DYNAMIX

Decoupling growth from resource use and environmental impacts

Development of DYNAMIX Policy Mixes

Revised Deliverable D4.2

European Commission

SEVENTH FRAMEWORK PROGRAMME

DYNAMIX is a project funded under the European Union Seventh Framework Programme

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Project coordination and editing provided by Ecologic Institute.

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Deliverable D4.2 "Final public report on pathways and policy mixes" of the DYNAMIX project

Manuscript completed in February 2015 and revised in March 2016

This document is available on the Internet at: http://dynamix-project.eu/

ACKNOWLEDGEMENT & DISCLAIMER

The research leading to these results has received funding from the European Union FP7 ENV.2010.4.2.3-1 grant agreement n° 308674.

DYNAMIX PROJECT PARTNERS

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LIST OF ABBREVIATIONS

BAU	Business as usual
CAP	Common Agricultural Policy
CBD	Convention on Biological Diversity
CEN	European Committee for Standardization
CEO	Chief executive officer
CFP	Common Fisheries Policy
CO_2	Carbon dioxide
CSR	Corporate Social Responsibility
DK	Denmark
EFSA	European Food Safety Authority
EHS	Environmentally harmful substances
EIA	Environmental Impact Assessment
ELV	End-of-life vehicles
EPR	Extended Producer Resonsibility
EREP	European Resource Efficiency Platform
ETR	Environmental tax reform
ETS	Emission trading system
EU	European Union
FEBA	European Federation of Food Banks
FSC	Forest Stewardship Council
FP7	7th EU Framework Program
GAEC	Standard of good agricultural and environmental condition
GHG	Greenhouse gas
GDP	Gross Domestic Product
HNV	High nature-value farming systems
IET&F	Increased environmental taxes and fees
IPPC	Integrated pollution prevention and control
ISO	International Organization for Standardization
LCA	Life cycle assessment
LULUCF	Land use, land-use change and forestry
MS	Member State(s)

MSC	Marine Stewardship Council
NB	Nota bene
NDA	Panel on Dietetic Products, Nutrition and Allergies
NGO	Non-governmental organisation
NECD	National Emissions Ceilings Directive
NIC	National Insurance contributions
OECD	Organisation for Economic Co-operation and Development
PEFC	Programme for the Endorsement of Forest Certification
PES	Payment for ecosystem services
PP2	2nd DYNAMIX Policy Platform
PRO	Producer Responsibility Organization
PVC	Polyvinyl chloride
R&D	Research and development
RBMP	River basin management plan
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RED	Renewable Energy Directive
RMC	Raw material consumption
RoHS	Restriction of Hazardous Substances
SE	Sweden
SEA	Strategic Environmental Assessment
SET	Strategic Energy Technology
SFM	Sustainable forest management
TGAP	Taxe générale sur les activités polluantes
UK	United Kingdom
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value-added tax
WEEE	Waste electrical and electronic equipment
WFD	Water Framework Directive
WP	Work Pack
WRAP	Waste & Resources Action Programme
WTO	World Trade Organisation

Executive summary

The DYNAMIX project is a collaborative project within the 7th EU Framework Program (FP7). It aims to identify and assess dynamic and robust policy mixes that help shifting the European Union onto a pathway to absolute decoupling of long-term economic growth from resource use and environmental impacts. It also aims to support policy makers with advice on analytical frameworks and/or best procedures to identify and design appropriate policy mixes.

This report documents the development of the three policy mixes that were developed for assessment in the project. These were designed within three different policy areas to address absolute decoupling in general and, specifically, the use of virgin metals, the use of arable land and freshwater, the input of the nutrients nitrogen and phosphorus, and emissions of greenhouse gases.

Each policy mix was developed within a separate author team, using a common methodological framework. The policy mixes were developed based on previous findings in the project: we had investigated the current use of resources to identify and identified reasons for both efficient and inefficient resource use in the economy. Some of these findings are summarised in Section 2.3 of this report. We had also investigated current policies to find which features set apart an effective policy from a policy shortcoming (see Section 2.4). In addition, we discuss and draw conclusions, based on the analysis of the current situation, on how to achieve the paradigm shifts that are necessary to obtain an absolute decoupling (Chapter 3).

Each author team presents the development of their policy mix in a separate chapter (Chapters 4-6). Specific drivers and barriers for resource use and resource efficiency are discussed in these chapters. Specific policy objectives and targets are also discussed before the actual policy mix is presented. This revised version of the report also includes a section for each policy mix presenting how the policy mix was revised after it had been assessed.

One of the three policy mixes has an explicit overarching focus. It aims at reducing overall resource consumption in the EU and also at reducing the emissions of greenhouse gases and other pollutants. This policy mix includes a broad variety of instruments (see Chapter 4):

- A circular tax trio consisting of taxes on the extraction of selected virgin materials and on landfilled and incinerated waste.
- Feebate schemes for selected products.
- Reduced value-added tax (VAT) for the most environmentally advantageous products and services.
- Boost of the extended producer responsibility.
- Skill enhancement programme.
- Local currencies for labour-based services.
- Enabling a shift from consumption to leisure.
- Step-by-step restrictions of advertising and marketing.
- Minimum requirements on the life-cycle performance of products.
- Compulsory sustainability reporting for companies.

The ex-ante assessment of this policy mix did not call for adding further instruments, but for adjustments in the design of individual instruments. Several instruments were revised to increase public acceptability and momentum. The circular tax trio should be presented as part

of a larger tax reform. The VAT reduction should be expanded into a wider VAT reform and coordinated with the feebate schemes.

Another policy mix aims at reducing land use, freshwater use and nutrient surplus through improvements in food production, changes in diet, and reductions in food waste (Chapter 5). This policy mix emphasises five instruments to improve food production through, for example, revisions of already existing policy documents (Section 5.4):

- Stronger and more effective environmental and climate dimension for EU land management in the Common Agricultural Policy.
- Revised emissions levels in the National Emissions Ceilings Directive and additional measures for better management of the nitrogen cycle on farmland.
- Promotion of Payment for Ecosystem Services programmes.
- Revised regulation for land use, land-use change and forestry.
- Revised Pesticides Directive, and guidance to farmers on pesticide management.

These five key instruments are in the policy mix supported by a range of accompanying measures. These include, for example, increased prices on irrigation water, the establishment of an EU soil legislation, and the promotion of research and monitoring.

The policy mix on land-use also includes three instruments to influence the food consumption and food waste (Section 5.5):

- Targeted information campaigns on changing diets and on food waste.
- Development of food redistribution programmes/food donation to reduce food waste.
- Increased VAT on meat.

The ex-ante assessment did not explicitly call for any additional instruments to be added to this policy mix; however, it highlighted the need to add clear objectives and quantitative targets to several of the instruments. For this purpose, the development of an indicator to reflect the net land use of the EU should be added as a key element in the policy mix. The development of an integrated long-term strategy for land use would also contribute to making this policy mix more effective and feasible.

The third policy mix (Chapter 6) primarily aims at reducing the use of virgin metals in the EU through increased recycling and material efficiency. At the same time, it aims to avoid merely shifting burdens to the use of other resources or regions in the world, or to increase environmental impacts. For this reason, the metals policy mix was expanded to include also competing materials and includes several instruments of an overarching character. A key element in this policy mix is a gradual green fiscal reform, where tax revenues over time shift from labour to material use, resource use and environmental impacts.

The structure of the policy mix was revised after the ex-ante assessment and other discussions. Extended producer responsibility and retraining programmes were added to the mix. The green fiscal reform was presented in a more disaggregate way to highlight the measures taken to alleviate the negative side-effects of material and environmental taxes. The instruments were also more clearly categorised into primary and supportive instruments. The following primary instruments are included in the revised policy mix on metals and competing materials (see Section 6.6):

- A substantial tax on materials used in the EU, to increase material efficiency.
- Extended producer responsibility, to increase global recycling.
- Technical requirements, for materials substitution and efficiency.

- Increased environmental taxes, to reduce resource use and environmental impacts.

The policy mix also includes a range of supportive instruments to reduce negative side-effects of the primary instruments and to make the policy more politically feasible:

- Border tax adjustments, to reduce the impact on the competitiveness of EU industry.
- Labour tax reductions, to stimulate employment.
- Removal of harmful subsidies, for a coherent fiscal reform.
- Spending on research and development, to facilitate changes in technology.
- Retraining programmes, to facilitate a change in economic structure.
- Information campaigns and infrastructure to facilitate changes in behaviour.
- Sharing systems, to facilitate behavioural change.
- Advanced recycling centres, also to facilitate behavioural change.
- Fora for communication, to stimulate networking.
- A common EU strategy, to harmonise legislation in Member States.

The ex-ante assessment of the policy mixes indicates that they would contribute to reducing the use of virgin metals, arable land and freshwater, the input of nutrients, and the greenhouse gas emissions. However, any single policy mix would not be sufficient to reach all the predefined targets. All three could also not be implemented in parallel, as they are partly overlapping. The three policy mixes illustrates different ways to address the challenge of developing policy mixes for a resource-efficient future EU; however, further work is needed to combine and refine the policy mixes and to make them ready for implementation.

1 Introduction

1.1 The DYNAMIX project

The acronym DYNAMIX stands for "DYNAmic policy MIXes for absolute decoupling of environmental impacts of EU resource use from economic growth". The DYNAMIX project is a collaborative project within the 7th EU Framework Program (FP7). The initially stated aim of the project is to identify and assess dynamic and robust policy mixes to shift the European Union (EU) onto a pathway to absolute decoupling of long-term economic growth from resource use and environmental impacts and to a sustainable future. To support this objective we established the following five targets for the year 2050 (Umpfenbach 2013):

- **consumption of virgin metals**: to be reduced by 80 % compared to 2010 levels, measured as raw material consumption (RMC) in the EU. This target represents the scarcity of metals and environmental impacts caused by extraction, refinement, processing and disposal of metals;
- **greenhouse gas emissions**: to be limited to 2 tonnes of CO_2 equivalent per capita per year. This is to be measured as a footprint to reflect embedded emissions and also in terms of emissions generated within the EU. This target represents climate change impacts of greenhouse gas emissions through energy use as well as agricultural and industrial processes;
- **consumption of arable land**: to reach zero net demand of non-EU arable land. This target represents, as a rough approximation, the impacts of biomass production on soil quality, water quality and biodiversity;
- **nutrients input**: reducing nitrogen and phosphorus surpluses in the EU to levels that can be achieved by the best available techniques. This target represents the impacts of agricultural production on marine and freshwater quality as well as soil quality; and
- **freshwater use**: no region should experience water stress.

During the course of the project the following two project objectives were agreed upon:

1) supporting policy makers with advice on analytical frameworks and/or best practices to identify and design appropriate policy mixes to achieve absolute decoupling; and
2) designing a few policy-mixes and testing them against our own framework.

The second objective will support the first. However, we do not aim to design policy mixes that policy makers can simply copy and adopt to achieve absolute decoupling in the EU by 2050. Rather, a tailored approach to identifying and developing policy mixes is required depending on, for example, national circumstances, interests and political expediencies. The findings of the study seek to support policy makers in the process of identifying and developing appropriate policy mixes to meet their decoupling objectives.

The DYNAMIX project began with an ex-post analysis of existing inefficiencies in resource use (Tan et al. 2013) and an assessment of current resource policies in several case studies across the EU (Mazza et al. 2013, Fedrigo-Fazio et al. 2014). These provide a basis for identifying what paradigm shifts are required in the way production and consumption is organised and regulated, and what policy mixes might be able to contribute significantly towards absolute decoupling in the EU by 2050.

Relevant findings from these previous steps provided a basis for shaping promising policy mixes for the future. These promising policy mixes were then tested through ex-ante assessments for effectiveness (benchmarked against absolute resource and impact decoupling), efficiency, sustainability and contribution to eco-innovation. The ex-ante assessment is in part done through environmental and economic quantitative modelling. Such models are powerful tools for assessing economic and environmental impacts in the EU and globally; however, models have limitations in representing various social, political and legal aspects, including factors influencing human behaviour. DYNAMIX thus also systematically integrates qualitative assessments to fully assess the real-world performance of the proposed policy mixes. We use the results from the ex-ante assessments to revise the proposed policy-mixes. Recommendations and conclusions will then be based both on the analysis of the existing situation, the process of developing the policy mixes, and the results and insights from the assessments of the initial policy mixes.

The primary target group for the project is policy-makers directly involved in designing and implementing policies addressing levels of resource use and related environmental impacts at the EU and national levels. The project strives at strengthening the capacity of these policy makers in selecting, identifying, designing and implementing effective policies to reduce EU resource use and its related environmental impacts. Accordingly, a group of policy-makers and key stakeholders has been involved in a systemic participatory process throughout the whole project. This process is designed to facilitate mutual learning and allow policy-makers, stakeholders and external researchers the opportunity to influence the project's design based on their views. This approach will help increase the likelihood that the results of DYNAMIX can provide tangible support to EU policy-making for resource efficiency.

1.2 The report

This report is the main deliverable of Work Package (WP) 4 of the project. This WP forms the nexus between the ex-post analysis of current resource flows and existing policies on the one hand and the ex-ante assessment of promising policies identified by the project team on the other hand.

The report presents the development of the three initial policy mixes. Each policy mix was developed within a separate author team, using a common methodological framework. This framework is presented in Chapter 2. Section 2.1 presents criteria for the selection and development of policy mixes in DYNAMIX. Section 2.2 presents and briefly discusses the three policy areas for which we develop policy mixes. Section 2.3 includes a general discussion on the drivers of resource use and barriers to resource efficiency. It also summarises some of the findings from the DYNAMIX WP2, where we investigated the current use of resources to identify and explained both efficient and inefficient resource use in today's economy. In WP3 we investigated current policies to identify what features set apart an effective policy from an ineffective policy. These findings are summarised in Section 0. Section 2.5 discusses the need for the policy mixes to be adaptive in the light of the inherently uncertain future. Section 2.6 briefly presents the organisation of the work.

Based on the analysis of the current situation, we discuss and draw conclusions on how to spark the paradigm shifts that are necessary to achieve an absolute decoupling in the EU. Chapter 3 presents the analysis of paradigms and paradigm shifts that also informed the author teams involved in the policy mix development.

Each author team presents the development of their policy mix in a separate chapter (Chapters 4-6). Specific drivers and barriers for resource use and resource efficiency are discussed in each of these chapter. Specific policy objectives and targets are also discussed before the actual policy mix is presented. All key element in the policy mix are then described in the common format of a policy fiche that details the design, scope, governance aspects and expected impacts of that policy element. Some of these policy fiches describe an individual policy instrument, while other fiches present broader policy activities.

Although the methodological framework is common between the author teams, each implementation of the framework was partially independent from the others. As a result there are variations in the structure between Chapters 4-6. However, each of the chapters ends with a section that summarises how the policy mix is revised in response to the ex-ante assessment.

2 Method

This chapter outlines the methodological framework for the development of policy mixes in DYNAMIX. The policy mixes were developed based on a list of criteria (see Section 2.1) and based on previous findings in the project (Sections 2.3-2.5 and Chapter 3).

2.1 Overarching criteria and procedure

The DYNAMIX project strives to provide advice on relevant policy decision frameworks to policy makers and assesses selected policy mixes. To make this possible, it is important that the policy mixes are not too complex to assess effectively. Furthermore, they should match the expertise and methods available to the project team. To best support the goals of the DYNAMIX project, the policy mixes should ideally also be:

- expected to be effective (see Section 2.4),
- diverse with, for example, emphasis on different types of policy instruments (see, e.g., Section 2.2),
- addressing important drivers, barriers and lock-ins (Section 2.3),
- adaptive (Section 2.5),
- contributing to the needed paradigm changes (Chapter 3),
- relevant to policy-makers and stakeholders,
- addressing little-managed resources,
- not sufficiently investigated and therefore providing knowledge gaps, and
- at least in part offer the possibility for quantitative assessment.

Some of these criteria are connected. Effective policies are, for example, likely to address important drivers and barriers and also to contribute to relevant paradigm shifts. As paradigms shift, some policy instruments can become effective while others may become less effective. This means that the policy mixes should be dynamic and adaptive, and that also the sequencing of different instruments is important to ensure maximum effectiveness.

The research that has already been completed in DYNAMIX provides an important part of the basis for the development of the policy mixes. The analysis of the system drivers (e.g., Tan et al. 2013 from WP2) and the lessons from the ex-post analysis of existing policies for resource efficiency (e.g., Fedrigo-Fazio et al. 2014 from WP3), together with our wider knowledge about policy, give insights into what policy instruments are potentially effectice. This knowledge is essential to the development of our initial policy mixes. The following steps and measures are taken in the development of these policy mixes:

- Define and prioritise drivers of particular patterns of consumption and production, and their resulting impacts;
- define specific targets and objectives for each policy mix;
- consider the potential linkages between different policy instruments in a mix; and
- recall the evidence of the ex-post analysis of case studies carried out in DYNAMIX (Fedrigo-Fazio et al. 2014) as well as additional literature on effective and ineffective policy mixes.

2.2 Selecting the policy areas

We decided to develop a policy mix in three policy areas addressing: metals, land-use, and overarching, structural drivers. These policy areas were selected to address the five targets to 2050 that have been established in the project (Umpfenbach 2013; cf. Section 1.1). More specifically, a policy mix for metals use focuses on the reduction of primary metals. A land-use policy mix is essential to address both the consumption of arable land, the input of nutrients, and freshwater use. An overarching policy mix is necessary for addressing emissions of greenhouse gases and also relevant for addressing the underlying, structural drivers affecting all of the key targets. This selection of policy mixes is divergent in terms of policy areas and complementary in terms of policy targets.

However, there is a risk that a policy mix that focuses specifically on reducing the use of virgin metals in the EU can lead to an increase in the use of polymers, concrete and other materials, or to increasing the use of virgin metals outside the EU. To avoid such burden shifting, the metals policy mix is broadened to consider also the use of other materials. This means it includes strong overarching elements, which makes the metals policy mix more similar to the overarching policy mix. To keep them divergent, we deliberately strive to include in the two mixes different versions of instruments that on the surface appear to be similar. Specifically, the materials tax in the metals policy mix (Section 6.4.2) is very different from the raw materials tax in the overarching policy mix (see Section 4.4.1). Including both of these taxes in the study makes it possible for us to compare the two versions of the materials tax.

2.3 Identifying the main drivers and barriers to resource (in)efficiency

As a starting point for developing each specific policy mix, we identify the major drivers of resource use and barriers to change in the systems we address. For this purpose we need to be aware of the fact that there are many types of drivers. Figure 1 shows examples of some of the types of drivers that can be of interest, based on a typology presented by Tan et al. (2013). Some of these influence resource efficiency directly, while others have indirect or intermediate impacts on resource efficiency. Drivers and barriers also exist on different scales: macro-economic, or company, or household level. We face a challenge in deciding on the right level and scale of drivers for each policy mix.

2.3.1 Main areas of inefficiency in resource use

The DYNAMIX WP2 examined the main inefficiencies of resource use in the EU and investigated their drivers and underlying causes. It analysed resource inefficiencies from the perspective of individual resources (e.g., raw materials, energy, water, land, ecosystem services) as well as main sectors / consumption areas (e.g., food, buildings, transport).

This analysis provides an excellent starting point to define objectives for the selected policy mixes. As we are analysing systems, it is relevant to define objectives for each policy mix in terms of the resulting set of (changed) drivers that we would like to see. This will enable us to estimate the impacts from the consumption and production patterns resulting from the changed set of drivers.

The report from DYNAMIX WP2 (Tan et al. 2013) provides an overview of the main areas of inefficiency, which also correspond to the areas where significant potential for improving

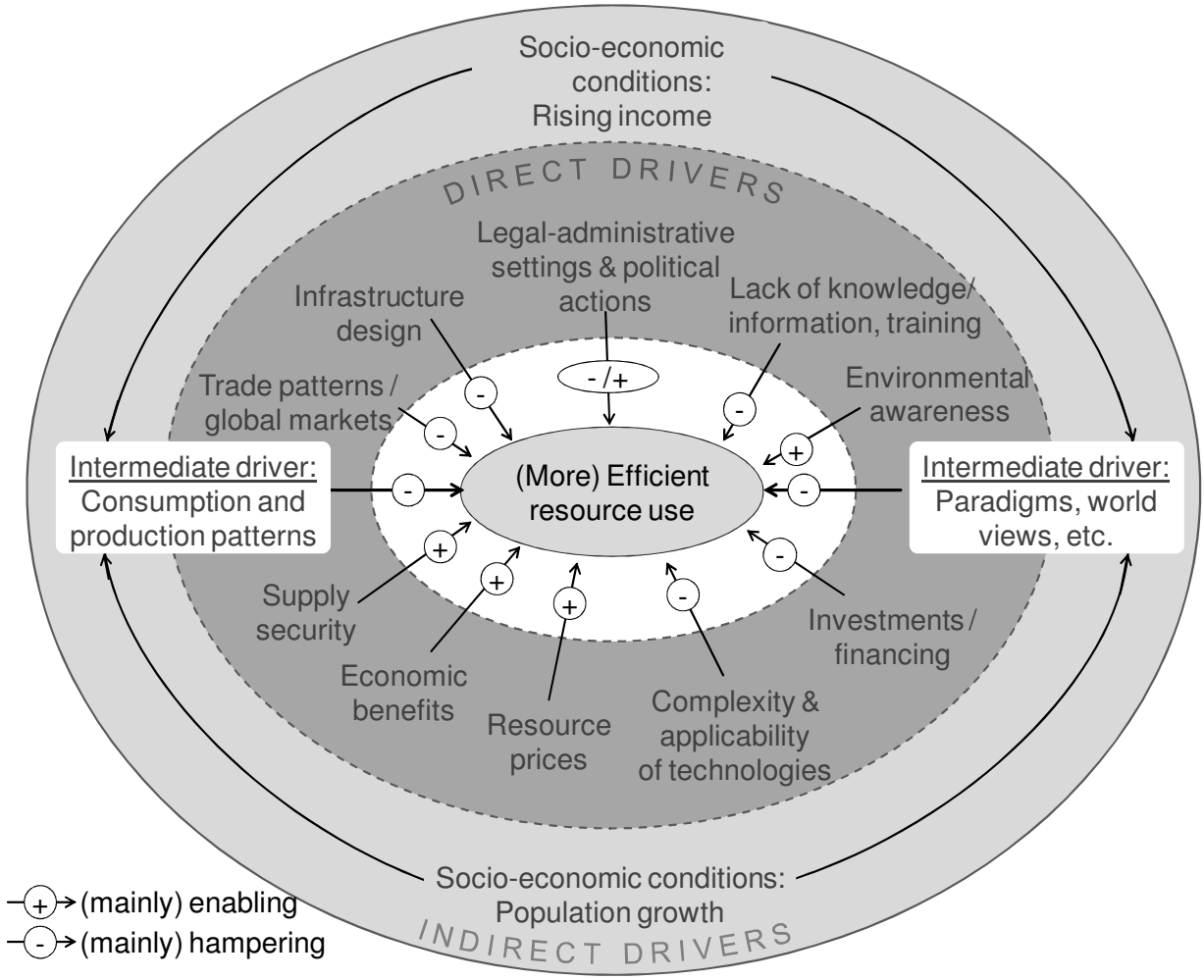


Figure 1: Schematic illustration of different drivers that affect (in)efficient resource use, based on a typology from Tan et al. (2013)

resource efficiency and thereby achieving (absolute) decoupling seem to lie. For example, key areas in relation to food and metals are set out below:

- The EU food system is particularly resource intensive in terms of biomass extracted, freshwater withdrawals, land use, application of fertilizers and wild fish catches. While there is significant potential to improve resource efficiency related to agriculture, fisheries and food production, the greatest potential seems to lie in addressing food consumption, including diets, overconsumption and food waste.
- Compared to other resources, metals are generally the most valued within the economy. Despite being inherently recyclable, they are often sent to landfills at the end of their life cycle. In addition to reducing the demand for metal through better design and longer product lifetimes, closing material loops seem to have the greatest potential for increasing the resource efficiency of metals.

