of CIC for the construction of new filling stations for bio-CNG or bioLNG. More specifically, if the producer sustains a certain share of the infrastructural cost of a new filling station (at least 51 % individually or together with other producers), this will result in an increase in the allocated CIC up to 70 % of the cost of entire structure built or at most € 600,000 per the CNG filling station or € 1,200,000 per the LNG filling station (if the investment is made by a joint venture the additional contribution will be allocated on the basis of financial participation shares). The statistics show that the availability of refueling points stimulates the purchase of natural gas vehicles, also in the agricultural sector. Therefore, this mechanism suggests an interesting multiplier effect in favour of the developing use of methane in the automotive sector. [1]

In 2016, Italy recorded an overall share of 7.2% renewable energy in the transportation sector, including double-counting biofuels, which means that the country overachieved its obligations.[60] In 2020 this obligation will reach 9%, of which at least 0,9% must be covered by advanced biofuels (Table 1.). Biomethane can offer an important contribution since it is considered as an advanced biofuel and thereby it can help Italy to reach both rate simultaneously.

Table 1. Mandatory share of emission of biofuels in consumption by years

Year	Mandatory share
2016	5,5%
2017	6,5%
2018	7,0% (0,6% advanced biomethane)
2019	8,0% (0,8% advanced biomethane)
2020	9,0% (0,9% advanced biomethane)

[59] Cucchiella, F., D'Adamo, I., Gastaldi, M. (2019). Sustainable Italian Cities: The Added Value of Biomethane from Organic Waste. *Applied Sciences*, 9(11), 2221

[60] https://theicct.org/sites/default/files/publications/Advanced_biofuel_policy_eu_update_20181130.pdf

2021	9,0% (1,5% advanced biomethane)
from 2022	9,0% (1,85% advanced biomethane)

9. **Is this instrument following up on EU policy? Either transposed policy to national/regional level or a policy to reach EU policy targets/ambitions?** If yes, which policy and which EU targets and ambitions?

This instrument helps Italy to reach the goals of the Revised Renewable Energy Directive related to biofuel consumption.[61]

The Commission's 2014 Guidelines on State aid for environmental protection and energy allow Member States to support advanced biofuels under certain conditions.[62]

It also takes into the account the Directive 2014/94/EU on the deployment of alternative fuels infrastructure. [63]

10. **Can you explain the impact of the policy in type, size, time and money spent?** (*Should be based on evaluations)*

The Italian scheme supports the production and distribution of advanced biofuels and advanced biomethane, also known as second and third-generation biofuels, for use in the transport sector. The scheme has an indicative budget of €4.7 billion. It started in 2018 and will run until the end 2022.

11. Why can this policy be seen as a good policy example?

Because it connects to the EU level goals and policies, from the regulatory side it can be implemented easier in the other EU member states. The instrument helps the country to reach the EU level biofuel and environmental protection quotas and at the same time helps bio-based technologies to be more competitive and attractive on the market. The double-counting helps the development of advanced

[61] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC

[62] https://ec.europa.eu/commission/presscorner/detail/en/IP_18_1441

[63] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0094

biomethane production. It also stimulates the construction of new filling station for bio-CNG or bio-oLNG, which is a key aspect in the spreading of biomethane based transportation, because without enough specific filling stations the vehicle owners can't even think about that kind of transportation.

12. **Would you recommend this policy instrument to be replicate in regions in low, medium, high BBE development stage? Explain why.**

The set-up of the whole system (production plans, transport, filling stations) requires experience on the field, therefore we would suggest it to regions in medium and high BBE development stage.

13. **Are there similar policy instruments implemented in other EU countries/regions? If yes explain which ones.**

Although some EU countries have significant biomethane production stimulatory policies, Italy was the first country to introduce an obligatory system for transport fuel retailers thereby focusing on the use of biomethane in transport sector and fulfilling Italy's future mandatory share of emission of biofuels in consumption. For example in Denmark the economic and political environment focuses on the use of biomethane in Combined Heat and Power (CHP) units, while in Germany there is no favorized way of biomethane use. [64]

14. **Barriers and solutions encountered in the development and implementation of this policy instrument**

The first version was introduced in 2013, which had an adverse effect on the number of new biogas projects. [65] Compared to the past the subsidies have been decreased and have been extended from 15 to 20 years thereby it became less interesting and profitable for investors. This subsidy system favoured the smaller biogas plants and plants using more by-products or organic waste.

The new Italian biomethane decree gives subsidies only in the the case of use of biomethane in the transport sector, thereby making the sector more focused and in the same time the country can achieve its biofuel obligations related goals.

[64] https://www.ifri.org/sites/default/files/atoms/files/mathieu_eyl-mazzega_biomethane_2019.pdf

[65] http://www.isaac-project.it/wp-content/uploads/2017/07/D5.2-Report-on-the-biomethane-injection-into-national-gas-grid.pdf

15. References used and more information available at:

1. Maggioni, L., Pieroni, C., Pezzaglia, M. (2018). The biogas and biomethane market in Italy. Gas for Energy Issue 2/2018.