For more information on the resource use, see Chapter 4 of Tan et al. (2013, pp. 23-49).

2.3.2 Analysis of underlying drivers and barriers

Food, buildings, and transport are often identified as three major areas of consumption. Tan et al. (2013) analysed the underlying causes of inefficiency in each of these areas. The consumption of food is closely related to the land-use. This part of the findings of Tan et al. (2013) can be directly applicable in the development of a policy mix for land use. As an example, Figure 2 shows how different factors cause and drive unsustainable diets. Section 5.2 in the WP2 report (Tan et al. 2013, pp. 58-70) provides more details and explanation on the food consumption.

Sections 5.3-5.4 (Tan et al. 2013, pp. 71-94) present the analyses of drivers and causes related to buildings and transports. These are relevant for the development of the overarching policy mix and also for the policy mix on metals and other materials.

When developing a policy mix, it may be more effective to select policy instruments that address the main drivers (e.g., food prices) or underlying causes (e.g., marketing) of what needs to be improved rather than the result (e.g., the diets). A main driver can be defined as a driver that either has an important contribution to the described inefficiency, or has significant potential to contribute to decoupling.

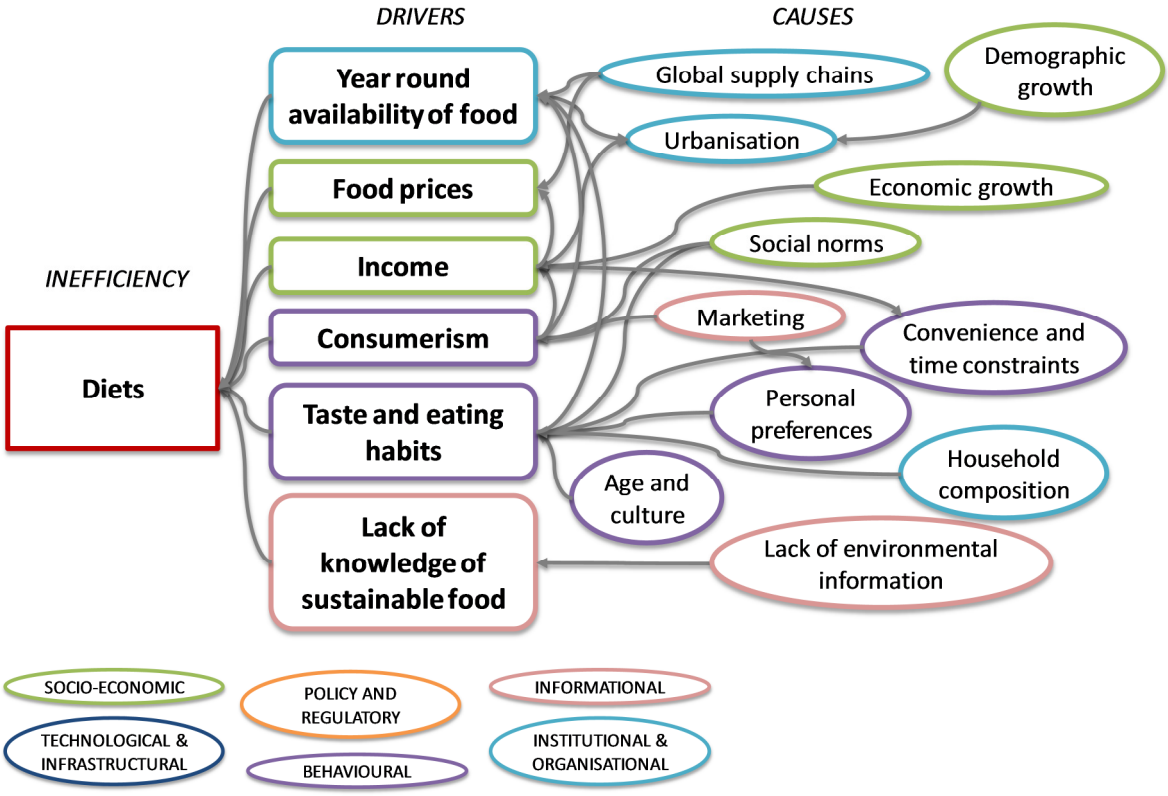


Figure 2: Drivers and causes of unsustainable diets and resource inefficient food choices (Tan et al. 2013, p. 61)

The underlying causes might also reflect current paradigms and socio-economic trends, for example increasing preferences for meat consumption in China or India following the notion of westernised lifestyles. This could also be used as a starting point for identifying which paradigms need to change in order to achieve absolute decoupling.

An attempt was made in WP2 to rank the key areas, drivers and causes of inefficiency in relation to the potential for decoupling, and also in relation to the feasibility or ease for EU policy to influence resource efficiency improvements (see Figure 3). This attempt included a discussion among the WP2 partners. However, the matter is very complex and the results should be regarded as preliminary indications rather than conclusive evidence on what areas are the most important. The diagram below sets out the results of this exercise in each sector/consumption area and indicates some of the most likely 'intervention areas' which, if changed, would make a significant difference to resource efficiency.

The preliminary results in Figure 3 can help identify the key areas for intervention as well as the main drivers and causes relating to each policy mix. This identification of key drivers can provide initial thoughts on the selection of potential policy instruments that would be most effective to address them, in each context.

Furthermore, the different nature of drivers and underlying causes provide an idea of what appropriate policy instruments could be. For example, food prices might point to using market based instruments, whereas education and information campaigns seem better suited to address the area of lack of knowledge.

2.3.3 Systems of drivers and barriers

Usually, policy assessments define the problem to be tackled as a market failure, which can be removed by the right policy. That has a nice linear chain of causation, between existing drivers, barrier removal and impact. Where there are several market failures, policy plans usually assume that you need to remove or address each of them - probably at around the same time - to obtain a functioning market. The chain of causation is still linear.

For our policy mixes - which include attempts at paradigm change, and considerations of future political feasibility - we are more likely to be looking at several changes to drivers and barriers. These do not have linear causality but form an inter-related system. In addition to market failures, we are also aiming to tackle 'system failures'. The policy mixes will not have linear causality, as a change in the system of drivers and barriers is the result of more than one factor - and thus requires a different form of assessment. A systems perspective is particularly important as we need to take into account feedback mechanisms such as the rebound effect, and also because we are aiming at radical change.

Within the current political-economic system, radical change is very difficult to achieve without systems change: there is lock-in to the existing production and consumption systems. Similarly, there are limitations on radical policy change within the political-economic system, which has its own inertia. This document starts from the position that 'systems lock-in' to the current socio-economic structures is an obstacle to the radical change we need to meet the identified 2050 targets. Thus, adopted policy mixes would need to overcome this systems lock-in (i.e., resistance to change).

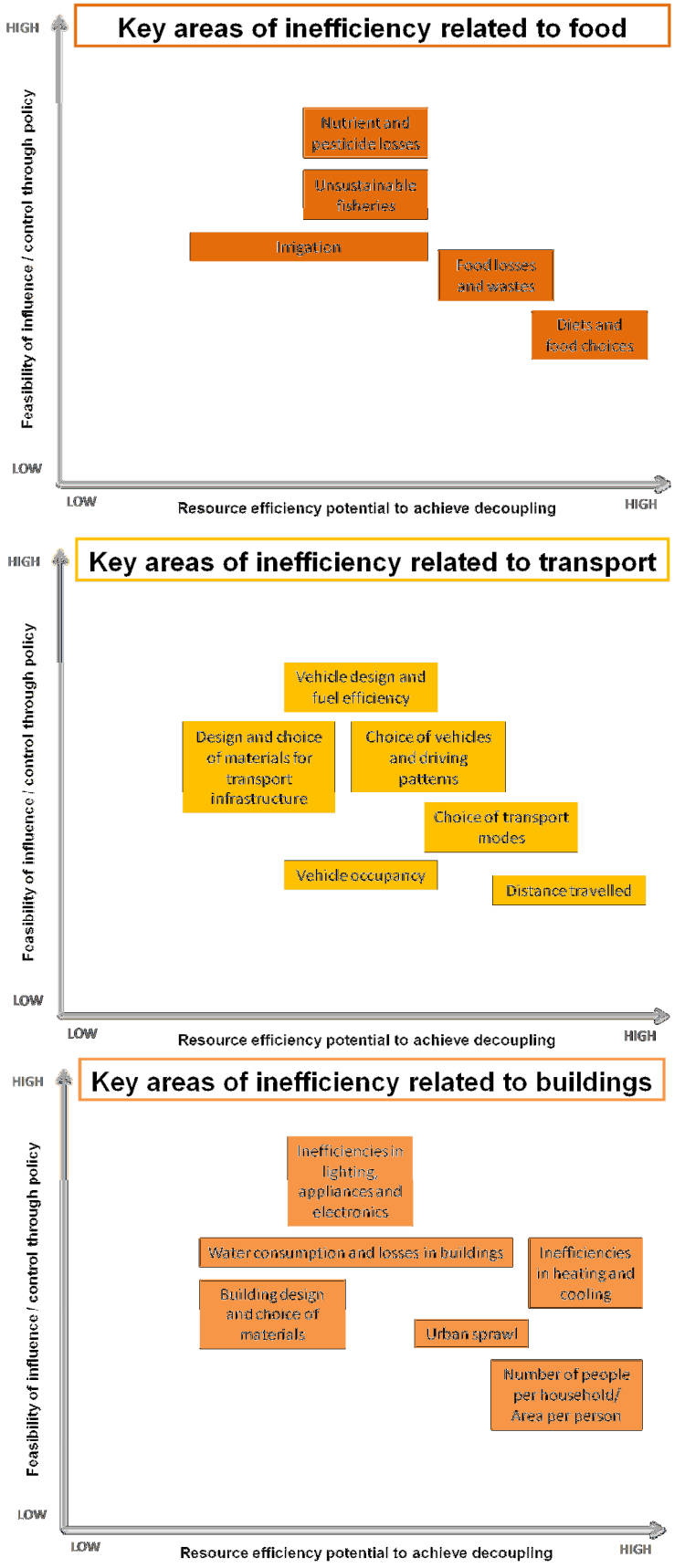


Figure 3: A preliminary assessment of key areas of inefficiency in relation to potential for decoupling and policy intervention (Tan et al. 2013, pp. 111-112)

We recognise the complexity and challenge of considering the impact of a 'mix' of policies, rather than individual policies. To help address this, we can usefully form common frameworks for considering how drivers in the system interact and thus how policies might interact. The Sensitivity Model is a tool that can assist in structuring the knowledge on the interrelations and interdependencies of different variables in a complex system, such as the system that is affected by a policy mix (Vester 2007; see Box 1). Structuring this knowledge can be useful in the development of a radical policy mix and also valuable when planning for the ex-ante assessment of the policy mix.

2.4 Effective policy instruments

In many cases, a significant increase in resource efficiency can be obtained through the use of already existing technology. There is also often sufficient knowledge to implement incentives (such as taxes) to use this technology. However, a number of obstacles prevent the adoption of these technologies. Therefore, political and behavioural barriers can be more important than technological barriers as obstacles to greater resource efficiency. Thus, to improve the effectiveness of policy instruments they should be designed and presented in a way that eases political and consumer concerns, changes paradigms and thereby changes behaviours. To reduce political and/or behavioural barriers, the design of the policy instruments can be adapted to, for example:

- Generating net benefits through 'resource' efficiency.
- Contribute to altering worldviews - and so the value society gives to goods and time - thereby transforming how citizen’s consider the behavioural change being called for.
- Promoting new ways to capture (or deliver) value.
- Creating clear, credible political and market signals for alternative innovation paths (changing paradigms/business model expectation).
- Reducing transition costs - timings to fit investment cycles, retraining etc.
- Creating sufficiently politically strong groups of winners.
- Compensating politically strong 'losers'.
- Providing alternative and divergient incentives for those within existing aggregated political lobbies (e.g., industrial organisations).
- Stimulating 'alternative' innovations/behaviours to come into commercial production/use.
- Changing political institutions (e.g., silo-based departments) which lock-in policy.

The DYNAMIX WP3 examined existing policies and their effectiveness for improving resource efficiency and obtaining decoupling. We assessed 16 cases of existing policy mixes. From these case studies Fedrigo-Fazio et al. (2014) gained insights into what is important for a policy mix to be effective and what can make a policy ineffective. To summarise, Fedrigo-Fazio et al. (2014) identified the following key factors of success:

- Policy mixes focused on a specific resource or sector are more likely to achieve decoupling.
- The complexity of the resource through the economy is an overriding factor in the level of complexity of the policy mix.

Box 1: The use of the Sensitivity Model (Vester 2007) in DYNAMIX

In this project we only apply the first four steps of the Sensitivity-Model procedure, namely:

1. Identify 20 to 40 important variables (GDP, resource use, environmental pollution, etc.) in each policy field.
2. Qualitatively estimate to what extent they affect each other with an Impact Matrix
3. Analyse the systemic role of each variable to identify those that are the most sensitive (i.e., strongly affected by policy instruments or other variables), active (i.e., affect other variables strongly), or critical (i.e., strongly affected by and strongly affect other variables).
4. Create an Effect System to illustrate the dependency among parameters, thereby allowing for the elimination of redundant variables.

As an example, we identified the following important variables for the policy mix on metals (Chapter 6):

1. Steel use
2. Copper use
3. Gold use
4. Aluminum use
5. Use of critical metals
6. Use of other materials
7. Use of energy
8. Global warming
9. Pollution
10. Construction of buildings (driver of, e.g., steel and aluminum use)
11. Construction of infrastructure (driver of, e.g., steel and aluminum use)
12. Energy infrastructure
13. Size of car fleet (driver of, e.g., steel use)
14. Consumption of electric products (driver of, e.g., copper and gold use)
15. Use of coins and bars (driver of gold use)
16. Consumption of jewellery (driver of gold use)
17. Rate of technological innovation
18. Development of new business models
19. Recycling rate (drives, e.g., reductions in the use of energy and global warming)
20. Material efficiency (drives, e.g., reductions in the use of energy and global warming)
21. Economic growth (driver of, e.g., constructions and car fleet)
22. Competitiveness (driver of, e.g., economic growth)
23. Security of supply
24. Economic instability (driver of the use of gold coins and bars)
25. Demand for short-term profit
26. Degree of materialism
27. Strength of social norms
28. Strength of environmental policy
29. Well-being

Some of these variables are common in all policy areas, but several variables are specific for the metals policy area: the use of different metals, the drivers for this use, etc.

- Policy mixes need to be designed in relation to the level and type of 'lock-in' to achieve transformation.
- A clear understanding of targets, limits and thresholds helps move towards decoupling.
- Internationally traded resources require policy mixes addressing global impacts of resource use, particularly imports.
- Effective policy mixes struck the right balance between effectiveness and acceptance.
- The efficiency of policy mixes increased with the predictability of their effects on, for example, prices, costs and/or behaviour.
- Long-term effectiveness of policy mixes tends to be enhanced through clear targets and built-in monitoring, review and revision mechanisms.
- Information instruments have proven to be useful supporting instruments but in isolation will usually fail to deliver the scale of change required for decoupling.

Fedrigo-Fazio et al. (2014) also observed several shortcomings in the policy mixes examined and some key challenges for future policy design:

- Lack of policy coherence or conflicting policy objectives.
- Gaps and loopholes in the policy mixes.
- Rebound effects are insufficiently taken into account in most of the policy mixes.
- Targets and objectives that are unclear or inadequate undermine the progress towards decoupling.
- Insufficient monitoring, control and adjustments over time.

2.5 Adaptive policy mixes

One important criteria for promising policy mixes is that they should be adaptive – i.e., that it should be possible to adapt the policy mixes to be adequate in a society that changes over time for other reasons than the policy mixes. In DYNAMIX Task 4.1, Gustavsson et al. (2013; Section 3.2) particularly discussed possible changes in the rate of innovation and in the predominant values and lifestyle of the population. While these changes can be affected by the policy mixes developed, they may also be strongly affected by other external factors. Such changes can, in turn, affect the need for and effectiveness of specific policy instruments within the policy mix, and may even have implications on the type of policy instruments that can be introduced.

Gustavsson et al. (2013; Chapter 4) describe five possible background scenarios based on different assumptions regarding the rate of innovation and the predominant values. These include a reference scenario and four cornerstone scenarios (see Figure 4 and Box 2). When developing the policy mixes, we consider if and how the policy mix will be revised if in the year 2030 society is moving from the reference scenario towards any of the cornerstone scenarios.

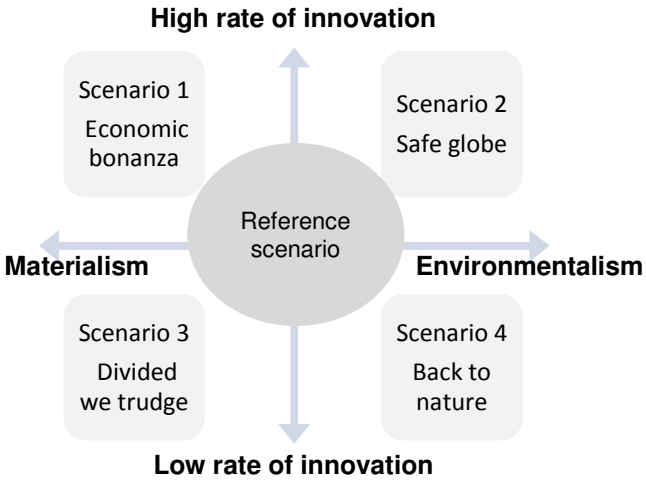


Figure 4: The five background scenarios of the DYNAMIX project

2.6 Organisation of the task: author teams

Each policy mix is developed and described by a team of authors. Each author team has approximately five to eight members in total, spread across the different DYNAMIX partners according to expertise, capacity and interest (see Box 3).

One of the factors influencing the choice of policy mix is what we can learn from assessing it, using the tools we have. For this reason, each author team has at least one member who is involved in the economic modelling in the expected ex-ante assessment of the policy mixes. This gives the author team direct access to knowledge on whether a policy idea can be modelled or not.

In order to make best use of our findings on the current use of resources (WP2) and the current policies (WP3), we sought to involve in each author team researchers that were directly involved also in these WPs.

Each author team presents the development of their policy mix in a separate chapter (Chapters 4-6). Draft policy mixes have been presented and discussed with the full DYNAMIX consortium. The complete chapters have also been read and reviewed by partners involved in other author teams; however no complete harmonisation between the chapters mixes have been conducted. As a consequence there are variations in the structure between Chapters 4-6. in these chapter. There is also some overlap and might even remain inconsistencies between the discussion of drivers and barriers in the different chapters.

Box 2: The DYNAMIX background scenarios (Gustavsson et al. 2013)

- **Reference Scenario**. This scenario describes a surprise-free future. It is not a likely future, however, because surprises are likely to occur. Improvements in technology continue at a good pace in the Reference Scenario, but the society is not transformed by any major technological break-through. The balance between materialistic and environmental values stays the same as today. The balance of power between Brussels and national governments also remains the same. Important current trends continue, however, towards, e.g., increased globalisation. The EU slowly expands to include and integrate more countries. For further details, see Section 4.1 in Gustavsson et al. (2013).
- **Scenario 1: Economic bonanza**. This scenario includes technological breakthroughs in many areas and several new business models. Countries as well as most individuals focus on increased production and consumption. The economic efficiency and growth are the highest in this scenario. The difference between rich and poor individuals increases in the EU, however. The difference between rich and poor Member States also grows, but the balance of power between Brussels and national governments remains as today. Global competition over rare metals, phosphorus, etc. becomes fierce. The resource efficiency of existing processes and products increases even without the policy mix, due to technological innovations and high resource prices. However, new wasteful products are introduced at a rapid pace. For further details, see Section 4.2 in Gustavsson et al. (2013).
- **Scenario 2: Safe globe**. This is a scenario with a high rate of technological and social innovation, including breakthroughs in several areas. Industrial and environmental disasters in different parts of the world make consumers and voters focus on the safety and well-being of all humanity, future generations, and nature. Most individuals strive for close social bonds and cultural achievements, rather than economic wealth. Social norms are strong and make it difficult for companies and politicians to take actions that risk significantly harming the environment. This background scenario does not have the highest resource efficiency but the most advanced technology for environmental protection. The increased focus on safety leads to an increased centralisation of decisions and power in the EU. This makes it easier for the EU to introduce and implement new policy instruments. The scenario includes global cooperation on environmental protection, workers protection, product safety, etc. For further details, see Section 4.3 in Gustavsson et al. (2013).
- **Scenario 3: Divided we trudge**. In this scenario, lack of cooperation and increased nationalism in Europe lead to diminished knowledge transfer between stakeholders as well as countries, and to a low rate of innovation. Economic growth is sluggish despite a materialistic focus on production and consumption. Resource use is similar to the reference scenario due to low efficiency. The EU is politically weak and focuses mainly on resolving internal conflicts. For further details, see Section 4.4 in Gustavsson et al. (2013).
- **Scenario 4: Back to nature.** This scenario combines a low rate of technological innovation and societal values that focus on the well-being of all humanity, future generations, and nature. In this scenario, repeated failures of experts and advanced technology cause distrust, and society becomes dominated by small-scale solutions, local production and trade. The economy to a large extent becomes informal. Both the EU and the national governments become politically weak. For further details, see Section 4.5 in Gustavsson et al. (2013).

Box 3: The DYNAMIX policy author teams

Author team for overarching policy mix (Chapter 4):

- Katharina Umpfenbach, Ecologic, previous coordinator of DYNAMIX and head of the author team
- Leonardo Mazza, IEEP, representing WP3
- Martin Hirschnitz-Garbers, Ecologic, current coordinator of DYNAMIX and representing WP2
- Patrick ten Brink, IEEP, representing WP3
- Martha Bicket, PSI
- Francesco Bosello, FEEM, representing the economic modellers

Author team for policy mix on land use (Chapter 5):

- Daniela Russi, IEEP, head of the author team until maternal leave
- Martin Nesbit, IEEP, head of the author team from halfway through the process
- Mary Ann Kong, BIO, representing WP2
- Maria Elander, IVL, representing WP3
- Andrea Bigano, FEEM, representing the economic modellers and WP3
- Clunie Keenleyside, IEEP
- Graham Tucker, IEEP
- Evelyn Underwood, IEEP
- Robin Vanner, PSI
- Stephanie Wunder, Ecologic

Author team for policy mix on metals and other materials (Chapter 6):

- Tomas Ekvall, IVL, leader of WP4 and head of the author team
- Adrian Tan, BIO, representing WP2
- Doreen Fedrigo, IEEP, representing WP3
- Jan Gaska, WISE, representing the economic modellers and WP3
- Fabio Eboli, FEEM, representing the economic modellers
- Aleksander Sniegocki, WISE, representing the economic modellers
- Christian Hudson, Ecologic

3 Paradigms and the development of DYNAMIX policy mixes

This chapter summarises the analysis of paradigms as relevant to the development of policy mixes. It incorporates an analysis of paradigms from the ex-post analyses undertaken in WP2 and 3. It also incorporates some insights from the WP5 on how the public have previously responded to proposals such as these. This shows where thresholds of public acceptability were found[1] in these proposed policies, and which of these represent a threshold which would promote a paradigm change if the policy was to be implemented.

This section responds to the following questions:

- **What are paradigms and why are they important to DYNAMIX?** We briefly introduce the concept of paradigm in the context of DYNAMIX, and explore why taking a paradigm perspective is important.
- **How do the DYNAMIX stakeholders view different paradigms?** We asked the DYNAMIX stakeholders within a policy platform to explore how they see different paradigms. This was done by looking at preferences for, and the perceived feasibility of, a range of different systems concepts, such as the circular economy.
- **How can DYNAMIX promote paradigm change**? We present our conceptual understanding of how DYNAMIX can look at policies that go beyond the limits of existing political paradigm by looking at how the policies themselves can promote paradigm change over time.
- **What kind of paradigm changes are desirable within DYANMIX?** We illustrate this by developing a simple mapping for the cornerstone scenarios, and explore how these relate to the DYNAMIX objectives. This therefore provides the broad direction of paradigm movement required to move towards the DYNAMIX objectives.
- **What has the analysis of paradigms got to tell those developing resource efficiency policy?** We present the high-level set of paradigm-relevant insights and recommendations provided to the policy author teams. We also provide the policy specific thresholds of acceptability from the public acceptability analysis in WP5.

In addition to these elements aimed at briefing the policy author teams, researchers were appointed to two of the three policy author teams to ensure that the paradigms' insights and perspectives were incorporated into the detail of the policy package development.

[1] This information was not available to the author teams when they developed the initial policies proposals for the first edition of this report; however, it was available when revisions of the policy mixes were being considered as this revised version of the report was produced.

3.1 What are paradigms and why are they important to DYNAMIX?

3.1.1 What are paradigms?

Paradigm is a term that has come to be applied loosely with a range of different meanings; it is synonymous and used interchangeably with belief, concept, theory, and even tradition, practice, or attitude. In broad terms, an individual or group of people's paradigm is the worldview – the set of sometimes unconscious values, beliefs and ideologies – in which they are immersed and which they use to navigate any new evidence, challenges or choices with which they find themselves confronted. Paradigms manifest themselves externally via discourses and are reinforced within society via the creation of social technical systems.

Paradigms exist across society in different shapes and forms. Typically, the literature classifies paradigms into two subcategories:

1. **Scientific paradigms encapsulate those paradigms held by scientists and professionals in both the natural and social sciences.** Thomas Kuhn popularised the concept of paradigm in his book The Structure of Scientific Revolutions (Kuhn, 1962). Kuhn described the development, progress and lifecycle of science in terms of the broad scientific community's strength of conviction in a set of prevailing theories or methods: a dominant paradigm. Kuhn postulated that science goes through alternating periods of stability and changeability – in which a combination of factors, such as the emergence of new contradictory evidence and the availability of alternative plausible hypotheses, may coincide to provide more favourable conditions for the shift to a new paradigm.

   Social science paradigms represent a subset of scientific paradigms but with a greater tendency toward numerous competing paradigms, reflecting different world views and models of how society will respond to a given intervention. They in many respects reflect the complexity and diversity in human behaviour, with different models being relevant depending on the context. The important difference between social science paradigms and socio-cultural paradigms is that the judgements and models used by social scientists are subject to review and challenge about the degree to which they reflect how the world works, unlike the beliefs underlying socio-cultural paradigms which need not be.
2. **Socio-cultural paradigms which represent the remaining non-technical ideologies, beliefs, and values of society.** The concept of socio-cultural paradigms as defined here represents a particular philosophy of life or a framework of ideas, beliefs and values through which a community or an individual interprets the world and interacts with it. The term often reflected in (and reflects) religion and political ideology. Unlike scientific paradigms, which tend to be clear-cut and incommensurable with one another, it is quite common for there to be a number of socio-cultural paradigms within society, apparently contradicting one another. Socio-cultural paradigms have the capacity to create their own stability when collectively held; with observable behaviour reinforcing the prevailing world view held by those around you. This therefore makes culture and cultural differences essential in permitting different world views to exist and paradigm shifts to occur when cultural exchange occurs.

3.1.2 Paradigms and sustainability

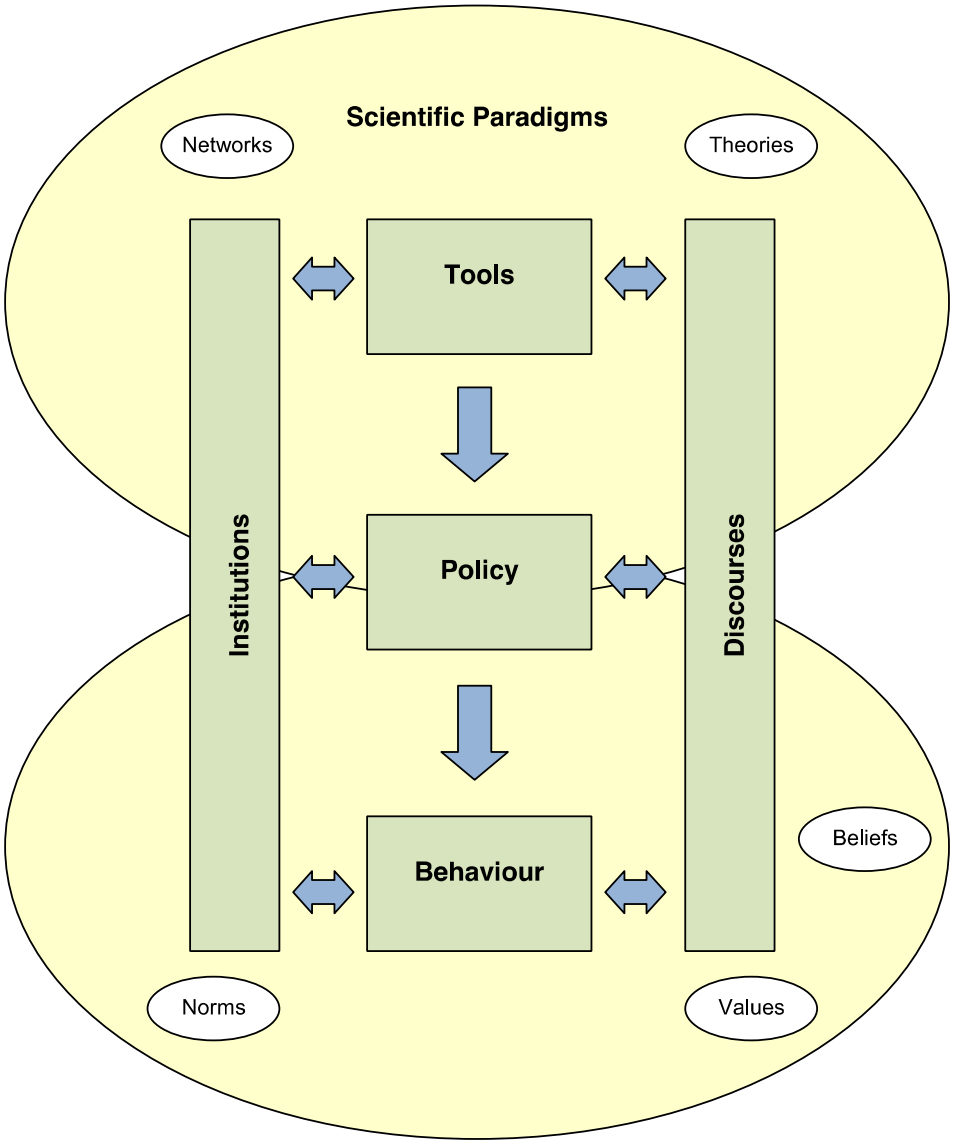
Alongside the limits to growth discourse (see Meadows et al. 1972), the desire for resource efficiency and decoupling has increasingly become a socially co-constructed concept. Therefore, the definition of paradigm to be used within DYNAMIX requires an understanding of how socio-cultural and scientific paradigms interrelate and how they become tangible via the notion of discourses. A review of the literature reveals that while it is possible to define socio-cultural paradigm, scientific paradigm and discourse as separate concepts, many of the resource efficiency terms and paradigms can be placed in any of these three categories depending on the context in which the paradigm is used and to whom it relates (policy makers, individuals, institutions, etc.), and of course, from whose perspective the term or paradigm is reported from. For example, the concept of sustainability might be observed and theorised by both natural and social scientists but seen to be a socio-cultural paradigm within a social justice discourse. The new constraints required by sustainability have also led to scientific paradigm shifts within established fields such as economics.

3.1.3 Why are paradigms important to DYNAMIX?

One's paradigm can bias the way one engages externally in collective discussion about phenomena, problems and solutions. This collective external manifestation of a given paradigm is known as the **discourse**. According to Driesch (2007), discourses establish meanings, identify agents, confirm relations between actors and other entities, set the boundaries for what is legitimate knowledge, and generate what is accepted as common sense. In essence, an individual's discourse is the interface between his or her (inner) paradigm and the outside world. Importantly for DYNAMIX, discourses represent the main interface between scientific paradigms and socio-cultural paradigms, and therefore often highlight areas of significantly different perspectives and worldviews.

When discourses are seen in context with scientific, socio-cultural paradigms, institutions (including governments and the tools and policies they develop in order to influence behaviour), a wider paradigm system forms as shown in Figure 5.

The paradigm system presents the means that paradigms can be observed, co-created and re-validated. So for example, social science paradigms can become self-reinforcing when interacting with socio-cultural paradigms via policies. The scope for changes in socio-cultural paradigms perceived achievable by social scientists working for policy makers can become limited by existing worldviews of how people will respond, reinforced by observations. There is also the potential for people's socio-cultural paradigms (and therefore behaviour) to be constrained by the worldview messages communicated within the way that policies are constructed and are communicated. This makes paradigm changes and shifts complex to implement.



Source: DYNAMIX deliverable D1.1[2]

Figure 5: Mapping of the paradigm system

3.2 How do the DYNAMIX stakeholders view different paradigms?

The DYNAMIX project team engages with policy makers and expert stakeholders on a regular basis through Policy Platform events held in Brussels. During the 2nd DYNAMIX Policy Platform, which took place on 24 and 25 October 2013, the DYNAMIX team explored the feasibility and potential impact of alternative paradigms, as viewed through concepts (such as 'green growth') which are often not the dominant paradigm but reflect and reveal large parts

[2] http://dynamix-project.eu/use-paradigms-dynamix

of a paradigm system as explored in Figure 5 by offering an alternative conceptual view of an alternative paradigm. This was done within an interactive working group session of 58 participants from 16 European countries attending the Policy Platform, including policy makers, researchers, and representatives from civil society organisations, business, environmental protection agencies, and international organisations.

The working group exercise sought to use participants' experience and expertise to explore their current perspectives, identify barriers to, and comment on the potential of different paradigm conceptual terms. In small groups of 4-6, participants discussed a sub-section of three of the following paradigm concepts: *green growth*, *circular economy*, *biomimicry*, *green economy*, *transition towns*, *reliance on markets*, and *beyond GDP*. Participants assessed the concepts' (i) potential to realise absolute decoupling, and (ii) the feasibility of and (iii) any specific barriers to their widespread adoption, drawing on their personal experience and perspectives. Groups were given a 'concept sheet' for each of the three concepts with a brief description of the concept, and questions on impact, barriers and feasibility to discuss and complete together. The outcome from the exercise is shown in Box 4 below.

Stakeholders also offered comments on the apparent inverse relationship between the feasibility of a paradigm concept and its decoupling potential, remarking that concepts with high decoupling potential often focus on lifestyle and consumption changes, which are considered more difficult to achieve. Participants further discussed the paradox of scarcity and how since many resources are not scarce, policy should focus on the decoupling of economic growth from *environmental impact* rather than from resource use. The important issue of whether growth and decoupling of environmental impact can be complementary goals was also raised, with divided opinions.

3.3 How can DYNAMIX promote paradigm change?

Achieving certain targets of the proposed policy mixes requires the inclusion of policies that go beyond the perceived limits of political feasibility with respect to the existing paradigm. While paradigms may be deeply embedded and appear difficult to change, paradigms are not immovable, and can be influenced and reshaped over time in response to both new evidence and positive experiences of similar actions. Furthermore, depending on how things are presented, different groups and individuals have been shown to be adaptable to different perspectives and values. The analysis of public acceptability within DYNAMIX has sought to map-out how policy sequencing can be used within these pathways of interactions in a way that might lead to the required paradigm changes over time.

'Theoretical pathways for paradigm change' are proposed to support policies presently outside the existing political paradigm to become acceptable and feasible to implement at a later date. A 'theoretical pathway for paradigm change' maps out the envisaged pathway of interactions between society and actors which would lead to the required paradigm change over time.

Box 4: DYNAMIX stakeholders' views of different paradigm conceptual terms

- ***Transition towns*** was seen to have some decoupling potential, but perceived feasibility of widespread implementation was generally low, with concerns raised over its scalability, the amount of time needed for broader implementation, and the degree of change from current lifestyles required.
- ***Green growth*** was seen by the majority of participants as a concept with only modest decoupling potential, but also as a 'first step towards more radical change', with moderate to high feasibility, as participants felt that the paradigm was already widely in place. However, the lack of financial industry and business people promoting it, high shareholder pressure for short-term profit, measurement challenges, and the feeling that the concept is not concrete enough ('same game, new name') were all cited by participants as barriers to more successful adoption and application of the concept as a paradigm. Still, the concept was one of the most popular, with several stakeholders championing the concept as an 'improvement on the current status' and a 'top policy priority'.
- ***Reliance on markets*** and market-based instruments were felt to be good concepts, but nonetheless highly dependent on the state of the economy, strength of political will, and on the design, implementation and regulation of market mechanisms. Feasibility was considered to be generally high, depending to an extent on the Member State political context. Key criticisms of the concept included public and private acceptability ('nobody likes taxes'), coordination issues between market actors, distributional issues, predictability of policy outcome, and competitiveness issues.
- **The *circular economy*** was the most popular among stakeholders in the Policy Platform working group session, with moderately high scores for both the decoupling potential and feasibility of widespread application. Participants noted that policy designed around this concept needs to be supportive of both industry and consumers and the connection between them. Low current levels of producer responsibility; a disconnection between producers and consumers of waste throughout the different value chains; and a lack of collection infrastructure and innovation in recycling capabilities were all listed by participants as barriers to the more successful application of the circular economy concept. It was championed by many as having 'strong potential' and as a 'good direction, but a lot to do.'
- ***Beyond GDP*** – a paradigm concept which focuses on developing indicators that are as clear and appealing as GDP, but more inclusive of environmental and social aspects of progress – was considered to have a high potential for achieving absolute decoupling, participants considered it to have a very poor chance of widespread adoption, due to the challenge of defining and reaching consensus on indicators that can be useful and meaningful.

This process makes reference to the 'two circle' model of paradigm change presented in case B of Figure 6 below, where positive outcomes from early sequenced policies lay the foundations for previously 'out-of-paradigm' policies to be implemented in subsequent steps. This is in contrast with the less problematic case A where the there is already at least one 'target' policy or policy mix that leads to a safe operating space which fits within the acceptability limits defined by the current paradigm. In case B, the key is to design a policy pathway which, whilst challenging, is publically acceptable to present citizens but that moves the paradigm towards one compatible with a safe operating space in the longer-term, through a series of 'stepping-stone' sequencing policies.

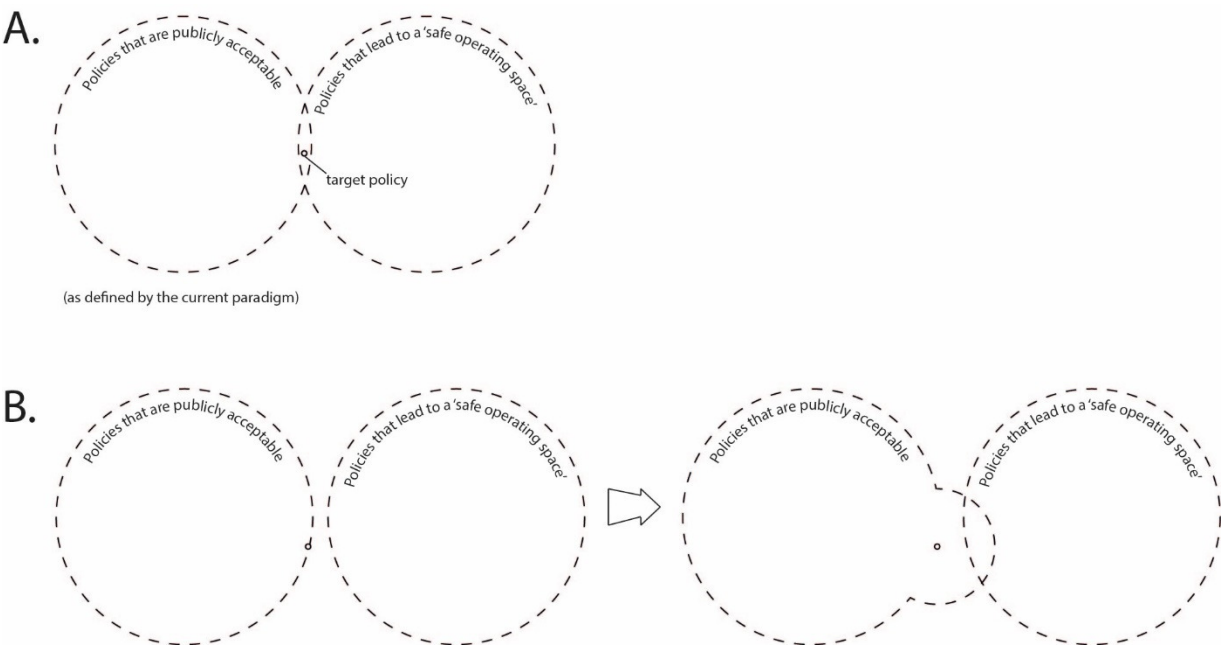


Figure 6: The two circle model for policy pathways towards a safe operating space

This model calls for policies to be designed in a way that not only changes behaviours (via a tax for example), but additionally considers how the policy might support a change in people's worldviews in a way that supports future policy measures that are even more 'contentious' and 'highly contentious' than is presently considered publicly acceptable. The policy therefore needs to be adjusted and extended in a way that creates a safe pathway of future policies.

The factors that permit the extension of what policies are publicly acceptable include how the policy is developed in partnership with stakeholders, and the political capital available to do so. To support this process in the ex-ante assessment, the policy development process needs to make an initial, simplified attempt to describe this pathway by responding to a few questions for each proposed policy considered beyond the present paradigm. We therefore asked policy author teams to answer the following questions when a policy measure was perceived beyond the present paradigm:

1. Why might the proposed policy fail if implemented at present?
    a. Is there a top-down barrier within the existing relevant political authority to implementing this? If so, what/who/what form does this take[3]?
    b. Is there a corresponding bottom-up resistance within society to its successful implementation? What value or behaviour is being threatened?
    c. Is there an established channel of discourse between policy and society on this issue? If so, who initiated the discourse and what form did it take?
2. Are there envisaged 'natural'[4] (or counter-factual) processes of change which would significantly change this situation?
3. Using the responses to the questions above, what do the changes which would need to occur over time to make the policy implementable look like?

It was envisaged that the responses to these questions both support policy author teams to develop 'smarter' and more ambitious policies, as well as support the analysis of paradigms within public discourse in WP5.