2.Cucchiella, F., D'Adamo, I., Gastaldi, M. (2019). Sustainable Italian Cities: The Added Value of Biomethane from Organic Waste. Applied Sciences, 9(11), 2221

3. https://theicct.org/sites/default/files/publications/Advanced_biofuel_policy_eu_update_20181130.pdf

4. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC

5. https://ec.europa.eu/commission/presscorner/detail/en/IP_18_1441

6. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0094

7. https://www.ifri.org/sites/default/files/atoms/files/mathieu_eyl-mazzega_biomethane_2019.pdf

8. http://www.isaac-project.it/wp-content/uploads/2017/07/D5.2-Report-on-the-biomethane-injection-into-national-gas-grid.pdf

Policy Factsheet 58: Bioeconomy Technological Platform (Smart Specialisation Strategy) Piemonte

1. **Title policy instrument**

The Piemonte Bioeconomy Technological Platform (Smart Specialisation Strategy)

2. **Main aim of the policy instrument (short)**

Peimonte's Regional Technology Platforms: Technology Platforms are one of the main funding schemes of the Piemonte's European Regional Development Funding programme. A technology platform supports the collaboration and coordination of industrial and research stakeholders around a relevant technological trajectory identified among the key sectors of the regional Smart Specialization Strategy. The technology platform helps to reach an appropriate critical mass and create a common vision in a mid-term perspective, with the final aim of increasing regional competitiveness through new marketable solutions. Through this funding scheme, a limited number of relevant projects with large partnerships are funded.

The Piemonte Bioeconomy Technology Platform specifically target to promote large and strategic R&D projects within the S3 priority sectors of Green Chemistry/Clean Tech and Agrifood, focusing on their connection in the framework of a circular economy approach. The Platform aims at promoting circular productive ecosystems at regional level by leveraging regional supply chains, thus enabling sustainable growth processes with low environmental impact.

The final goal is to set the basis for a long-term development of bioeconomy in the Region.

A Technological Platform is also a concept that was already developed by the European Commission in 2003 (European Technology Platforms – ETPs), but differs slightly from the Piemonte Technology Platforms. ETPs aims to contribute to competitiveness, boost research performance and concentrate on more coherence among sectors by strategizing, mobilizing and disseminating. The Piemonte Technology Platforms on the other hand are funding schemes collecting projects in a specific area identified in the S3 strategy.

3. **Country where it is implemented**

Italy, more specifically in the Piemonte region.

4. **Year of first implementation**

The Bioeconomy Technological Platform was launched in Piemonte region in 2018, based on the funding scheme of Technology Platforms originally launched in 2007, with the first technological platform focusing on Aerospace.

5. **Is the policy still implemented? If not specify final year of implementation.**

Yes

6. **Type of instrument***

Financial instruments; information and advice sharing.

7. **Biomass value chain position targeted****

Mainly on processing and conversion: waste management, waste water management, secondary raw materials/pollution management, biorefinery and non-food biomass conversion plants

8. **Description of the instrument (long)**

(*What is the instrument meant to bring about, how does the instrument work, who are targeted by the instrument*)

The region of Piemonte included in its regional smart specialisation strategy the sectors Agrifood and Green Chemistry/Cleantech that has the aim to boost the regional growth via specialisation[66].

It was stated in the bioeconomy technological platform call that one of the main challenges is to strengthen research and innovation for the development not only of technologies directly related to a specific branch, but of technologies that are the result of a trans-sectoral symbiosis aimed at the creation of "circular" productive ecosystems with initiatives developed within the framework of Bioeconomy.

Therefore, the Bioeconomy Technological Platform was established since 2018 and it is stated that the platform includes three strands:

•Agrifood (S3 innovation area)

•Green Chemistry / Clean Tech (S3 innovation area)

•Circular Economy (projects connecting the two above areas, aiming at developing regional circular ecosystems and sustainable supply chains)

The platform has the role to support large and strategic R&D projects of industrial research (higher TRL) a/o experimental development (lower TRL) focused on area of bioeconomy and gathering technology leaders and industrial and academic competencies available at regional level.

Bioeconomy Technological Platform Priorities are:

- Sustain the industrial research and technology innovation
- Facilitate the collaboration among enterprises and the research system to foster innovation and competitiveness in the Bioeconomy sector

[66] https://www.slideshare.net/TR3S_PROJECT/piedmont-region-towards-ris3-regional-innovation-smart-specialisation-strategy

- Facilitate, where possible, the participation of actors from different, heterogeneous sectors, in order to foster the integration of themes for the development and implementation of projects related to Circular Economy, as well as strengthen the research and innovation level in their respective sectors.
- Facilitate the sharing of knowledge and expertise among enterprises and research entities, and support the creation of partnerships among them
- Support the territorial outcomes, also in terms of job opportunities and competitiveness of the regional productive system
- Foster the formation of skilled workers and researchers in the field of Bioeconomy, through projects of high-level training and apprenticeship (note: additional funds were allocated from ESF for training and high skills formation activities.)ote:

Bioeconomy Technological Platform specifically focuses on:

AGROFOOD

- Traceability, tracking down, and authentication of agrifood products, logistics in the agrifood sector
- Innovation on quality, security and structural composition of food; innovation of food production chain's processes; security of food value chain; innovation in packaging
- Innovative approaches for the commercialization of food value chain products
- Innovative technologies and approaches for precision farming and precision livestock; innovation in mechanization of farming, efficiency and security of farming machines
- Materials for the selective protection of crops
- Production of probiotics and nutraceuticals
- Energy optimization and rationalization of the production and distribution processes of the food value chain

GREEN CHEMISTRY/CLEANTECH

- Increase of the efficiency, remuneration and versatility of biorefineries, with reduction of their environmental impact, through new processes development and associate technologies for the transformation, upcycling and purification of products
- Management, treatment and valorization of urban and industrial waste
- Management, treatment and valorization of waste waters
- Management, treatment and valorization of secondary raw materials
- Technologies for polluted sites remediation and reconversion of dismissed industrial areas
- Use of CO2 as raw material

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CIRCULAR ECONOMY

- Optimization of the natural and water resources use; of the ri-utilization of byproducts, and of the reduction of environmental impact of the agri-food industry

- Conversion of non-food biomass and local livestock wastes for the production of chemicals, biofuels, bioplastics

- Symbiosis between Agrifood and Chemical sectors

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The funding scheme is implemented through a call for collaborative projects, made by large and relevant partnerships (9 projects approved).

9. **Is this instrument following up on EU policy?** Either transposed policy to national/regional level or a policy to reach EU policy targets/ambitions? If yes, which policy and which EU targets and ambitions?

Yes, in Piemonte this Bioeconomy Technological Platform is funded through ERDF and supports the implementation of the Regional Smart Specialisation Strategy (RIS3). This Regional Smart Specialisation Strategy is a precondition to access the ERDF and is therefore part of the European Cohesion Policy (Period 2014-2020)[67].

10. **Can you explain the impact of the policy in type, size, time and money spent? (*Should be based on evaluations)***

The impact of the bioeconomy technological platform Piemonte (situation spring 2019) is[68]:

- 9 projects approved (out of 11 submitted)
- 2/3 of approved projects (6 out of 9) focused on Circular Economy
- 46,6m€ total value of approved CE projects (out of 66m€)
- 20,2m€ ERDF contribution granted to CE projects (out of 29,2 m€)
- 112 partners involved in approved CE projects: 87 companies (both large, leading companies and SMEs), 33 Research Organizations

11. Why can this policy be seen as a good policy example?

This instrument is a good policy example because the new explorative collaboration projects between research and industry may result in new products and technologies that can be sold on the bio-based market. The technology platforms are the arena where experimentation for new products and technologies take place, resulting in improved level of technological readiness. The platforms are in fact the motors to bioeconomy development and play a major role in improving regional competitiveness and creating new jobs.

[67] https://rsa.tandfonline.com/doi/full/10.1080/00343404.2019.1607970

[68] https://www.gov.si/assets/vladne-sluzbe/SVRK/SZJ_Konferenca_Retrace_3_7_2019/Predstavitve/03Retrace_IDE_July-2019_Piemonte_pdf.pdf

12. **Would you recommend this policy instrument to be replicate in regions in low, medium, high BBE development stage? Explain why.**

Yes, mainly in medium and high regions because the innovation potential is already available, which makes the implementation of a technology platform more easy.

13. **Are there similar policy instruments implemented in other EU countries/regions? If yes explain which ones.**

Yes, there are more bioeconomy technological platforms across Europe. For instance the Polish Technology Platform of bioeconomy (https://www.p.lodz.pl/en) or Bio-based Circular Business Platform in the Netherlands (https://www.bio-basedeconomy.nl/bcb/) or SAS PIVERT in France (https://sas-pivert.com/).

14. **Barriers and solutions encountered in the development and implementation of this policy instrument**

Experienced barriers of this policy instrument is that it was difficult to engage farmers and forestry sector as well as SMEs in the R&D projects. These companies do not have the operational, financial, technical and planning capacity to carry-on projects with a mid/long-term vision. They need to see a benefit on the short term but bioeconomy technologies are often not mature yet on a short term. This has also hampered the technology exchange and intake by SMEs and the production sector.

A large part of the funding for the Bioeconomy Technological Platform is coming from ERDF, and due to different rules and procedures, the combination with EAFRD (that would have been useful in order to involve farmers) proven to be very difficult. Moreover, the different State Aids rules applicable to industrial and agricultural activities make it almost impossible to fund a complete regional value chain with a single fund.

15. **References used and more information available at:**

- https://www.efi.int/projects/becoteps-bio-economy-technology-platforms-join-forces-address-synergies-and-gaps-between
- https://www.slideshare.net/innobasque/ris-3-piedmont
- https://www.efi.int/projects/becoteps-bio-economy-technology-platforms-join-forces-address-synergies-and-gaps-between
- https://www.regione.piemonte.it/web/temi/fondi-progetti-europei/fondo-europeo-sviluppo-regionale-fesr/ricerca-sviluppo-tecnologico-innovazione/piattaforma-tecnologica-bioeconomia