3.4 What kind of paradigm changes are desirable within DYNAMIX?

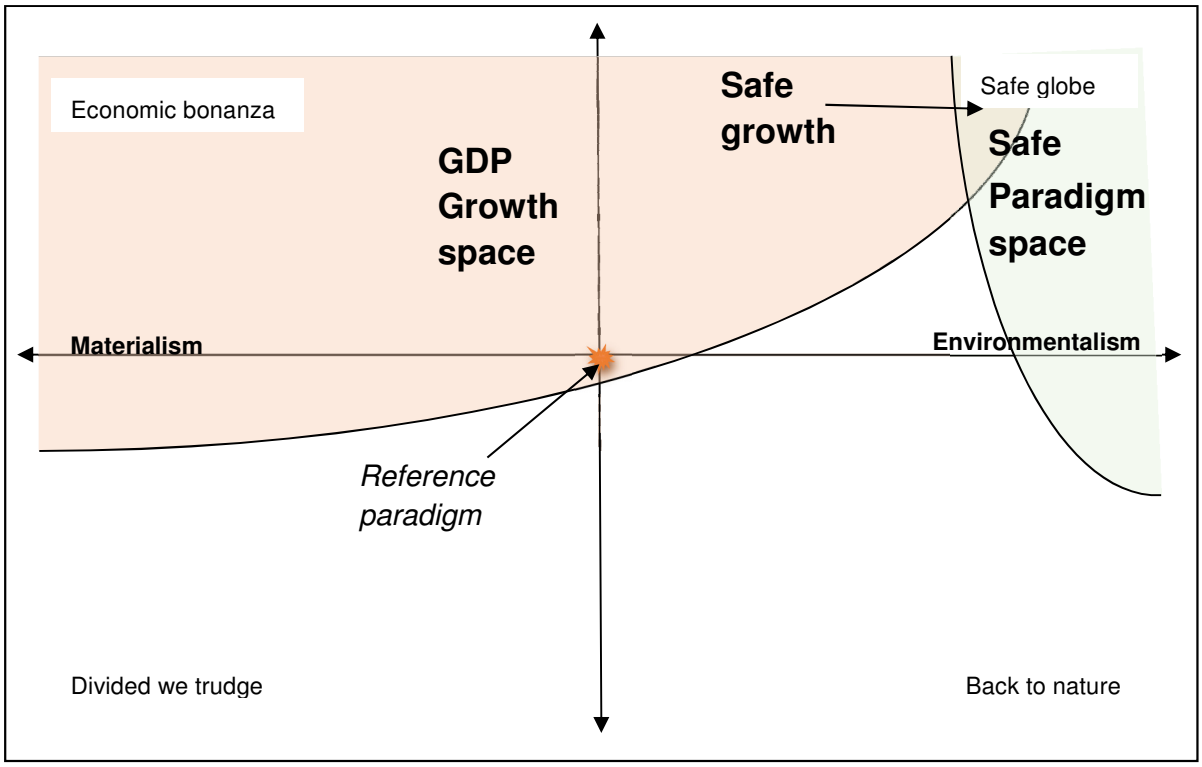
The cornerstone scenarios, as introduced in Section 2.5, propose the two variables considered to be most important in supporting or hindering the achievement of the DYNAMIX objectives. These two variables (materialism versus environmentalism; and the level of innovation, both social and technical), can therefore be mapped on and axes and used to illustrate different directions of paradigm change, and how these relate to the DYNAMIX objectives and cornerstone scenarios. Within this mapped space, there will be a theoretical '**safe paradigm space'** in which the population would need to inhabit to meet the DYNAMIX environmental objectives. In addition to this, there is also a theoretical (and unknown) **growth space** in this mapped area which divides the negative-GDP growth space from the positive-GDP space. These two curves are conceptually plotted in Figure 7 below.

Within DYNAMIX we are proposing to use resource efficiency policies to make the economy more efficient and expand the safe operating space closer to the reference scenario. In addition, we are also seeking to design the policy packages to move the underlying paradigm (the reference paradigm) closer towards the **safe growth space** as seen by the overlap between the growth space and the safe operating space. These changes are illustrated in

Figure 8.

[3] This includes any business lobbying interest.

I.e. Are any of the contextual issues from question 1 likely to change within the foreseeable future (i.e. change of government) or are there long-term processes of social change which would change these circumstances, notably occurring in the absence of political intervention?



Note: The positions and lines on this figure are for illustrative purposes only

Figure 7: Conceptual representation of existing paradigm context

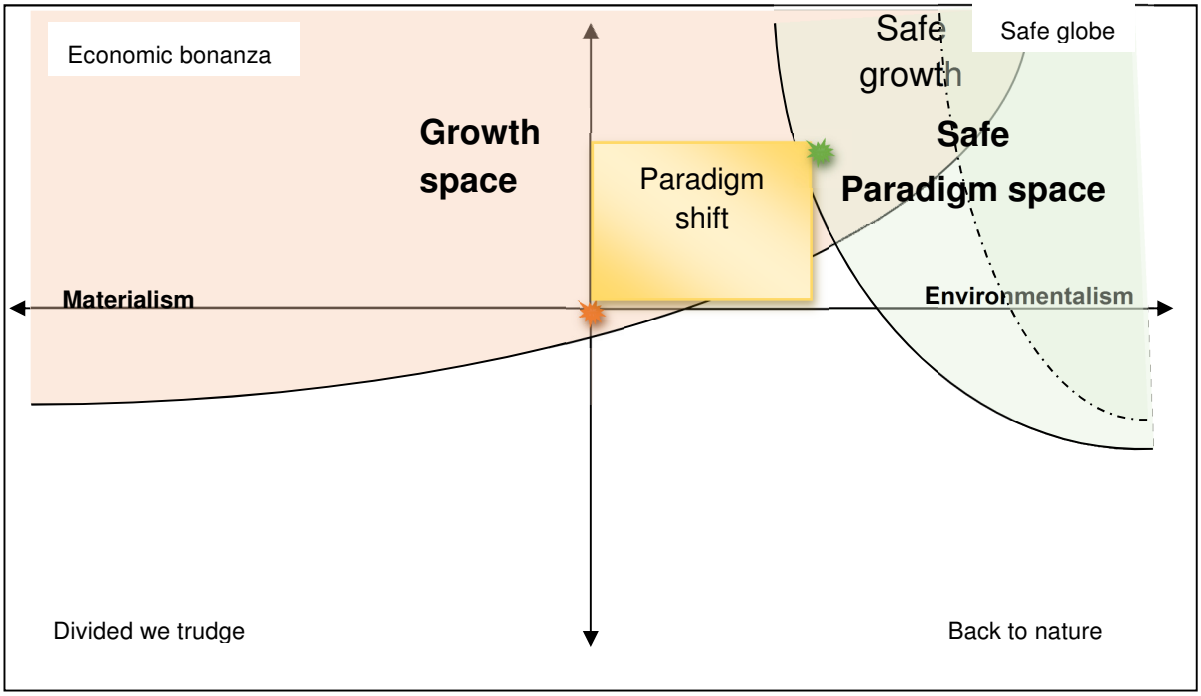


Figure 8: Conceptual representation of desired paradigm shift

Whilst theoretical, this mapping exercise is able to offer a few insights into the cornerstone scenarios:

1. The safe growth space will be cantered within the safe globe quadrant of the mapped area. Under the safe globe scenario less paradigm intervention is required and policy can work within the high innovation and collaborative paradigm context.
2. Under the back-to-nature scenario, we need not necessarily move towards safe growth, only safe operating space. This is because under this scenario the population has already expressed an acceptance for policy outcomes that do not necessarily deliver positive growth in GDP. There may be a need within this scenario for targeted 'green-innovation' to ensure the efficient use of resources.
3. Under the economic bonanza scenario, high levels of innovation offer the apparent prospect for green growth but high levels of materialism-driven consumption means that it is less likely (than the safe globe scenario) that a safe operating space is realised. The policy choices under this scenario context are to either implement far-reaching policy measures intended to cap consumption but risk social-regressivity, or social engagement leading to paradigm shift. However, it seems unlikely that the political capital could be present within a materialist paradigm to implement policies which significantly cap consumption.
4. Under the divided we trudge scenario, there would very unlikely be sufficient levels of innovation or cooperation necessary to be in safe operating space or safe growth space. Successful intervention under this scenario would have to involve attempts at paradigm change. In this context, prioritising moves towards a more environmentalism paradigm may also provide the cooperation needed to stimulate innovation.

3.5 What has the paradigms analysis to tell those developing resource efficiency policy?

3.5.1 Recommendations to those developing and implementing policy

Detailed guidance has been provided to the policy author teams in the development of the policies. Further to this, for two of the policy packages, research staff were embedded into the policy author teams to provide guidance on the sequencing from a paradigm perspective. This was preceded by a general set of recommendations as formulated for a broad range of policy makers in this area. These were based on the findings of the paradigm analysis conducted on the WP3 case studies and input from the 1st and 2nd DYNAMIX Policy Platforms:

- **Become aware of the worldviews and paradigms of all those inputting into the policy formulation, including your own and those supporting you. Failure to do so risks disconnect and a reactionary discourse.** There is the potential for people's socio-cultural paradigms (and therefore behaviour) to be influenced by the worldview messages communicated within the way that policies are constructed and are communicated. Additionally, those developing policy also need to be aware that the scope for changes in socio-cultural paradigms perceived achievable can become limited by the worldviews held by policy makers (and their advisors) of how people will respond. This will likely be validated by ex-post observations and risks being reinforced ex-post via the policy once implemented.

- **Be aware that the terminology used around paradigms is used interchangeably.** A review of the literature in this area highlights a lack of consistency in the use of some of the terminology among authors and, in some cases, with important concepts being used interchangeably. Indeed, an exploration of these issues has revealed that a given concept can justifiably be categorised differently depending on the context. For example, the concept of sustainability might be seen to be a socio-cultural paradigm within a social justice discourse which is observed and theorised by social scientists. The new constraints required by sustainability have also led to natural scientific paradigm shifts within established fields such as economics.
- **Strong and credible government is a key point of commonality amongst successful policy mixes for decoupling.** Political capital is especially important at the point of policy design and introduction; once the hurdle of introducing the policy is overcome, there is little evidence amongst the WP3 case studies at least of repercussions arising from political changeover. Furthermore, participants in the 1st Policy Platform working group on paradigms remarked that initial public support is not always a necessary ingredient for successful policy where the political capital exists to carry it through instead; indeed, participants identified a range of such cases of successful policy where public support rather grew with time. To this end, it may be worth considering supplementing the policy mix with policies to improve citizen engagement with politics, improve governance and public institution structure and efficiency, increase credibility and trust (e.g., through transparency) and encourage cross-party agreement on key policies.
- **Give prominence to public acceptability issues and be prepared to make adjustments to the policy to maintain it.** Policies must be sensitive to the current paradigm; policies which out-step the boundary of current thinking, behaviour, values and beliefs are more likely to be met with significant or prohibitive resistance from target groups, policy makers themselves and/or the wider public in general, making them politically unfeasible. Measures which can serve to improve acceptability include:
    - **Value and engage with all perspectives and groups** through consultation and participation in the policy design process to explore mutually agreeable solutions to new barriers.
    - **Choose words, concepts, discourses and rhetoric carefully.** The understanding of terms and concepts such as ‘green growth’ or ‘sustainability’ may differ subtly between different groups and stakeholders in society; they are riddled with preconceptions, various associations and incite biases for or against.
    - **Demonstrate that such changes are possible.** Highlight where possible how equivalent paradigm shifts have occurred in the past in particular sectors (e.g., in transport, telecommunications).
    - **Consider making concessions to target groups** to ease the introduction of the suggested policies, and make a policy more palatable overall**.** For example: in the case of fisheries management in Iceland, resource permits were allocated via grandfathering rather than by auction.
    - **Be prepared to support transitions in sectors most affected.** The presence of laggard industries (especially the large or traditionally valued sectors) can discourage policy initiatives and prevent wider societal paradigm change if they are unable to adapt or transition without substantial (economic and/or social)

cost. Consider and tackle industry lock-in amongst laggards with policies to enable and support a sustainable transition to alternatives.

- **Frame the change in the context of a wider transition over the longer term and highlight where equivalent paradigm shifts have occurred.** Although such transitions can often have short-term and very visible costs (e.g., job losses, factory closures), they typically have benefits which although are in the future and theoretical, will often outweigh these costs (e.g., cost reductions, jobs in new industries, efficient allocation and use of scarce resources).
- **Use policy sequencing of softer measures, such as voluntary schemes, to introduce the concept change required.** This is particular the case where the policy is proposing a paradigm level change which people are not familiar with and have concerns over. Sequencing of policies permits people to try and experience what a different system feels like and how it works in practice.
- **Recycle any revenues generated from implementing policies, aiming the benefits close to these most affected by the policy.** As was done with the UK Aggregates Levy, where revenue was initially earmarked to enable a reduction in employers' National Insurance contributions (NICs) and for a Sustainability Fund to provide funds to help address the environmental impacts of aggregate extraction (the Sustainability Fund closed in 2011, while the Levy continues).

- **Beware the trade-off with effectiveness.** If the end-result of the policy mix is that the target resource is substituted in such a way where the environmental pressure is merely displaced, a paradigm shift towards consumption within limits cannot be said to have successfully occurred. Consider the alternative type (or manner of use) of resource being promoted, and the risk of the environmental pressure being displaced or exported without at the same time being reasonably reduced. Similarly, consider and address possible rebound effects of the policy or policy mix.
- **Avoid sidestepping difficult paradigms, and where necessary, be prepared to invest considerable political capital.** Often the most challenging and needed paradigm changes will provide a return on the investment with 'interest'.

In summary, an understanding of paradigms and public acceptability issues is important. Designing policy to maximise public acceptability can be time-consuming and may require the policies to be sequenced or adjusted. However, the benefits include maintaining political capital for the future and permitting policy objectives to be achieved which would not have otherwise been possible. It is worth reiterating that resistance to a policy can be triggered by implicit paradigm messaging built into the policy itself, and that of preceding policies. This can occur via the worldviews held by those who design the policy.

3.5.2 Where are the existing paradigm edges?

The findings from the public acceptability analysis in WP5 identified the limits or **thresholds in public acceptability**. Some of these thresholds are more contextual in nature and represent transition type concerns that policy makers are tasked to respond to and consider making concessions and mitigations for. Other thresholds, whilst challenging to work with, identify the paradigm edge of the existing social-political system to implement policy in this area (as exemplified by case B in Figure 6 of the 'two-circles' model). It is these thresholds

that are worth investing more political capital in overcoming as the return on this investment will likely make policy making in this area easier once the policy has met its objectives. These types of threshold are highlighted by underlying in the following:

- ***Green fiscal reform*:** The threshold of the measure centres not only on individual's loss, but also a sense that they are being imposed fairly and evenly, and not just where it is possible.
- ***Stimulation of sharing systems*:** The threshold of acceptability is associated with those citizens who either don't want to or can't participate, and then focused on the level of public funding provided.
- ***Product standards***: Consumers in some more Eurosceptic Member States are presently liable to reject collective action for environmental purposes.
- ***Food waste policies*:** Acceptability thresholds have been identified around policies that threaten to increase living costs or significantly reduce the consumer's right to shop freely and throw unwanted food away.
- ***Value added tax (VAT) on meat products*:** Acceptability thresholds have been identified associated with fairness concerns, border issues and competitiveness issues.
- ***Step-by-step restriction of advertising and marketing***: The threshold of acceptability is associated with restrictions on advertisement on luxury goods linked to conspicuous consumption.
- ***Local currencies for labour-based services*:** It is likely that there would be objections to Local Exchange Trading Systems (LETS) where they are perceived as being primarily motivated as a way of avoiding taxation, or where they become compulsory for buyers or sellers to participate in.

3.6 Next steps for paradigms and policy mixes in DYNAMIX

The theory of change and recommendations set out in Sections 3.3 to 3.5 above have served along with the other various detailed components of analysis in DYNAMIX so far to inform the conception and design of three policy mixes, set out here in the following chapters of this report. In terms of paradigms, this is an iterative process; in WP5 we assess the acceptability and effectiveness of policies and reflect on the scope for adjustment of existing instruments or introduction of sequencing policies as necessary. It is not necessary to eliminate from consideration those policies perceived to be politically unacceptable. The approach proposed here encourages the sequencing of policies to support transitions in acceptability.

The following Chapters 4-6 present the initial DYNAMIX policy mixes together with the topic-specific discussion and analysis, which formed the basis for the selection of instruments within each policy mix. The first policy mix is overarching (Chapter 4) while the other two focus on land use (Chapter 5) and materials (Chapter 6).

4 Developing the overarching policy mix

4.1 The current problem situation, drivers and barriers

4.1.1 Current trends in resource use in the policy mix target area

The overall environmental impact related to consumption of goods, services by households and companies in the EU continues to grow, creating impacts within the EU and globally. In its Roadmap to a Resource Efficient Europe the European Commission (2011a, p. 2) suggested that "if we carry on using resources at the current rate, by 2050 we will need, on aggregate, the equivalent of more than two planets to sustain us". EEA analysis of nine EU Member States (representing 268 million or 53.5 % of the EU's total 501 million people) has found that the majority of key environmental pressures caused by total national consumption can be attributed to food and drink, housing and infrastructure, and mobility. These three broad consumption areas are estimated to have contributed approximately two-thirds of consumption-related material use, greenhouse gas emissions, acidifying emissions and ozone precursor emissions (EEA 2012a).

The indirect pressures that are created along the production chains of the goods and services consumed result in environmental impacts, as for example global warming, biodiversity degradation, soil sealing and erosion and air and water pollution. Since an increasing share of the final and intermediate goods consumed in Europe is imported, a growing proportion of impacts caused by our consumption takes place in other parts of the world. The average environmental footprint (an indicator of pressures from consumption) per person in EEA member countries is about double the available biocapacity (an indicator of land which is biologically productive) of those countries (EEA 2012a).

4.1.2 (Main) drivers of those trends?

The trends towards increasing consumption of resource-intensive goods and services observed in the EU over the last decades have no single driver. Rather, a web of interrelated direct and indirect drivers results in the observed trends. Drivers include inter alia demography (e.g., population growth, higher life expectancy), rising affluence, decreasing production prices, increasing pace of product innovation, increasing consumer choices through the expansion of trade,infrastructure design and consumption patterns shaped by social norms, advertising and consumerist values (Tan et al. 2013, EEA 2012a).

On the **demand side**, the integrated and widespread cultural, economic, institutional and political system that supports **consumerism** encourages individuals to establish their place in society through the purchase of material possessions (e.g., housing, vehicles, products) and the lifestyle choices they make (e.g., diet, holidays, transport mode choice). Widespread consumerism, which is promoted by advertising and peer-pressure leads to consumption of resource-intensive goods far beyond the satisfaction of basic needs, in order to cultivate an identity, an image and prestige vis-à-vis other individuals and groups. In these cases "wants" are often perceived as "needs". Thus demand-side drivers are essentially about individual and societal choices.

Table 1: Overview of the identified past and current drivers

Demography (e.g., population growth, higher life expectancy, smaller households)
Rising affluence
Inadequate resource pricing, i.e., a lack of internalisation of external costs of resource use
Environmentally harmful subsidies
Short product lifespans (e.g., because of built-in obsolescence, fashion, limited options for and high cost of repairing or up-dating)
Limited whole-life costing assessments in investment decisions
Limited liability rules
Demand for high profits and short pay-back periods of investment linked to the institutional framework in which companies operate (rules for listed companies, banking system)
Technological and social lock-in
Decreasing production and retail prices
Increasing pace of product innovation
Increasing consumer choice through the expansion of trade
Advertising and marketing reinforcing consumerist values
Infrastructure design reinforcing unsustainable consumption patterns
Social norms and habits
Institutional bias of governments towards promoting growth
The influence of vested interests on policy-making

On the **production** side, drivers causing inefficient resource use include demand for high profits and short pay-back periods of investment, inadequate resource pricing (not reflecting the provision of the resource and its resource value) and a lack of internalisation of external costs of resource use (Withana et al. 2014). These drivers lead to short product lifespans, which in part is also due to built-in obsolescence (Slade 2006, Guiltinan 2009) and limited life-cycle costing[5] in investment decisions. This is exacerbated by limited liability rules and warranties for products for the private sector and the existence of environmentally harmful subsidies (Oosterhuis and ten Brink 2014).

Together, production and consumption-side factors are leading to technological and social lock-in leading to unsustainable consumption patterns, i.e., systemic linkages between technology, existing infrastructure and behaviour patterns that appear hard to break. This is for example the case with transport infrastructure, where a wide range of factors mean that we are currently locked-in carbon intensive road transport. Here, the crisis has much constrained the financing of large-scale infrastructure, as banks are less willing to invest in

[5] Life-cycle costs refer to the total cost of ownership over the life of an asset.

innovating and more sustainable long-term projects such as railways and underground networks. Institutional barriers like market failures, uncertainty, investors' inexperience and the absence of dedicated tools in the public sector, as well as social factors like convenience, motorisation rate, customs or even esteem, continue to make investing in green transport infrastructure a really difficult choice for policy.

Linked to the issue of externalities is the wider issue of a frequent conflict between public and private interests; which can in many cases be characterised as a conflict between short-term (particularly reflecting the interests of current population cohorts) and the long-term (reflecting a public responsibility for the interests of future generations, or other species). Market and governance failures mean that there are not enough obstacles to corporations increasing private profits while disregarding the wider social costs of their operations – a process that globalisation of the world economy has rather strengthened. Similarly, the provision of public goods by private endeavour (e.g., climate change mitigation through agricultural land use practice) is often not or not adequately rewarded in existing market and regulatory signals. Until long-term societal interests are more adequately reflected in decision making at all levels, the trend towards over-resource use and pollution will be difficult to address.

The underlying drivers of resource overconsumption are strong; they are deeply embedded and often mutually reinforcing. Our economic model is fuelled by consumption spending, and GDP growth is generally seen by policy makers as a fundamental necessity to ensure jobs and prosperity. Institutions and their policies have more often than not encouraged consumption, and aligned with business. Even in a context of austerity as the current one, consumer spending is encouraged as it is seen as necessary to keep the economy going while public expenditure is cut back. In a world of infinite resources and infinite capacity to absorb pollution or innovate to avoid pollution, this model could work. However, both natural resources and the planet's capacity to absorb pollution are limited.

There is a growing agreement between scientists and analysts that a significant reduction of overconsumption challenges the premises on which our economies are built and would require important, structural changes (Jackson, 2009, Daly 1996, UNEP 2011b, OECD 2011). However, the academic community does disagree about the extent of the required changes. Particularly, they debate the future role of economic growth (understood as growth in GDP) in industrialised countries (Urhammer and Røpke 2013).

Proponents of 'green growth' or 'a green economy', most prominently the OECD and UNEP, argue that economic growth *per se* does not pose a problem, but that material intensive growth that is associated with high environmental impacts does (OECD 2011, UNEP 2011b). They advocate that economic dynamism, market processes and technological innovation – if properly incentivised – can be harnessed for addressing environmental problems and increasing resource efficiency (EEA 2011a). Thus, the benefits of growth could be preserved while at the same time ensuring that (public and private) investments and policy frameworks spearhead the shift towards a less resource intensive and material wealth-driven economy.

Towards the other end of the spectrum, authors arguing for a 'steady state economy' (Daly 2008), 'prosperity without growth' (Jackson 2009, Schor 2010, NEF 2010) or 'degrowth' (Assadourian 2012, Schneider et al. 2010, Martínez-Alier et al. 2010) claim that – in rich countries – additional GDP growth and sustainable levels of material and energy use cannot be combined. The argument rests on the understanding that physical expansion of the economy (physical growth) is bound by limits, often referred to as 'planetary boundaries' building on Rockström et al. (2009). These authors stipulate that reducing the use of natural

resources and the environmental impacts to sustainable levels while the economy grows is unrealistic, particularly because rebound effects limit the absolute effect of efficiency improvements (Jackson 2009).

The latter approaches also build on the recognition that there is a weak correlation between GDP growth and increases in well-being in high-income countries and pursuing growth per se might actually undermine the realisation of wellbeing benefits.[6] Another argument is that, independently of environmental issues, high levels of economic growth in the rich world are highly uncertain or even improbable to achieve in the future. Reasons for slowing of growth include ageing, resource scarcity and the shift to services in the economy which have lower potential of productivity improvements than industrial production (Demailliy et al. 2013, Miegel 2010).

Both of the research streams depicted above, however, see a need for shifting consumption patterns towards more sustainable options. This is supported by empirical evidence: The key areas with the highest potential for contributing to decoupling are linked to lifestyle-based consumption choices in the three consumption areas food, housing and mobility, such as diet choice, number of people per household, living area per person, distance travelled and choice of transport mode. The areas of food, transport and buildings are indeed those that contribute the most to environmental pressures in the EU (UNEP 2011b, Tan et al. 2013, European Commission 2011a).

Yet, what drives consumption patterns is subject to intense debate as well as leading over to the key question if and how policy could shift consumer behaviour. Judging from the popularity of information-based policy instruments (e.g., energy efficiency labelling, ecolabelling, organic food labelling, etc.) used to promote behavioural change, deficiency in consumer information and lack of awareness seem to have long been seen as the one of the main drivers of unsustainable consumption patterns. Evaluations of past policies, including within the ex-post analysis of DYNAMIX, have shown, however, that information-based instruments used in isolation are not effective (Southerton et al. 2011, Fazio-Fedrigo et al. 2014). This points to other drivers shaping consumption patterns and hence calls for different (additional) policy instruments as part of a policy mix.

Research in the multi-disciplinary field of behavioural economics has produced evidence on the role of framing, anchoring, mental shortcuts, information overload and emotions in decision-making (Kahnemann 2011). Recent sociological research in the field of practice theory emphasises the interplay of materials (for example infrastructure and technology), competences (mainly skills and knowledge) and meaning (referring to values, attitudes and emotions) in shaping everyday practices (Shove et al. 2012). Practice theory confirms earlier findings about the strong influence of habits in consumption choices (Defra 2011) and seeks to explore the social setting in which they evolve and change. Thereby, it puts the focus on groups of people who carry out the same practice (for example bike riding or car sharing)

[6] Easterlin (1974) found that while within countries there was a noticeable positive association between income and happiness, there was little evidence of happinesss differences between rich and poor countries. For a more recent assessment, see Kubiszewski et al. (2013), which notes that welfare as estimated by the Genuine Progress Indicator has declined since 1978, notwithstanding increases in GDP.

rather than putting the individual and his or her general attitude towards the environment at the centre as most conventional consumer policies do (Shove 2010, Umpfenbach 2014).

Another explanation for escalating consumption patterns has been proposed by Schor (1998) who has introduced the concept of the work-and-spend-cycle. Longer work hours and fewer boundaries between work and free time, partly create a lifestyle that is driven by convenience and therefore more wasteful, but also characterised by higher stress levels and higher income, for both of which consumerism can be a compensation.

Finally, lack of transparency in decision-making and strongly vested interests at various levels of governance across the EU are another persistent systemic problem when addressing resource use challenges through policy.

4.1.3 Implications for the conception of policies

The differences in problem analysis outlined above lead to different policy proposals (Urhammer and Ropke 2013). While proponents of green growth and a green economy mainly argue for internalising environmental bads in policies and prices, reforming environmental harmful subsidies, stimulating green technologies, innovation and improving education and governance, authors aiming for prosperity without growth or degrowth propose deeper changes to the socio-economic system – though with variation between authors (see Table 2). The proposals include stricter regulation of the financial sector, labour market changes and redistribution mechanisms to share wealth between social groups (Table 3).

Table 2: Policy measures proposed by different schools of thought

Measures	Green Growth	Green economy	Prosperity w/out growth	Degrowth
Ecological tax reform	pro	Pro	pro	pro
Carbon tax	pro	Pro	mentions	pro
Cap and trade	pro	Pro	mentions	pro
Border tax adjustment	not incl.	Pro	not incl.	mentions
Technology policies	pro	Pro	pro	mentions
Stopping environmental harmful subsidies	pro	Pro	not incl.	pro
Green subsidies	pro	Pro	not incl.	pro
Green stimulus	pro	Pro	mentions	not incl.
Education and re-education	pro	Pro	mentions	mentions
Increasing demand for low-resource services	not incl.	not incl.	pro	mentions
Pension fund investment in green infrastructure	pro	Pro	not incl.	not incl.
Eco-tax revenues invested in green transition	not incl.	Pro	mentions	pro
Financial transaction tax for green transition	not incl.	not incl.	pro	pro
Advertisement tax revenues for green transition	not incl.	not incl.	not incl.	pro

Source: Adapted from Urhammer and Ropke 2013, p. 65.

Table 3: Proposed changes to socio-economic structures by different schools of thought

Measures	Green Growth	Green economy	Prosperity w/out growth	Degrowth
Local currencies	not incl.	not incl.	not incl.	pro
Strengthening the informal economy	not incl.	not incl.	not incl.	pro
Enhancing local production and services	not incl.	mentions	pro	pro
Maximum and minimum income	not incl.	not incl.	pro	pro
Citizen's income	not incl.	not incl.	pro not incl.	pro
Worksharing	not incl.	not incl.	pro.	pro
Division btw. Investment and retail banking	not incl.	not incl.	not incl.	pro.
Demerging of banks 'to big to fail'	not incl.	not incl.	not incl.	pro
Financial transaction tax	not incl.	not incl.	pro	pro
Capital control	not incl.	not incl.	not incl.	pro
Co-operative ownership	not incl.	not incl.	not incl.	mentions
New business models	not incl.	not incl.	mentions	mentions
Regulation of international trade	not incl.	not incl.	pro	mentions
New measures of economic progress	pro	Pro	pro	pro

Source: Adapted from Urhammer and Ropke 2013, p. 65.

This analysis shows that there is clear common ground between the different approaches, mainly with respect to price-based instruments, incentives for innovation, information for and education of consumers, improved governance (for example mainstreaming of resource efficiency concerns into all EU policies) all of which the EU has also recognised as policy priorities (European Commission 2011a).

In addition to the measures mentioned above, regulations (bans, emissions or quality standards, targets) as well as wider governance tools (transparency, accounting, assessment tools, participation and an improved science-policy interface to provide for evidence based policies) are also important for increasing resource efficiency and reducing environmental impacts associated with resource consumption. The policy design within DYNAMIX will build on this common ground.

With respect to the question of growth, DYNAMIX takes an a-growth position, i.e., the team is agnostic about the possibility or need of future economic growth in the EU. The environmental goal of staying within limits, of decoupling social well-being from resource use and its environmental impacts is assumed to take primacy over any other objective. This means that the policy mix will not include policies to change the fundamental institutional structure of the EU's socio-economic system (which would also go beyond the project's scope), although it will occasionally point to the existence of choices which could have this effect.

At the same time an a-growth position also implies that GDP growth does not play the role of an overriding policy objective, and that it cannot therefore be put forward as a veto against ambitious environmental policy, a role that it often occupies in public discourse (whether this is directly, or indirectly through the reference to intermediate objectives whose ultimate purpose is GDP growth, for example the trade liberalisation and competitiveness agendas).

In the current dominant political discourse growth is viewed as necessary to sustain high employment levels. Economic performance plays a central role in shaping the revenues available to governments and, correspondingly, the resources available for public services such as education, health care, policing, transport, pensions and other forms of social security. Growth is thus perceived as fundamental to the functioning of many aspects of modern society[7]. Resistance to major changes to this system are linked to fear of financial collapse, social and political instability, and loss of influence of vested interests. In addition, the remaining discrepancies in standards of living in the EU – both within as well as more importantly between Member States – are also used to justify policies that further stimulate economic growth. Moreover, the EU is an open economy interacting and competing with other world regions and any policy mix has to take into account impacts on trade and competitiveness.

It can thus be argued that to convincingly follow an a-growth position, we would at least assume that EU's society could also function with a stable GDP under certain circumstances, even if we cannot demonstrate this in detail within DYNAMIX, let alone test the robustness of this assumption.

4.2 Guiding vision for 2050

The ambition is that by 2050 all European citizens meet their basic needs and enjoy high levels of quality of life and well-being. At the same time, significant shifts in production and consumption patterns mean that impacts associated with the average consumption of a European citizen have gone down significantly and Europe's overall footprint is within the earth's carrying capacity. Efficiency and recycling in the economy have been substantially improved, including through system innovation (rather than only through technical improvements of previously used processes and products). Energy and materials input are very effectively used in an almost perfect circular economy (Ellen MacArthur Foundation 2012).

Both because of increased levels of awareness and the incentive structures in place (i.e., prices), consumers demand low environmental, health and social impact products. In a range of key consumption categories, habits have changed – with change of diets, increased collection rates of waste and end of life products, and potentially increased use of leasing or sharing of products such as cars and other equipment to facilitate innovation and reduce overall impacts.

Products that are adaptable to changing user demand, long-lived, and designed for remanufacture are easily available and affordable, thus it has become widely shared consumer practice to use these products and services. Also, a combined set of technological and social innovations has brought about new, resource-light ways of fulfilling consumer needs through, for example, enabling wide-spread sharing, custom-fit design and re-design. The principle of stewardship ensures that resources are shared according to need, rather than squandered in conspicuous consumption. Infrastructures and land planning have been

[7] See for example the assessment in the EEA's 2010 "Assessment of Global Megatrends", p. 50 (EEA, 2011a).

adapted in a way so as to make sustainable living, moving and consuming the obvious choice for all social groups.

Attractive options exist and it is socially accepted practice to substitute income with leisure to a certain extent. Overall, resource intensity of leisure activities has gone down substantially while consumption of immaterial or resource-light goods and services has gone up.

4.3 Objectives for 2030 and 2050

By 2030:

- Consumption in the EU has shifted towards more sustainable goods. Products are better designed, more durable and can be recycled easily.
- Systematic use of green public procurement, more systemic use of whole-life costing in public decisions and EU's as well as MS's budgets are climate and biodiversity proofed to ensure net positive impacts and hence the public sector leads by example.
- At MS level financial incentives make consumers choose products with reduced environmental impacts.
- By 2030 today's niche markets (organic food - with a low GHG emissions impact-, eco-labelled products etc.) have become more mainstream and the quality of labelling is improved.
- The curriculum in schools addresses head-on issues of systems thinking, environmental scarcity and helps to improve understanding of the benefits to individuals and society of healthy, low (environmental) impact lifestyles and become aware of the risks associated with pollution and the threat associated with going beyond planetary boundaries.
- Europe's ecosystems and associated biodiversity are recovering; stocks of renewable resources are more wisely managed and depletion of non-renewable is slowed/halted.
- Decision-making is becoming more transparent with the science-policy interface strengthened; natural capital accounting and associated metrics of progress (beyond GDP) are widespread in place. Public decision-making better takes into account the long-term.

By 2050:

The resource demands and environmental impacts associated with the average per capita consumption of a European citizen has reached a level where Europe's footprint would allow 9 billion people benefitting from the same high living standards to live on earth while staying within planetary boundaries.

In particular by 2050 the policy mixes will have helped to progress towards the following objectives (see also Umpfenbach 2013):

- Circular economy is the norm (close to 100 percent collection and recycling rates) across materials (e.g., use of virgin metals is reduced by 80 % compared to a 2010 baseline) and thanks to the achievement of almost 100 % collection and recycling rate.
- The economy has finally been almost completely decarbonised thanks in particular through a steep increase in the share of energy coming from renewable sources and energy efficiency measures (per capita GHG emissions are reduced by 90 % compared to 1990 levels) (or 2t $CO_{2\text{-eq}}$ per capita per year).

- No net demand of non-EU arable land, or a significant reduction in the net demand (the EU aims to produce its fair share of nutrients to feed an increased global population).
- Sound management of water resources means that no region experiences water stress linked to human overuse.
- All fish stocks in European waters are viable and managed in a way that ensures their long-term health and sustainability.
- All European ecosystems are in good ecological conditions (thanks to substantial restoration measures and effective conservation policies).
- Climate impacts that have not been avoided have led to a fundamental shift in decision-making frameworks and modes. In particular the role of the public sector and citizens has changed towards a longer-term perspective being taken into account, reflecting a greater appreciation of systems thinking.

Table 4 (see below) defines intermediate objectives for the pathway on the road towards 2050. Each of the objectives is paired with the driver of resource inefficiency it is meant to address.

The table's third column proposes policy instruments suited to reach the objectives. With the exception of instruments that were judged to be out of the scope of the research project or extensively covered in numerous previous studies, detailed instrument descriptions were developed for this first set of promising set of policy instruments. The descriptions are presented in section 6.4. Obviously, this selection of potential interventions is neither complete nor will it in itself suffice to fully and securely reach the vision and objectives outlined above. It does however aim at covering the most relevant drivers with at least one or several instruments.

Given the project's limited resources for in-depth qualitative and quantitative assessment, an additional selection process was required to determine the set of policy instruments to be subject to in-depth ex-ante impact assessment. The following criteria were used to guide the selection (see also fourth column of Table 4):

- Potential for systemic impact.
- Balanced mix addressing both supply-side demand-side drivers.
- Policies may deliver important benefits in terms of improving quality of life.
- Policy intervention is necessary, because markets won't bring about the necessary changes.
- Feedback on proposed instruments and additional instrument ideas from stakeholders.
- Limited number of studies exist to date.

In addition, to facilitate the quantitative assessment and modelling of the proposed policy instruments, precedence is given to tools and instruments which have effects on:

- input prices,
- consumer prices,
- availability of and costs of supply,
- demand (e.g., niches, growth),
- innovation rates (e.g., autonomous energy efficiency improvements),
- elasticity of demand (i.e., ability to go to substitutes).

Table 4: Drivers, intermediate objectives and corresponding policy instruments

Drivers	Objectives 2030	Instruments (see also section 6.4)	Assessment?
Demographic change	Outside the scope of the policy mix		No, outside the scope.
Rising affluence	Enabling translation of higher income levels to more leisure instead of additional consumption.	Labour market reform fostering a shift from consumption to leisure, including tax incentives and regulatory change.	Yes.
Inadequate resource pricing, decreasing retail prices, increasing consumer choice	Smart pricing – full cost pricing for resource provision, internalisation of externalities to the extent this is feasible.	Tax on material use and polluting activities for both producers and consumers. Revenues used to lower prices for resource-efficient products. Support for local currencies, incentivising use of services and locally produced products.	Yes. Yes.
Environmentally harmful subsidies	No environmentally harmful subsidies.	Reform to abolish EHS step-by-step.	No, extensive studies exist.
Short product lifespans	Products have longer durability and operational lives.	Extended producer responsibility, international collaboration for more ambitious product standards.	Yes.
Limited whole-life costing in investment decisions	Investors and consumers are enabled to consider whole-life costs.	Price incentives for resource-efficient products through VAT reductions and feebates; compulsory sustainability accounting of companies to increase transparency.	Yes (feebates).
Limited liability rules.	The polluter pays principle is fully implemented.	Extended environmental liability rules.	No, limited potential for quantification.
Demand for short pay-back periods of investment	Adapting incentives to reward long term investments.	Improve sustainability accounting of companies to increase transparency; promoting shareholder responsibility	No, limited potential for quantification.
Technological and social lock-ins, increasing pace of product innovation	Radical innovation have emerged and replaced some of the most inefficient and resource intensive systems.	Skill enhancement programme; green public procurement and support to niche technologies; privileging sustainable behaviour in city, land use and infrastructure planning.	Yes (qualitative) No, green procurement extensively studied.
Consumerist values fuelling consumption	Encourage responsibility *vis à vis* overconsumption as well as waste and end of life products	Step-wise approach to restricting advertising; ensuring credibility of green claims.	Yes, (qualitative).
The influence of vested interests on policy-making	Improved governance focused on appropriate policies for public goods and wellbeing.	Improve transparency, participation and accountability, mainstreaming and proofing tools.	No, outside the scope.

Finally, the selection of instruments for the detailed assessment takes into account the instruments assessed in the two other DYNAMIX policy mixes on land and metals. The aim is to avoid duplication and overlaps as much as possible.

4.4 The overarching policy mix: Promising policy instruments

4.4.1 Circular economy tax trio

Brief intro and summary of the measure

Numerous countries already use environmental taxes and charges in order to put a price on resources and reduce environmentally harmful activities. Countries like Denmark, Sweden and the United Kingdom have combined taxes on raw materials (Sweden's gravel tax, UK's aggregates levy and Denmark's tax on certain raw materials), on landfilling (UK) and on waste in general, either through taxes on landfilling or incineration (Sweden, Denmark).

The "*circular economy tax trio*" (taxes on virgin materials, landfills and waste incineration) described in more detail in this policy fiche is an attempt to produce a mix of tax instruments which would be an "upwards harmonisation" of the use of such instruments across the EU (i.e., taking the best practice in the implementation of each one of these taxes and trying to combine them into one EU-wide mix of tax instruments). The combination of a virgin materials tax (based on UK's aggregates tax, the Swedish gravel tax and the Danish tax on raw materials), a landfill tax (UK) as well a waste incineration and landfill tax (Sweden and Denmark) would pursue three objectives simultaneously:

a) reducing raw virgin resources extraction;
b) encouraging recycling/making recycling more profitable;
c) internalising externalities linked to (1) the extraction/transportation of raw materials (2) landfilling and incineration.

Assessments came to the conclusion that the instruments used in the UK, DK and SE have been effective in achieving their objective at a reasonable cost (in the UK, administrative costs represented 0.5% of total tax revenues, while enforcement costs represented 0.3%, while in Sweden the proportions were 2% and 3-5.5% respectively (Ecorys 2011)). We assume here that this would also be the case if these were applied more widely, across the EU. The aim is to set up a hypothetical instrument in order to investigate the effects it would have and whether, overall, it would be a useful measure that would contribute to meeting some of the objectives and targets the overarching policy-mix pursues. The materials that could be covered by the virgin materials tax would in particular include: marble, chalk and dolomite, slate, limestone and gypsum, sand and gravel, as well as metals (Eunomia and Aarhus University, 2014).

Brief description of the design and scope

a. <u>When would it be introduced (2020 or 2030)?</u>

The tax instruments would be introduced in all EU MS around 2025.

b. <u>What is its aim?</u>

The combination of virgin materials, landfills and incineration tax would pursue primarily three objectives:

1) reduce the extraction of virgin raw materials both inside and outside the EU;
2) encourage recycling/make recycling more profitable;
3) internalise externalities linked to the extraction/transportation of these materials and the landfilling an incineration of waste.

c. Which economic sectors and point(s) in the lifecycle would be targeted at?

The tax-mix will target both the early stages of the lifecycle, by making use of raw materials more expensive through a resource extraction tax on aggregates of €2.40 per tonne by 2020 (approximately 38 % of the average price of materials in Europe, which was €6.7 per ton in 2012 according to UEPG, 2013), and the final stages (disposal) - landfilling and waste incineration becoming more expensive too (€90 per tonne of landfilled waste and €15 per tonne of incinerated waste by 2020).

The virgin materials tax will target virgin raw materials' suppliers and importers. The landfilling tax will have to be paid by all waste producers who choose to discard their waste using landfill sites, with the primary aim to incentivise them to produce less waste or if that is not possible, to recycle it. Therefore the landfill tax acts as an incentive to consume more efficiently and will contribute to the waste pyramid in the EU, which fixes the following priorities in the EU: prevention, re-use, recycling recovery and disposal (in order of priority) (Waste Framework Directive: Directive 2008/98/EC on waste).

The incineration tax will be paid by the incineration plants and will lead to increasing incineration gate fees. That will eventually determine higher recycling rates. In Denmark, the incineration tax rate was initially set the same as the one for landfilling at €5.37 per tonne, though landfill taxes increased substantially more since 1993, to reach €50 (Söderholm, 2011). Since 2001, the incineration tax was raised to €44.4 by the Danish government. In Sweden, the incineration tax is composed by an energy tax (€16.5 per tonne) and fossil coal and CO_2 tax (€371 per tonne of fossil fuel used), while deductions exist for energy generating plants or due to their energy efficiency (Swedish Ministry of Finance, 2006).

Raw materials that are exported will not be exempt from the virgin materials tax; and the tax will not be levied on imports, given (i) the difficulty, potential trade complexities, and likely displacement impacts of setting up systems to identify virgin from recycled materials and (ii) the policy objective of preserving European resources for future generations.

d. What requirements does it place on relevant players?

The tax on virgin materials will be paid by those extracting them. Higher taxes on virgin raw materials will require the industries/sectors that so far have relied heavily on their use to use these more efficiently and /or identify alternatives to virgin raw materials as inputs into their production processes (e.g., with a preference to recycled materials). While there is an argument for applying the tax also to imports of virgin materials, initial implementation should avoid this, on the grounds of (i) the complexity, possible conflict with trade obligations, and risk of displacement effects associated with setting up a mechanism to distinguish virgin from recycled materials at import, and (ii) the policy objective of preserving EU resources for future generations.

The taxes on landfilling/incineration will increase price on waste incineration and landfilling, and therefore they are expected to conduct the shift from disposal and incineration to recycling.

e. Links, synergies and interlinkages with other instruments within policy-mix

There should be particular synergies with the extended Bonus-Malus scheme and the reduced VAT for environmentally friendly products which should further stimulate the market for products with a high share of recycled material. In addition there are synergies with the measures foreseen in the context of the extension of the Ecodesign directive meant to increase the recyclability of goods as this will increase the extent to which alternatives to using virgin raw materials can be found.

f. For taxes and subsidies: what is the level of the tax or subsidy?

For the sake of this exercise uniform tax rates applying across Europe are specified below. In reality there would still be some level of discretion to account for existing discrepancies in prices across different countries.

The rates of the **virgin materials tax** would initially be low but would increase every year (cf UK aggregates tax escalator for raw materials, from €1.8 in 2002 to €2.28 in 2009 (IEEP 2012) which reflects the average costs of extraction, and the Swedish gravel tax from €0.567 per tonne in 1996 to €1.44 per tonne in 2006, corresponding to 20-30% of the price of a tonne). Therefore for aggregates the UK level of €2.40 per tonne, indexed to inflation (Eunomia and Aarhus University, 2014), could be a good starting point. By 2050 it could reach 50% of the average value of the prices of materials extracted.

Regarding **landfill taxes**, the UK landfill tax also provides a good example (from €54.6 per tonne of active waste in 2010 to €90 in 2014, while inactive waste is charged at €2.8 per tonne)(Ecorys, 2011). In Sweden, the tax has progressively increased as well, from €27.53 in 2000 to €40.74 in 2003 (Swedish Environmental Protection Agency, 2005), and to a further €63 in 2010 (ETC/SCP, 2012)..

When it comes to **incineration taxes**, they should encourage higher recycling rates and provide additional revenues, and rates should evolve in a consistent manner with other residual waste treatments. By 2020, an incineration tax of €15 per tonne is considered to be an effective incentive, given the results attended in best-performing countries – this would be in line with the actual Swedish incineration rate, which is considered to be consistent with rates applied to other waste management treatments (Eunomia and Aarhus University, 2014).

Consideration could be given, for both the landfill and incineration taxes, to have rates that are variable depending on the type of waste. The French “tax on polluting activities (TGAP)”, mainly aimed to discourage polluting activities through the polluter-pays principle is a good example. The TGAP is due by enterprises (natural or legal persons) whose activity is considered a pollutant one: waste, pollutant emissions, oils, detergents, extractive materials, pesticides, chemical products, while its rates depend on the activity they carry and on the type of product they produce (Ministère de l'économie, des finances et de l'industrie, France, 2014), with possible deduction for materials for which landfill stands for the best environmental solution, or materials that could be biologically treated for biogas production or incinerated.

- For tax: Who is to pay it and how are the revenues to be used?

As far as the **virgin or raw materials tax** is concerned, those extracting them would be subject to the tax. For low tax rates and considering the low price elasticity of these materials (-0.22 in the UK between 2002 and 2003, revenues from the tax could eventually be passed on to users of these products, whereas in some cases, local and national authorities will also have to contribute as they represent one of the biggest consumers of construction materials

(ECOTEC, 2001). It may make sense to initially earmark some of the virgin tax revenues to the restoration of former quarries and extraction sites that will close as a result of the reduced consumption rate, while the biggest share of tax revenues would serve lowering the fiscal pressure on labour. The restoration would contribute to EU's objective of restoring 15 % of degraded habitats and avoiding net loss of biodiversity and ecosystem services. For the purposes of the assessment, it should be assumed that 80 % of the tax revenues are used to reduce labour taxes and charges, and 20 % is used for restoration.

As regards the **landfill tax**, this would be paid by waste producers in order to encourage them to produce less waste or to recycle it. The tax should apply to all kinds of waste. Part of this tax could be earmarked for R&D to increase recycling of waste and the use of waste materials for the production of new goods. Besides, the tax could support treating and recycling waste in a more sustainable and resource-efficient way (Swedish Environmental Protection Agency, 2005).

As regards the **incineration tax**, this would be paid by waste incinerators, increasing the incinerator gate fee. In Denmark, its rate increased to €44.4 in 2001, while the landfill tax has also substantially increased, which is in line with waste priorities in the EU (Söderholm, 2011). An initial rate of €15 per ton, in line with the Swedish rate for incineration waste, would be a good starting point for this tax.

A small share of the tax revenues generated by these instruments should be used for the setting up of an institution like the WRAP in all EU MS. Tax revenues beyond this may be used by MS as they see fit.

- For subsidy: How would it be financed?

Not applicable

g. What physical/resource flows (if any) are directly targeted by the policy instrument?

The materials that could be covered by the virgin materials tax would in particular include: marble, chalk and dolomite, slate, limestone and gypsum, sand and gravel, as well as metals (Eunomia and Aarhus University, 2014). The virgin metals tax would also incorporate the proposal for a virgin metals tax from the metals policy-mix. Thus, the flows of metals are also expected to be targeted by the virgin materials tax.

Governance

a. At what governance level should the instrument be deployed?

In order not to distort competition on the Single market and to avoid that waste be traded across countries this should be a Europe-wide tax trio, to be levied/collected by authorities in each EU MS (as seen in the UK, DK and SE examples). The level of discretion for the exact rate needs to be specified. While we assume average tax rates as mentioned above, there may still be discrepancies across different countries to account for the difference in price levels and PPP.

b. What stakeholders should be involved in the negotiations and agreement?

For the virgin materials tax: Resource extraction and waste recycling industries, but also public authorities that sometimes prove to be an influential customer, as it was the case in Sweden (ECOTEC, 2001).

For the waste landfill and incineration tax: waste collection companies, landfill operators and waste incineration plants.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Public authorities will be responsible for the collection of the tax, generally through their taxation ministry or authority (as it is the case in DK, SE and UK, see ECOTEC, 2001). Failure to pay the tax would result in prosecution and a fine. Late payments, misdeclaration, non-compliance or evasion should also be prosecuted.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

Expert groups with individuals from national Ministries who would need to introduce the tax in their national system would be set up in order to prepare the European Framework (legislation) for the introduction of this instrument. Comitology may therefore play an important role in designing and implementing the policy instruments.

e. What is the perceived feasibility and acceptance among key actors?

Implementation will determine transaction costs in Member States. Up-front involvement of MS and relevant sectors in the development of the instruments is expected to increase feasibility and acceptability.

Environmental impacts and effectiveness

The introduction of a virgin materials tax is supposed to have limited direct effects on the environment, as the aggregates levy in the UK has shown (IEEP 2011, Söderholm 2011). On the contrary most of the impacts would come from the reduced amount of materials extracted (potentially leading to the closing of some mines and sites) or from substitutions through other kind of (usually recycled) materials; although it seems likely that global supplies of recycled materials may not respond immediately or in full, leading to some displacement effects. Later using the tax to finance research for reducing the demand for polluting materials, fighting pollution, and encouraging recycling, through a national WRAP (Waste and Resources Action Programme) may also result in longer term indirect positive impacts on the environment (IEEP 2011). The main environmental benefits include the reduction of noise and vibrations, air and soil pollution, waste management, and biodiversity. The Swedish example also showed that there may be some limits to substitutability. Substitution was difficult for some applications (for example playgrounds, mortar, etc.). It is rather consumers' interest for high quality materials that made them turn towards crushed rocks and therefore increase substitutability rates (Söderholm 2011).

As far as the taxes on landfills and on waste incineration are concerned, it would have the advantage of encouraging materials' recycling (in Denmark this has been the main contribution of the combined tax mechanism, since the raw materials tax itself was not very incentivising (IEEP 2011, Söderholm 2011, ECOTEC 2001) and lead to a recycling rate of 95% for construction and demolition waste in 2008 (ETC/SCP 2012). In Sweden, waste entering a waste facility and being taxed halved between 2000 and 2004 (Swedish Environmental Protection Agency 2005). An indirect target would be those industries and individuals that directly or indirectly are affected by the environmental impacts of extraction and transportation of virgin materials, as well as alternative materials' suppliers, as it happened in Sweden through price equalisation (ECOTEC 2001).

Key expected economic impacts

For some materials the UK aggregates tax can account on up to 20% of the average raw material price, €2.33 per tonne of materials being collected in 2011 (Ecorys 2011). The revenues therefore collected can potentially increase the total tax revenue although the primary goal of the environmental tax is not fiscal (0.1% of the total tax revenue in the UK comes from the aggregates levy (IEEP 2011)).

A material tax will generally change the production structure and will influence consumption. A tax on virgin materials' use is also expected to solve some market failures, such as of incorporating environmental externalities in raw materials' prices. In addition, taxes represent a more cost-effective solution towards packaging and waste issues than regulatory legislation, by imposing costs which reflect the external environmental costs and allowing operators to find innovative solutions.

With regards to competitiveness, the impact of such a tax would be strongly influenced by the extent to which the materials which are to be covered by the tax can be imported. Transport and other logistic costs may make some materials unsuitable for long distance trading, and therefore the tax should not procure major disadvantages to the national extractive industries, as assessments of the aggregate levy in the UK and of the materials' tax in Sweden provided (ECOTEC 2001). For the processing, resource-intensive industries however, the measure is expected to lead to loses in their processing capacity and therefore in their investment potential. Despite the disinvestment incentive, introduced system changes would require for new infrastructures to be built. Lock-in risks can therefore rise, which would further limit the potential for developing eco-innovations in the EU (European Parliament 2009).

A tax on landfill or waste incineration would have the benefit to create a playing field for the recycling sector, as it will generally become more attractive to recycle than to dispose of these materials. Thus, landfill and waste incineration taxes could create opportunities for businesses in the recycling and secondary materials sector, whereas overall waste and waste charges are expected to decrease for waste producers (IEEP 2011).

The tax-mix is expected however to have a negative impact on the construction sector since it will make the use of virgin raw materials more expensive. On the other hand, positive effects are expected for the recycling sector because of the incentives to recycling.

Key expected social impacts

Extracting sectors are likely to lose revenues, as previously discussed, which can be compensated by an efficient recycling of the virgin materials tax (as the IEEP study on the UK shows), through back to business transfers. Increases in prices determined by such a tax however, are likely to be passed on to the consumer if tax rates are set too low to compensate for the low price elasticity of demand, and therefore the tax impact on the extractive industry is arguable (IEEP, 2011).

Previous experiences with some virgin materials' taxes (gravel tax in Sweden and aggregate levy in the UK) have shown that the overall labour involved in the industry either remained unchanged given the limited labour market in the extracting sector in Sweden (ECOTEC, 2001), or it was overall positively affected, as funds collected through the tax were generally used for more employment intensive public expenditures or recycled back into the industry in the UK (Ecorys, 2011). On the other hand, it would also contribute to more high quality jobs in the field of recycling (the Tellus Institute estimates that two jobs are created for the recycling

of 1,000 tons of construction and demolition waste), but also in the field of organic farming, retail sales, timber production and tourism, as Friends of the Earth pointed out in Northern Ireland (Friends of the Earth, no date). These less-resource intensive sectors would necessitate the development of new skills. Other social benefits would include public health improvement, especially of population living close to mines (Office of Mine Safety and Health Research, 2010; Vrijheid, 2010), and local economic diversification through the restoration of abandoned mines. There is no evidence however on the impact for industry or households' equity of such a tax, although reduced environmental cost through mines' shutdown would be beneficial for poor populations situated downstream.

4.4.2 EU-wide introduction of feebate schemes for selected products categories

Brief summary of the measure

This measure would be to develop at EU level a common framework for the introduction of bonus-malus schemes across the EU, identifying the specific products for which such schemes should be introduced in the Member States and providing a methodology for setting both bonus and malus at the right level for the schemes to be cost neutral (in particular for accounting for differences in prices across different countries and different price elasticities).

The enhanced Bonus-Malus Scheme proposed here would

(i) imply applying an improved version of the French Bonus Malus scheme on cars across Europe (i.e., rewarding the purchase of smaller, fuel-efficient as well as hybrid and electric cars, and penalising the purchase of large and fuel-inefficient cars; but also applying to a wider range of environmental impacts, beyond GHG emissions - such as emission of other harmful substances and small particles, noise);

(ii) and (ii) be applied to other relevant product categories potentially including products such as batteries and accumulators, paints, detergents, refrigerators etc., based on their different environmental and social impact.

The 'Bonus-Malus' system introduced in France offered a financial incentive for the purchase of low-emitting cars and charged a fee for the purchase of high-emission vehicles and thus entails a system of price reductions and fees depending on the level of emissions of each new vehicle. It pursued a twofold objective. First, it is designed to change consumers' behaviour and encourage the purchase of low-emitting cars and discourage the purchase of the high-emitting vehicles. Secondly, it was created to stimulate technological innovation in new vehicles (Mission Ministérielle 2013).

The enhanced Bonus-Malus Scheme proposed here would be applied to other relevant product categories potentially including products such as batteries and accumulators, paints, detergents, refrigerators etc., based on their different environmental and social impact (ADEME, 2009). The two basic principles remain the same as the French Bonus-Malus scheme, namely to:

- Provide financial incentives for the purchase of low-emitting, environmental friendly products
- Charge a fee for high-emissions and highly resource use appliances (Ecologic institute, 2013).

Apart from the car market, feebates (a combination of fees and rebates) were previously used in Europe and North America to influence consumption towards favouring fuel efficiency,

some food groups, fair trade, nitrogen oxide emissions, and energy efficiency in buildings (Basque Centre for Climate Change, 2014). Recent research was carried out to study the possibility of the extension of these schemes to household appliances in Spain and Canada (Basque Centre for Climate Change, 2014; David Suzuki Foundation, 2007). Encouraging predictions call for an extended scheme to be applied to major household appliances based on their energy consumption, as well as batteries and accumulators, paints or detergents, for which feebates can positively influence offer and demand and therefore change bad behaviours.

The price reductions are to be financed through a dedicated fund covered by the fees charged on the products which have the worst environmental performance. The cost neutrality of the scheme will require carefully taking into account the elasticity of offer and demand when setting the rates of these incentives and fees. Indeed, while the French model was intended to be neutral on public finances, its success has contributed according to some sources to a deficit of €1.46 billion between 2008 and 2011 (WPS 2013).

Brief description of the design and scope

a. When would it be introduced (2020 or 2030)?

This instrument has already proved to be applicable. If developed over the next few years the system could be introduced progressively for different product categories around 2025.

b. What is its aim?

The two basic principles are to:

- Provide financial incentives for the purchase of low-emitting, environmental friendly products
- Charge a fee for high-emissions and highly resource-inefficient appliances and products. (Ecologic institute 2013)

This is expected to:

- Shift consumer demand towards low emissions and highly environmental products
- Encourage producers to develop and supply more environmentally friendly products (CREST 2013).

c. Which economic sectors and point(s) in the lifecycle would the be targeted at?

Different sectors manufacturing products that would be subject to such a scheme would be impacted by the measure and would have a stronger incentive to innovate in order to ensure that their products perform better from an environmental point of view and may benefit from a bonus or at least avoid the malus. A whole range of studies suggest that the household appliances producing industry could be a prime target for such schemes. Other products for which fees and rebates could positively influence their offer and demand and succeed in more environmentally friendly production and consumption patterns could then follow. The measure may well also have impacts over the product's whole lifecycle in the case of, for example, energy-using products, given the incentives provided by energy-savings.

As regards the practical implementation, the point-of-sale of these products could be the one where the bonus on a given product is granted and the malus is collected (which is the case in a whole range of Bonus-Malus schemes in use) (National Energy Policy Institute, 2013). This would ensure that domestic production and imports were treated equally; and that EU exports did not face a price disadvantage.

d. What requirements does it place on relevant players?

Generally, the scheme won't place strict requirements on anyone although consumers purchasing the least performing product within a given category subject to the Bonus-Malus scheme will be expected to pay the "malus".

The requirements that manufacturers will have to meet for their products to be granted the bonus will depend on the specific product and the specific criteria that will be determined for being granted a bonus or being subjected to a malus. Manufacturers will not be requested to strictly adhere to these criteria but will have to take these into account when deciding about the environmental performance they wish their products to achieve.

For the schemes to be set up and managed relevant authorities in the MS might have to be prepared to invest resources, at least in the short run, if the schemes are initially unbalanced and don't achieve cost neutrality. Such costs could however, at least in principle, still be recovered via the schemes in the long run; for example, through the mechanism of a dedicated fund suggested above, Member States might face only a one-off cost of providing working capital. In the event of the scheme proving more – or less – successful than expected in influencing behaviour, the fund could also produce a deficit (or a surplus).

e. Links, synergies and interlinkages with other instruments in the policy-mix

A wider application of Bonus-Malus schemes to relevant product categories and a tax on a range of key raw materials may complement each other. The Bonus-Malus system may be easier to implement as it is meant to be revenue neutral and may therefore face less resistance than ordinary fiscal measures such as taxes. Together with the extended producer responsibility schemes, the virgin materials, landfill and incineration taxes can however ensure that other stages of the product lifecycle are more effectively targeted as well, in particular disposal.

f. For taxes and subsidies: what is the level of the tax or subsidy?

There would not be a single level of bonus or malus for a specific category of products across all the EU. This common EU level framework for the introduction of bonus-malus schemes, which would also identifying the specific products for which such schemes should be introduced in the Member States (at MS level), would provide a methodology for setting both bonus and malus at the right level for the schemes to be cost neutral (in particular for accounting for differences in prices across different countries and different price elasticities).

The Bonus-Malus scheme is in fact a double mechanism; on the one hand a tax on less environmental products in a category, and on the other a rebate or subsidy for more efficient products. It seems clear that the tax element will need to be treated as a fiscal measure, since it is not related to administrative or other costs faced by public authorities, and is clearly based on the objective of reflecting external impacts. The revenues from the tax are intended to finance the subsidy or rebate that is paid. Thus, when setting the level of the tax and the level of the subsidy, attention will need to be given to the elasticity of demand/price elasticity for a given product category, as these will need to be carefully determined and adjustments to the scheme foreseen in order to balance out revenues and subsidies. The National Energy Policy Institute estimated that fees' and rebates' levels that would produce the biggest benefits and would be the most effecting in achieving financial neutrality would be the ones that equal the economy done, for example of average fuel consumption or electricity. This economy is dependent on the technological advances and therefore these levels will fluctuate over time (National Energy Policy Institute, 2013). That level has been estimated to be around

10% of household appliances' value by 2020, and it should progressively diminish (David Suzuki Foundation, 2007).

In France, the Bonus-Malus scheme for cars targeted less polluting cars, benefitting from a price reduction of up to €1000. For the most polluting ones, the fee their owners had to pay amounted to €2600 (CREST, 2013). Although very incentivising, and with some positive environmental impacts (ADEME, 2009), this level didn't prove to be sustainable in terms of public finances (WPS, 2013).

- For tax: Who is to pay it and how are the revenues to be used?

See above

- For subsidy: How would it be financed?

See above

g. What physical/ resource flows (if any) are directly targeted by the policy instrument?

A concrete example would come from the energy using products, especially major household appliances (refrigeration equipment such as freezers, refrigerators and water coolers, stoves such as cookers and microwave ovens, washing equipment such as washing machines, clothes dryers, drying cabinets, dishwashers, and others such as air conditioners and water heaters), commonly referred to as white goods. The assessment should therefore be based on this initial list of products.

As most of the literature suggests these schemes are particularly relevant for energy using household appliances, the main resource flow (indirectly) targeted would be fossil fuels and, in the case of cars, maybe some metals as there would be an incentive to using lighter metals when manufacturing cars (heavier cars use more petrol).

A Bonus-Malus scheme on imported and domestically-produced appliances can be designed to reduce their energy consumption, as well as other environmental impacts (use of hasardous or rare virgin materials, etc.) (National Energy Policy Institute, 2013). The other physical flows will depend on the other product categories to which this product would apply, which in turn depends on the criteria applied.

It must be noted, however, that in practice physical flows are primarily potentially affected in the instances where there is no or only a limited rebound effects (i.e the products aren't used more intensively because they have become more efficient).

Governance

a. At what governance level should the instrument be deployed (EU? MS?)?

In order not to undermine the common market this measure would be a common framework for the introduction of bonus-malus schemes across the EU at EU level, which would identify the specific products for which such schemes should be introduced in the Member States and providing a methodology for setting both bonus and malus at the right level for the schemes to be cost neutral (in particular for accounting for differences in prices across different countries and different price elasticities). The specific rates would have to be fixed depending on the national market for each one of these products given differences in prices across countries and probably differences in price elasticity of demand; although the product coverage should be the same in all MS, and common rules governing the calculation of the tax and the rebate will need to be established.

b. What stakeholders should be involved in the negotiations and agreement?

Member States, consumer organisations, manufacturers and retailers (of the products that may be targeted by the measures) will need to be involved. Scientific expertise and studies will also most probably be required for the design of the schemes at MS level.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Retailers and consumers have some obligations under such schemes, which they need to comply with if the scheme is to work effectively. In addition, Member States' authorities need to make the necessary resources available for such schemes to function. Close monitoring may be necessary to ensure that the revenues can pay for the rebates and the schemes are adjusted over time. Monitoring may also be useful in case prosecution and fines are needed to ensure compliance.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

The system acts as a subsidy and as a tax at the same time, therefore coordination is required, be it only to avoid distortions in the common market. It is assumed (see above) that the measure would be treated as a taxation instrument, and therefore subject to unanimity in Council.

e. What is the perceived feasibility and acceptance among key actors?

Consultation of involved stakeholders is a prerequisite for an effective implementation. The propensity for consumers to buy environmental-friendly products depends on their ability to make financial savings. For producers, their willingness to innovate and enhance products' characteristics depends on the difference between the marginal costs and the marginal benefits their products procure on a market with feebates (National Energy Policy Institute, 2013). A study on the French Bonus-Malus system showed that costumers made a substantial shift towards environmentally friendly classes of vehicles and therefore benefited from a rebate. Consumer may have acted in their own interest, but at least some suppliers were also pleased as the introduction of the bonus-malus scheme also seems to have contributed to boosting car sales (which increased by 13 % (CREST, 2013) but probably also because of a scar scrapping scheme which ran in parallel).

Environmental impacts and effectiveness

An extended Bonus-Malus is best suited to address environmental issues such as greenhouse gas emissions, energy consumption and other pollutant emissions but could probably also account for the toxicity of a product's components or the resource intensity in its production. It could potentially account also for other environmental externalities and impacts. If the right incentives are to be used in order to divert people's behaviour from environmentally damaging activities or products, such a scheme could be effective in reducing overall environmental degradation and resources' consumption. The French model of Bonus-Malus for cars proved to be efficient in reducing emissions' of the car fleet and therefore contributing to fighting climate change (the CO_2 emissions of new cars have decreased by 6 % between 2007 and 2008 according to ADEME). Rebounds effects in the form of increased use of these products that would offset the gains in emissions and resources will have to be avoided through adopting the right financial incentives and correctly setting the level of the discounts but may be difficult to fully avoid, depending on the product category. In the car Bonus-Malus system in France for example, newly registered passenger

cars were targeted by the measure (IEEP et al. 2014), but attractive rebates had rebound effects in the form of increased sales of new cars and therefore of an increasing number of drivers and overall increases in environmental impacts (IEEP at al, 2014). It must be noted, however, that a car scrapping scheme offering financial incentives to scrapping your old car ran in parallel in France and, given it was limited in time, may have contributed to temporarily boost car sales.

Key expected economic impacts

If the rates are not carefully set, the measure can contribute to changes in the consumption and production patterns that are not optimal. The Bonus-Malus system in France for example resulted in increased sales of new cars (CREST, 2013; Callonnec and Sannie, 2009; ICCT, 2011), which should not be the purpose of such schemes as they should be primarily environmentally motivated.

Eco-innovation and competitiveness can also be stimulated if the criteria according to which a bonus or a malus is applied to a good is transparent and manufacturers know which product characteristics they need to improve if they want consumers purchasing their product to benefit from the bonus or at least avoid having to pay the malus. The introduction of the Bonus-Malus for cars in France for example resulted in an increase in the number of patents linked to innovations related to the improvement of the environmental performance of the vehicles (CREST, 2013).

Key expected social impacts

Overall social well-being is expected to increase, as consumption of environmentally friendly products that result in less harm would increase at the expense of products that have adverse effects on human well-being and health. Low-income households should in principle also benefit, as the up-front cost of energy-efficient products will be reduced, making it easier to purchase products with a short payback in terms of energy savings (IEEP et al. 2014): however, in product categories where less energy-efficient products tend to be cheaper, lower income households may face additional up-front costs, and not be able or willing to choose the more efficient products.

4.4.3 Reduced VAT for the most environmentally advantageous products and services

Brief summary of the measure

This measure involves a reduced VAT rate (therefore applying at point of sale, with no impact on exports) of 6 % for the most environmentally advantageous or least resource intensive products and services across a wider range of products and activities, which may include environmentally beneficial works done in the housing sector (renovation, maintenance), some local, labour intensive services and products, and additionally virtual books (European Commission, 2008a), organic products, etc., for which policy instruments in the form of EU environmental standards (Ecolabel, EU energy label) already exist or could be easily introduced. In the long run, this is expected to:

- Increase resource efficiency in the production of these products and the delivery of these services (incl. the use of recycled materials where possible);
- Lead to products that have been designed to allow for an easier recycling;

- Provide energy savings throughout their lifecycle for energy using products;
- Result in a virtuous cycle that will speed up the process of withdrawal from the market of less efficient products and services.

In order to make this measure practicable it will have to build on existing practices and instruments. It is proposed to link the reduced VAT to the European Ecolabel[8] (IVM et al. 2008) (which itself may be subject to further changes to (1) better account for product's environmental impacts throughout the lifecycle (2) eligibility rules should regularly become more and more tightened and (3) apply to a broader range of consumer goods), and the EU energy label (reduced VAT could therefore apply to A+++ rated electronic equipment). For consumer electrical goods, this instrument would work alongside the feebate mechanism also proposed, and should provide additional incentives to manufacturers to continuously improve energy-efficiency (or other relevant environmental parameters) in order to benefit from the reduced tax rate. Products (and services) having been awarded the European Ecolabel or the highest A+++ grade in the EU energy label would benefit from the reduced VAT rate of 6% in all MS. This reduced VAT rate would also apply to electricity from renewable energies, installation of energy saving materials and equipment/retro-fitting of people's homes (including insulation materials), and a selected number of services such as retrofitting of household appliances in order to make them more energy efficient, hotels/tourist attractions (which can already be ecolabelled), or environmentally beneficial locally labour intensive services such as local transport, repair, refurbishing, etc.

Reduced VAT rates are already regularly used in MS all across Europe to pursue a wider range of objectives and this new environmental measure would be approved following the same procedures[9]. In the area of environment, some EU MS actually already apply reduced VAT rates linked to the energy consumption of households' appliances (i.e., to particularly energy efficient appliances), and most importantly, to public transport. 21 out of the 28 EU MS currently apply a rate which is lower than the recommended 15% standard VAT rate, for public transport (European Commission, 2014b). In those countries, amenities from using more public transport are obvious, and include environmental and economic efficiency, reduced congestion, less GHG emissions and lower local air pollution (Green Budget Europe, 2011). Studies proved that such a reform of the VAT system does not compromise revenues raised, but would rather shift the tax base towards more environmentally damaging products, according to the polluter pays principle (European Commission 2013a, Oosterhuis and ten Brink 2014).

Brief description of the design and scope

a. <u>When would it be introduced?</u>

A consensus between Member states would not be easy to achieve, especially at a time when most EU Member States are desperately looking for new sources of income. We do,

[8] The EU Ecolabel helps you identify products and services that have a reduced environmental impact throughout their life cycle, from the extraction of raw material through to production, use and disposal. More info here: http://ec.europa.eu/environment/ecolabel/index_en.htm

[9] Reduced VAT for restaurants in France, reduced VAT on fuels for heating in the UK, reduced VAT on renovation of old buildings in Belgium, reduced VAT on public transport in some MS…

however, assume here that this problem can be overcome and that, in the context of a broader tax reform, new sources of income would be identified (e.g., financial transaction tax, harmonisation of company taxation across EU allowing taxing the benefits like large groups such as Amazon or Google, etc.). Thus, the instrument could be introduced around 2025. If the unanimity requirement is thought to be a barrier it may be an option to use the open method of coordination (OMC) up to 2030 (in the context of which countries which would engage in this open coordination would be allowed to introduce the lower VAT rates even if this would result in some trade distortion across EU MS).

b. What is its aim?

The aim of this instrument would be to stimulate consumption of environmentally advantageous products and services, or of least resource intensive ones through lower VAT rates on products and services which meet higher environmental standards.

c. Which economic sectors and point(s) in the lifecycle would be targeted at?

All suppliers of goods to the EU market that are targeted at the end-consumer (and that therefore would be eligible for the European Ecolabel) would be targeted by the measure in the sense that they would be encouraged to change their production processes and products in order to be awarded the Ecolabel, or for electronic equipment, the highest ranking of the EU energy label, in order to benefit from the reduced VAT rate. The measure could also target some locally-supplied environmental-friendly services (such as public transportation, provision of locally source catering) which require a larger amount of labour for their delivery. The points in the product lifecycle which are targeted by this measure are closely linked to the criteria for the award of the Ecolabel: the idea is that the European Ecolabel would over time fully account for all impacts across the lifecycle, while some services will focus on one particular point in the lifecycle (such as the use of public transport).

d. What requirements does it place on relevant players?

The requirements would broadly in principle be the same as those required to be awarded the European Ecolabel (which themselves may be subject to change in order for the requirement to become more stringent over time). Improving products' and services' footprints would generally require their creators to innovate in order to foster resource efficiency. However, compliance costs are expected for businesses and tax authorities, especially for borderline cases, which will induce additional costs and resources' consumption (European Commission, 2007).

e. Links, synergies and interlinkages with other instruments in the policy-mix

The links to other taxes need to be further elaborated. For the time being, we assume that for some product categories (e.g., cars, white goods), Bonus-Malus schemes (and normal VAT rates) are better than the reduced VAT rates as the Bonus-Malus scheme is thought to be even better suited for shifting consumers' behaviours towards purchasing more environmental friendly products for particularly expensive goods. As this is however thought to be more onerous administratively, this will be limited to the product categories where environmental impacts over the lifecycle are particularly important and the Ecolabel typically has not been used.

f. For taxes and subsidies: what is the level of the tax or subsidy?

Although strictly speaking it is the end consumer which will pay the reduced VAT, the direct costs to the measure will have to be borne by public authorities who would see the revenues

from VAT somewhat reduced and would need to seek compensation for the revenue forgone. One option for compensating would be to increase the normal VAT rate at the same time as the reduced VAT rates are introduced. However, given that imposing constraints on funding the measure could make it more complicated to secure unanimous agreement in Council, for the purposes of the assessment it should be assumed that Member States will face a free choice on how to fund the shortfall, and will raise general tax levels by a small amount to compensate.

- For subsidy: How would it be financed?

This measure can be considered a subsidy. As mentioned above, one option to compensate for the revenue forgone, is to raise the normal VAT rate by 0.5 percentage points (or any amount thought to potentially compensate for the revenue forgone); although we assume that it will be for individual Member State finance ministers to make these choices.

g. What physical/resource flows (if any) are directly targeted by the policy instrument?

In principle this may affect a wide range of material flows which are linked to the production of products, as they will determine its final environmental impact. Reduced VAT rates will also concern goods imported from outside the EU, but they will not concern exported goods. The European Ecolabel tends to require a reduction in the use of the most harmful substances as product components. Hence, this measure may reduce the flow (extraction, use) of these types of product inputs in particular, whether they are imported or supplied domestically. Imported or domestically used flows of goods beneficiating from reduced VAT could be expected to have reduced impacts on air, land and water compared to the standard product in the same product category. In terms of outputs, reduced VAT for environmentally-sound products and services (e.g., having been awarded the European Ecolabel or the highest A+++ grade in the EU energy label) are expected to reduce GHG emissions and, to some extent, also contribute to reducing the quantity of waste generated in an economy as a whole range of ecolabelled products are made out of recycled materials or can be more easily recycled.

Governance

a. At what governance level should the instrument be deployed (EU? MS?)?

The measure would be introduced (i.e., adopted) at European level but implemented concretely at MS level (where responsibility for collecting taxes such as VAT lies). The reduced VAT rate should be the same across all MS to prevent trade distortion across the common market, especially for cross border sales and distance sales. A coherent application of the measure across Europe is also expected to increase incentives to invest in innovation in order to bring about products that may qualify for the European Ecolabel or for the highest grade under the EU energy label (Copenhagen Economics, 2008).

b. What stakeholders should be involved in the negotiations and agreement?

It will of course be key to bring Member States on board given the impacts that the measure may have on their finances and more specifically tax authorities. Actors involved in the implementation of the European Ecolabel will also need to be involved in the preparation and design of the measure in order to clarify how the two measures could be made complementary and how the Ecolabel could meet the necessary requirements to become one of the decisive factors for the application of the reduced VAT rates.

Building on existing procedures for the award of the Ecolabel but reflecting the new (economic) implications behind the award of the Ecolabel, an independent body may have to be set up in order to ensure the relevance of the criteria for the award of the Ecolabel and their strict application.

Finally, negotiations would also require the participation of those actors involved in the delivery of environmental-friendly services that would be targeted by the measure.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

The reduced VAT rates would have to be implemented by Member States' authorities. Failure to implement the measure once it has been adopted at EU level would lead to the Commission initiating infringement procedures against MS not implementing the reduced VAT rates on the ecolabelled products and other environmentally-friendly services and products.

Producers wishing to be awarded the Ecolabel will also be responsible for complying with the criteria. If the criteria are revised, they will have to remain compliant with the new criteria if they want to continue to be awarded the Ecolabel and benefit from the associated VAT reduction.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

Tax distortions risk undermining the level playing field in the single market. As a consequence, activities that are subject to VAT would risk not being treated equally across different MS. Within a single market, better relative prices which do not reflect production costs anymore, may induce a consumer to buy one product instead of another, even if it is not its first choice in terms of perceived satisfaction (Copenhagen Economics, 2007). To avoid these distortions, coordination would therefore be necessary in two ways: first, at the policy design and implementation level, using the comitology procedure, and later following the same principle decided for the VAT Information Exchange System[10], a system allowing customers to check which businesses and products beneficiate from such VAT rates in the EU. Distortions would not exist however in the case of locally-supplied services.

e. What is the perceived feasibility and acceptance among key actors?

The European Commission tends to push for a reduction of goods that benefit from a reduced VAT as the measure can sometimes be used as a protectionist instrument for labour intensive activities. Given the Commission's traditional reluctance in using reduced VAT rates as an

[10] A VAT Information Exchange System (VIES) designs a computerised information system allowing companies to easily and rapidly obtain information about their trading partners in the EU and administrations to monitor intra-Community trade flows. More information about the VIES is available here: http://ec.europa.eu/taxation_customs/taxation/vat/traders/vat_number/index_en.htm

instrument this proposal would therefore have to be pushed hard by a critical mass of Member States if it was to go through. In addition, depending on the decision-making procedure applying to these changes, a broader support for this measure would be needed within the European Parliament. However, in its recent communications, the Commission gave guidelines on products and services that could beneficiate from a reduced VAT rate in the EU. Some of those have clear environmental benefits, such as the housing sector (maintenance, renovation), local labour-intensive services (renovation, repair, transport), and virtual books (European Commission, 2008a).

Environmental impacts and effectiveness

A reduced VAT for environmentally advantageous products and services could be useful to reduce a range of adverse environmental impacts including in particular a reduction of greenhouse gas emissions, water use and quality and use of other specific resources which go into the production process. The reduced VAT rates would also mean that the full VAT rates applying to the non-eco-labelled products or services would, to a certain extent, reflect the adverse environmental externalities associated with the consumption of goods which have a higher environmental impact.

The instrument's effectiveness depends on:

(1) the extent to which consumers will respond to marginal changes in prices and hence the instrument's capacity to change people's purchasing decisions;
(2) The extent to which there may be a rebound effect - either direct (i.e., consumers buying more of the same product) or indirect (i.e., the money saved through the reduced VAT rates will be spent on other goods). This raises the question of the price elasticity of the products that may benefit from such a reduced VAT;
(3) The extent to which this new measure will create additional incentives for companies to invest in R&D to bring about products that meet the criteria of the European Ecolabel or that qualify for the products with the hightest grade in the EU energy label.

In addition, to assess the impacts of this measure, it will be important to look into ex-post assessment of the environmental impacts of the implementation of the European Ecolabel which would constitute a basis for extrapolation. It can be expected that this measure would not only accelerate the rate at which environmental impacts are reduced but also result in a higher diffusion of low environmental impact products and thus in a significant reduction on a wider range of environmental impacts.

Key expected economic impacts

The costs of this measure to the governments, in terms of forgone revenues, will depend on the overall value of the goods benefitting from reduced VAT being purchased. According to Copenhagen Economics, the average tax loss from lower VAT rates than the standard rates accounts for an average of 0.9 % of GDP, with cross-country variations. On the contrary, advantages in terms of welfare, productivity and GDP related to extending reduced VAT rates to sectors whose services can normally easily be substituted by do-it-yourself or underground work and therefore distracting high skills professionals from productive labour supply are seen in all Member states (Copenhagen Economics, 2007).

The economic benefits would mostly come from a higher rate of innovation in Europe generating products that are more competitive on the global market. This could therefore, in the long-run, increase Europe's exports to the rest of the world, especially as resources

become scarcer and their prices increase and the cost of labour across the world converges. This could reflect in positive trends as regards GDP growth and employment in Europe in the long run.

Thus, reduced VAT rates will also provide incentives for eco-innovation and knowledge-based resource efficient growth (Seely, 2013).

Administrative costs: Linking the introducing of reduced VAT rates to the already existing European Ecolabel as well as the EU Energy label (only for highest grade A+++) is thought to limit additional administrative-burden and create fewer inconveniences to both consumer and retailers than other direct subsidies or similar incentives.

Experience with reduced VAT for environmentally friendly products in EU MS proved that the changes in relative prices of such products would change consumer behaviour and encourage environmentally sound purchasing decisions. Price signals would be given for energy and resource efficient products if they are properly communicated, while pay-back times for more expensive energy-efficient products could be reduced (IVM et al. 2008).

Key expected social impacts

Energy-related spending constitute a big part of low income households' budgets (4.8% of lowest income quintile's budget is spent on energy in the EU-27 compared to 3.0% for the highest income quintile in 2005, according to Eurostat) that is why their incomes will be positively influenced through reduced prices of certain essential goods and services or through purchases of 'good' products that can actually increase their welfare level (Seely, 2013).

Income distribution may in particular benefit if a lower VAT rate would make goods that are mostly used by low-income groups more affordable. The consumption share of this group should also be stable and different from that of high-income groups, otherwise distributional effects will be minimal. This is the case for food, electricity and heating, for which low income groups generally spend twice as much of their total income than high-income groups (Copenhagen Economics, 2008). This is not the case however for the designed policy instrument, as the tightening Ecolabel standards will contribute to scaling up innovative solutions, and high-income households will tend to benefit, as they tend to be early adopters. In the longer run however, the promotion of eco-efficient goods and services will conduct to lower operational costs and therefore they will become more affordable to lower-income households.

Additional social benefits would come, with the introduction for example of a reduced VAT rate for local transport, from reduced congestions and lower levels of pollution.

4.4.4 Boosting extended producer responsibility

Brief summary of the measure

Following the recommendations of the European Resource Efficiency Platform (EREP), the Waste Electrical and Electronic Equipment directive (WEEE) (renewed Directive 2012/19/EU), the End-of-Life Vehicle (ELV) directive (Directive 2000/53/EC), the Packaging and Packaging Waste Directive (Directive 2005/20/EC amending Directive 94/62/EC) and the Battery and accumulators Directive (Directive 2006/66/EC) would be revised in an effort to further optimise enhanced producer responsibility.

The Extended Producer Responsibility (EPR) provides incentives to manufacturer for better product design and for setting up more resource efficient business models. The EPR schemes also encourage waste management solutions through the internalisation of the negative effects of waste resulting from end-of-life products.

The producers' responsibility proposed here would be extended to the entire lifecycle of a selected range of products (therefore including their take-back, recycling or disposal) to decrease total environmental impact of those products (EREP 2014, Hislop and Hill 2011). In 2013, such schemes were already in use in several Member States (Bio by Deloitte and al. 2014). For a few products categories EPR schemes are in place in all MS (e.g., batteries, electronic and electric appliances) while for other products only a handful of MS have put EPR in place. Although for long lifespan products, assigning responsibilities is more challenging, children's toys and construction materials could also be considered potential candidates (IIIEE 2006). Products which are not covered by EU Directives but for which such schemes have effectively been introduced in selected MS will be considered priority products to which such EU-wide schemes should be applied.

Under the new Extended Producer Responsibility (EPR) programmes, industry would have the full responsibility (including costs) for the disposal of packaging and other materials associated with the product it puts on the market. As for the other schemes already in place, this is expected to lead to the integration of the environmental costs associated with the goods throughout their lifecycle into the final market price of the products. They would therefore provide incentives to the producer for designing more sustainable, less toxic and more recyclable products (Aldersgate Group, 2011, p. 10).

Brief description of the design and scope

This new policy instrument would introduce an enhanced producer responsibility scheme (i.e., building on lessons learnt from existing schemes) which would apply to a selected number of products. In the EU, EPR schemes have been implemented at EU-wide level for sectors such as Batteries, WEEE, Packaging and Vehicles (as shown in the Table 5 below). These EPR schemes have been introduced to all the MS of the EU.[11]

[11] Data on the EPR implemented for End-of-Life Vehicles (ELV) in Malta was not available.

Table 5: Products for which EPR schemes are already in place in all EU MS

Sectors	EU Member states for which EPR exists	Materials	Environmental Impact	Economic Importance/ Scarcity
Packaging (Waste Packaging Directive 94/62/EC)	AT, BE, BG, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, RO, SE, SK, SI, ES, UK, HR (total 28 MS)	Metals (Steel, aluminium)	High (economically critical and CO2 intensive)	
		Glass	N/A	Low
		Wood/paper	High	Moderate
Electronic & electrical equipment (WEEE Directive 2002/96/EC)	AT, BE, BG, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, RO, SE, SK, SI, ES, UK, HR (total 28 MS)	Metals (rare earths, copper, iron, tin, aluminium)	High (economically critical, CO2 intensive and potentially toxic)	
		Plastics (Polystyrene-based polymers and polypropylene)	High	Moderate (related to oil prices)
Transport (ELV Directive 2000/53/EC)	AT, BE, BG, CY, CZ, DK, EE (only takeback obligation), FI, FR, DE (only takeback obligation), GR, HU, IE, IT, LV, LT, LU, NL, PL, PT, RO (only takeback obligation), SE, SK, SI, ES, UK, HR (total 27 MS)	Metals (steel, aluminium, copper)	High (economically critical and CO2 intensive)	
		Plastics (Polyethylene, polyurethane)	High	Moderate (related to oil prices)
Batteries (Battery Directive 91/157/EEC)	AT, BE, BG, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, RO, SE, SK, SI, ES, UK, HR (total 28 MS)	Metals (nickel, lithium, cadmium)	High (economically critical and highly toxic)	

Sources: PSI et al. (2014), TNO (2013), Ellen Macarthur Foundation (2013), DG ENTR (2014), Mani (2012)

Products for which EPR schemes have been put in place in a handful of MS would be considered for the introduction of a Europe-wide requirement for EPR and where analysis suggests a Europe-wide scheme would be relevant and practicable it would be introduced. An important aspect to take into consideration is the extent to which a product can be economically re-used at its end-of-life. The products/sectors that are likely candidates for the introduction of new EPR schemes are likely to include: **Tyres**, **Graphic paper**, **Medical waste**, **Oils** and **Agricultural films**, for which EPR has already been introduced in at least eight MS of the EU (Table 6). EPRs for particular waste streams (waste containing asbestos, pesticides and furniture and office equipment) have only been implemented in single MS (as indicated in Table 7). For the purposes of the assessment, it should be assumed that tyres, graphics paper, medical waste, oils, and agricultural films will be covered by an initial expansion of the scope of EU EPR legislation. The question of whether further products should be brought into the scope will be answered following evaluation of the impact of this initial expansion.

Table 6: EPR schemes implemented for specific waste streams in at least 8 EU MS

Product/Sector	EU Member States for which EPR exists	Materials	Environmental Impact	Economic Importance/ Scarcity
Tyres	AT, BE, BG, CY, DK, EE, FI, FR, IE, IT, LV, LT, NL, PL, PT, SE, SK, SI, ES, HR, HU (product fee legislation only) (total 22 MS)	Rubber	Moderate (land consumption and pressure from emerging market)	
		Chemicals	High (economically critical and strong environmental impact)	
Graphic paper	AT, BE, CY, DK, FI, FR, LV, LT, NL, SE, SK (total 11 MS)	Paper and Wood	High	Moderate
		Chemicals (ink)	High (contamination)	Moderate
Medical Waste	AT, BE, EE (only take-back obbligations), FI, FR, PT, RO, SE, SK, SI, ES, HR (total 11 MS)	Medicines	High	N/A
Oils	AT, BE, CY, DE, LV, PL, PT, SI, ES, HR (total 10 MS)	Mineral-based Industrial oils (Lubrificants, gearbox oils, Synthetic and waste oils)	High (economically critical and strong environmental impact)	
Agricultural Film	BE, FI, FR, DE, IE, IT, SE, ES (total 8 MS)	Plastic (polyethylene)	High	Moderate (related to oil prices)

Sources: BIO by Deloitte et al (2014), PSI et al. (2014), Ellen Macarthur Foundation (2013), Skole and Brent (2009)

The implementation of EPR schemes would be boosted thanks to the introduction of appropriate Standards. An example could be Canada, which has introduced a common standard bottle[12] for beer and soft drinks. As the majority of the brewers have adopted the standard, nowadays almost two-third of sold beers are distributed through reusable bottles. The introduction of the standard has helped the industry to reduce costs and has also paved the way for the Canadian government to implement an EPR (Ellen Macarthur Foundation 2013).

Table 7: EPR schemes implemented for particular products in single MS

Product/Sector	EU Member States for which EPR exists	Materials	Environmental Impact	Economic Importance/ Scarcity
Asbestos	HR	Asbestos	High (Toxic material)	Low
Furniture	FR	Metals (Aluminium and Steel	High (economically critical and CO2 intensive)	
		Plastics	High	Moderate (related to oil prices)
Office Equipment	FR	Metals (rare earths, copper, iron, tin, aluminium)	High (economically critical, CO2 intensive and potentially toxic)	
		Plastics (Polystyrene-based polymers and polypropylene)	High	Moderate (related to oil prices)
Pesticides	SL	Chemicals (Hazardous and obsolete pesticides)	High (on groundwater)	Moderate

Sources: BIO by Deloitte et al (2014), PSI et al. (2014), Ellen Macarthur Foundation (2013), Lubomir, Macaev and Biana (2013)

While collective responsibility schemes may initially be allowed for a transition period, producers' individual responsibility schemes would be preferred over collective responsibility

[12] the Standard Mould Bottle (SMB)

schemes, as these have proven to be more effective in delivering design change. Collective responsibility sometimes has not sufficiently stimulated investments in product design. The most likely explanation for this is that collective schemes mutualise costs, producers of goods paying an average cost for waste management. In this way eco-design is not incentivised anymore as it cannot be effectively internalised in the cost of each product. Moreover, the concentrated market structure of Producer Responsibility Organizations (PROs) tends to make them overly strong players in the waste management market, ultimately acting at the expense of fair competition and dialogue (Bio by Deloitte et al. 2014).

The proposed programmes would draw on lessons learned from existing schemes such as those outlined in OECD's publication "*Extended Producer Responsibility: A guidance manual for Governments*" (OECD 2001), which has identified several guiding principles for an effective enhanced producer responsibility program including the creation of incentives for producers to incorporate innovation since the design phase, a lifecycle approach with clear product specific responsibilities, clear communication and consultation strategies, a comprehensive evaluation of the programme, compliance mechanisms and full transparency (Brady 2003).

The extended producers' responsibility would act in support of the implementation of the European Waste Hierarchy, for increases in prevention, reuse and recycling (Bio by Deloitte et al. 2014).

Successful elements of the WEEE would be reproduced and its limitations addressed. The WEEE directive tries to facilitate dismantling and recovery, reuse and recycling of electrical and electronic equipment waste through innovations in design and development and therefore reduce end-of-life management costs. It details the implementation of recovery and treatment processes through allocating responsibilities for the final stage of the lifecycle of a product; it imposes designing and manufacturing that minimise environmental impacts, along with limits to the undue use of resources, energy and induced pollution (WEEE, 2008). Risks associated with the WEEE directive which the proposed programmes would include: high level of uncertainty, lack of awareness, misinterpretations of current take back schemes when manufactures use take-back requirements to impede valuable second-hand products to reach the reuse market, and the fact that it can only be a long run proposal.

As is the case with existing EPR schemes nowadays the newly introduced schemes would not only apply to EU-produced goods, but also imported goods would be targeted by these schemes. Exported goods would not be affected.

a. <u>When would it be introduced (2020 or 2030)?</u>

The Commission's work programme for 2013 indicated for the following years a review of EU's waste policy and legislation. In June 2014, the European Commission (2014c) published a communication on the circular economy (COM(2014)398), accompanied by a legislative proposal to review waste-related targets in the European Union, which emphasised the importance of setting minimum operating conditions for implementing effective EPR schemes across the different MS of the EU.

The work to include additional products in the scope of the ecodesign could be carried out over the next few years and found its way in EU legislation by 2020 given the announced review. By 2025 the schemes for the additional product categories could be in place in the MS.

b. What is its aim?

This policy instrument tries to develop an enhanced and expanded producer responsibility scheme for a various range of products for which such schemes appear to be most suited to effectively enhance the environmental performance of the products, namely for products for which EPR schemes exist in some Member states, as well as for children toys and construction materials.

Therefore the overall aim of these new extended producers' responsibility schemes would be to provide incentive for producers to take into account environmental considerations along the products' life, from the design stage until end-of-life in view of internalising environmental externalities and producing products which can be more easily recycled.

c. Which economic sectors and point(s) in the lifecycle would be targeted at?

Product manufacturers as well as distributors and importers would be the main target of the instrument. Additionally, the measure would affect waste treatment facilities and consumers. Indeed, an extended producer responsibility scheme would affect product management, from the manufacturing phase and up to end-of-life. Special attention should also be given to the use phase of the products, through consumer information and incentives towards separate collection coming both from the business sector and administration. The Belgian and Portuguese experiences with recycling systems have shown that raising consumer awareness towards separating packaging waste was a determinant factor in implementing these schemes (Marques et al. 2013).

d. What requirements does it place on relevant players?

An EPR scheme gives producers responsibilities during the entire lifecycle of a product, and especially in the stages of take-back, recycling and/or final disposal of the product. In some cases, producers decide to implement obligations from EPR schemes collectively, through Producer Responsibility Organisations, which in exchange of a fee, will take responsibility for dealing with discarded products. Under current EPR schemes, this is compulsory in Germany, while in France this method is optional (Da Cruz et al. 2014). Given the drawbacks of this method (lack of incentives for eco-design for example), individual responsibility would be preferred within an extended EPR scheme. Differences in types of responsibility, cost coverage, technical and economic reporting requirements and procedures would however need transparency on economic indicators and technical performance requirements (Bio by Deloitte et al. 2014).

Authorities, for their part, need to develop goal-orientated informative, administrative and economic instruments (Okopol, 2007). This includes clearly identified definitions of EPR schemes and objectives along the whole lifecycle, following a true costs principle, as well as surveillance over the economic and technical data, in collaboration with industries (Bio by Deloitte et al. 2014).

Generally, EPR would normally encourage a change in behaviour of all actors involved in the product value chain: manufacturers, retailers, consumers, citizens, public authorities, public and private waste management operators, recyclers, social economy actors (Bio by Deloitte et al. 2014).

To illustrate allocation of responsibilities in the context of producer take back schemes: in the context of the WEEE directive Member States, producers and third parties acting on their behalf and that are responsible for the collection, treatment, recovery and environmental

disposal of products are given a responsibility to finance, label, organise, collect and provide information (Ecologic and IEEP 2009).

e. Links, synergies and interlinkages with other instruments within the policy-mix

Enhanced Producer Responsibility and a developed Eco-design directive with more Lifecycle assessment requirements are mutually reinforcing, as both instruments work to protect the environment through better design. Their complementarity comes from the fact that while the minimum requirements on the life-cycle performance integrates recyclability, durability and sourcing requirements, from an early stage of the life-cycle to its end, the WEEE directive and implicitly the Extended Producer Responsibility should pursue concentrates on innovations in design and development that will later facilitate end-of-life management.

According to research done by the Institute for Prospective Technological Studies, when it comes to incentives to eco-design, the Eco-design Directive may actually be preferred by some companies over an enhanced producer responsibility as it is stated by the WEEE directive.

f. For taxes and subsidies: what is the level of the tax/subsidy?

Not applicable.

- For tax: Who is to pay it and how are the revenues to be used?

Not applicable.

- For subsidy: How would it be financed?

Not applicable.

g. What physical/resource flows (if any) are directly targeted by the policy instrument?

A manufacturer should adopt a system-wide view in order to understand the full implications of its products (Brady Kevin, 2003). This includes looking beyond the manufacturing processes and also account for the impact on the environment and resource use implied by the input materials, the suppliers, energy options, transportation, distribution, and end of life of the products. Environmental issues therefore become a way to reduce costs, maintain market access, gain competitive advantage, and finally increase revenues.

The precise flows would be determined by the specific categories of products that are to be included into the scope of new producer responsibility schemes.

For the time being, given the nature of the products to which producer take back already applies at the European level, this has large implications for metals used in cars and batteries, for which resources are limited and non-renewable in a lifetime. Expensive metals such as cobalt and nickel could be found in substantial amounts from Lithium–ion and Nickel–cadmium batteries. Reintroducing these materials back into the circle at the end-of-life of products instead of landfilling or incinerating them, would also allow manufacturers to catch the recycling potential (Espinosa and Mansur, 2012).

Governance

a. At what level scale should the instrument be deployed (EU? MS?)?

Effective EPR schemes would need comparable information between operators on the market, which supposes transparency on which economic indicators and technical performance companies have to comply with. As great discrepancies in performance

indicators at MS level would be ineffective a common EU framework setting at least minimal requirements would appear more effective (Bio by Deloitte, 2014).

As regards the implementation at MS level a slightly different approach better reflecting lessons learnt from past schemes (i.e., other EU Directives introducing producer responsibility) would be adopted. For example, consideration would be given to transfer their obligations for product take-back to Producer Responsibility Organisations would only be possible for a transition period but not in the long run, given this approach has proven to be less effective in meeting the objectives.

At the same time, EU final users and retailers could both play an important role for boosting the implementation of EPRs schemes. The establishment of a compliance scheme (based on a similar scheme used in Germany for packaging waste) could be enacted, by paying consumers whom return their WEEE to a collection point (Wiesmeth and Häckl, 2011). This would establish an economic incentive for final users to increase collecting rates and implementing a refund scheme based on the degree of "recyclability" of the product would also stimulate producers to improve the design of their products (Wiesmeth, 2012). Mandatory take-back arrangements could also be established to incentivise both suppliers and final retailers, in case certain products (e.g., magazines, bread) remain unsold (European Commission 2014d).

b. What stakeholders should be involved in the negotiations and agreement?

Stakeholders that should be involved in the design of an enhanced producers' responsibility scheme would be national authorities responsible for implementing the Directive in Member states, as well as individual producers, producer compliance schemes (or organisations), trade associations, consumer organisations and recycling and waste management companies (Okopol, 2007).

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Through specific design features or processes, producers could actually prevent that materials and products are taken back, reused, refurbished or recycled. Member states would be responsible for taking the appropriate measures in order to ensure this doesn't happen, unless such particular features prove to be on the contrary beneficial for the environment or necessary for safety requirements (Okopol, 2007).

In addition, awareness raising campaigns and public willingness to participate should be a priority in order to reach the overall long term objectives, as Bio by Deloitte identified on their study on actual EPR schemes. These should indeed help consumers recast social norms and behaviour as far as necessary for well-functioning EPR schemes.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

There are many requirements for an effective coordination of the instrument and the EU can create a framework for those requirements to be in place across all the MS:

- Share of responsibility and dialogue: definition and objectives of EPR should be clearly identified along the whole product's lifecycle
- Cost average and true cost principle: costs should cover at least the cost of the waste that has been separated, as well as administrative, reporting and communication costs related to the treatment of end-of-life products. Eco-design costs could also be internalised, so it would offer incentives for good environmental practices.

- Transparency and surveillance over the economic and technical data that needs to be harmonised at European level. Surveillance is necessary for ensuring traceability and reducing environmental impacts related to the treatment of waste. Authorities and industry alike would be involved in the monitoring and surveillance of EPR schemes (Bio by Deloitte 2014).

e. What is the perceived feasibility and acceptance among key actors?

Participatory democracy is needed in order to give high legitimacy to decision-making. Member States would be left with some scope to decide the details of the implementation. For example, as compliance imposes different and sometimes substantial costs to the business sectors, for a transition period, producers may be allowed to transfer their obligations for product take-back to Producer Responsibility Organisations but this would be limited in time given this system performs less well.

Environmental impacts and effectiveness

Extended producers responsibility would have positive impacts on the environment, as it would reduce waste and raw material consumption. The full implementation of the WEEE directive is estimated to result in a 131-340 kilotons of lead (Pb) reduction per year in the EU (Arcadis et al. 2008), while in 2007, 28 tons of platinum and 31 tonnes of palladium were recovered worldwide from automotive catalysts, which represents almost 15% of the global mining production (UNEP 2009). Implementation of the ELV directive also led to a reduction of over 50.000 tonnes of waste oils and other fluids in the EU per year (GHK 2006). Better designed products could also consume fewer resources and energy. As the scheme foster reuse and recycling, the overall pressure on natural resources such as water, biodiversity and soil might diminish. Greenhouse gas emissions (GHGs) are also reduced by means of innovation and eco-design during the entire lifecycle of a product. Environmental sound design to facilitate dismantling, reductions in the level of hazardous substances used and the amount of recycled materials used are side effects of the measure (Ecologic & IEEP, 2009).

In particular, the WEEE directive reduced negative externalities on the market originated from the discarded electrical and electronic equipment, while at the same time improved the overall social well-being through reduced greenhouse gas emissions and recycling. The directive also imposed to the EU member states a collecting target of 4 kilograms of electronic waste for recycling per capita per year by 2020. The WEEE also includes compulsory requirements regarding aspects of innovation and competition (e. g. the removal of certain substances from the manufacturing process) and a Producer Responsibility Principle which connects producers to the end-of-life phase of their products (Arcadis et al. 2008, p. 230). It must be pointed out, however, that the scope of the directive means that many products are not covered and that these benefits are somewhat limited: the directive is currently limited to the private households' goods and business goods are currently excluded from its scope (Hislop and Hill, 2011, p. 19).

The European Commission (2014a), in its latest communication on the circular economy, also indicated that financial support schemes implemented within the framework of the EPR, could be important drivers to be used for mitigating the environmental impact the littering of plastics.

Key expected economic impacts

Enhanced producers' responsibility should lead to growth, eco-innovation and increased competitiveness, as over the next decades more actions will be needed to reduce pressure on resources and to increase in resource efficiency. (Ecologic and IEEP, 2009). Several companies (e.g., Siemens) have registered lower production costs for their eco-products (Arcadis and RPA, 2008, p. 231).

According to data provided by a report published by TNO (TNO, 2013) there are substantial economic opportunities to be captured within the circular economy. A study carried on by TNO in 2013 has highlighted that in the Dutch economy alone, extensive reuse and recycle of metal and electrical products (e.g., home computers, televisions, mobile telephones and measuring equipment) would provide an additional annual added value equivalent to €2,9 billion (TNO, 2013).

Key expected social impacts

Efficient resource use through the entire lifecycle of a product would normally lead to increased environmental and health benefits. Innovation and the treatment of waste can also foster employment and local jobs opportunities, as a 2009 Ecologic and IEEP report pointed out for Belgium (Ecologic and IEEP, 2009). In terms of equity (income distribution and inequalities), an EPR scheme would have a minor role though providing enhancements in products' durability, which is an important purchase decision factor for low-income households. The development of the necessary skills and expertise to enable this expansion of employment opportunities to be realised would be facilitated by the skills enhancement programme also proposed in this policy mix.

The implementation of enhanced EPR schemes could also have an effect in terms of waste shipments and recycling. If refunds and the fees are set properly, illegal shipments of waste should diminish, as the companies might have more incentives in reusing and recycling better-designed products (Wiesmeth 2012).

4.4.5 Skill enhancement programme

Brief summary of the measure

The EU develops (a) a strategy for mainstreaming resource efficiency aspects into relevant academic and vocational curricula (economics, engineering, marketing, architecture, design, business accounting, land management, craftsmen, etc.) and (b) conceptual frameworks for training for professionals to develop skill and techniques relevant for implementing resource efficiency measures in existing firms or developing new business models. The Strategic Energy Technology (SET) Plan Roadmap on Education and Training could provide a useful blueprint (European Commission / Joint Research Centre 2014).

It is important to address both white collar and blue collar jobs. Therefore, the skill enhancement programme will have to have targeted programmes, contents and design for (i) professionals and leaders responsible for strategic decisions, implementation of innovations, etc, and (ii) broader programmes which provide workers with "green" skills suitable for the new business models. Thus, both the necessary changes on managerial and leadership level can be initiated as well as the swift reallocation of workers can be organised which is a necessary part of the decoupling.

The skill enhancement programme could (partly) be financed by revenue from the circular economy tax trio.

Brief description of the design and scope

a. When would it be introduced (2020 or 2030)?

In order to unfold its effects as soon as possible given the time needed to educate the next generation of academics, professionals and blue-collar workers, as well as to reach out to established professionals, the instrument would be introduced at the earliest possible date (realistically by 2020).

b. What is its aim?

The aim of the instrument is to embed systems thinking on resource use and efficiency as well as environmental impacts into relevant academic and vocational training in order to equip the next generation of academics and professionals with the ability to recognise resource efficiency potentials as well as options for exploiting them. In addition to knowledge transfer, the second aim is awareness raising about the need to think more long-term.

Similarly, training professionals that are already on the job has the same aim, but a shorter time-frame as it may take more immediate effect among already established professionals.

c. Which economic sectors and point(s) in the lifecycle would be targeted at?

With economics, engineering, architecture, design, craftsmanship, etc. as focus areas of mainstreamed resource efficiency curricula, all sectors and also all stages of the life-cycle (engineering, design and economics for extraction, processing, manufacturing, marketing, recycling) are targeted.

d. What requirements does it place on relevant players?

Relevant business and sectoral associations need to be engaged into discussions on their skill needs in light of resource scarcities and planetary boundaries. Universities, chambers of commerce, vocational training institutions, companies should be encouraged to consider systems thinking in their curricula and trainings and to be more open towards changes to long-standing, traditional curricula development processes.

e. Links, synergies and interlinkages with other instruments in the policy-mix

Compulsory reporting on resource efficiency issues at company level could benefit from implementing mainstreamed resource efficiency thinking into academic and vocational training as such training will foster sustainability oriented mindsets and thinking and hence foster acceptance of and increase need for such reporting from company employees and top-management. However, assuming that the next generation of trained academics and professionals will be more inclined towards sustainability issues due to skill enhancement, the initially compulsory reporting may no longer be needed to be compulsory after some years.

f. What physical/resource flows (if any) are directly targeted by the policy instrument?

The instrument is a supporting instrument. It does not directly target physical flows.

Governance

a. At what level scale should the instrument be deployed (EU? MS?)?

EU standard setting as regards the scope of the skill enhancement would be beneficial in order to achieve harmonised training contents. In addition, the EU can provide funding and a

platform for best practice exchange. Given the large diversity in education systems and industrial structure, the implementation should nonetheless rest with the Member States.

b. What stakeholders should be involved in the negotiations and agreement?

Industry associations, universities, chambers of commerce, vocational training institutes, resource efficiency agencies, professional trainers.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Not applicable.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

Coordination at EU-level would be beneficial to ensure harmonisation of education and training standards, but implementation and detailed design could be left to Member State level.

e. What is the perceived feasibility and acceptance among key actors?

In principle, skill enhancement should both be politically feasible and accepted among addressed stakeholders as it is a future-oriented measure helping increase future-proofing and competitiveness. However, in order to get significant planetary boundary and systems thinking issues embedded into curricula which previously had not integrated that at all needs longer-term exchange and commitment from those setting up the training content.

Environmental impacts and effectiveness

Reduction of environmental impacts, increase of resource productivity and also likelihood of fostering alternative business models will increase through skill enhancement. The actual effect on impacts and resource use are difficult to quantify, but the measure can serve as a support to ease the implementation of the circular economy policy cluster.

Key expected economic impacts

Skill enhancement will increase resilience of the economy and increase likelihood of adaptation to emerging opportunities, as new business models, technologies, pay-back and investment cycles come into existence. The skill enhancement programme could partly be financed by revenue from the material input tax (Metals Policy Mix) and the circular economy tax trio (overarching policy mix).

Key expected social impacts

Additional skills relevant for improved resource efficiency can increase companies' competitiveness as well as the workers' individual career opportunities resulting in higher employment levels and increased wages.

This requires, however, in-depth assessment of the existing skill gap towards decoupling technologies, processes and services and a close, continuous monitoring of the labour market development in order to minimise (i) the mismatch between prevailing and needed skills as well as (ii) the time-lag between skill needs and skill enhancement programme impacts.

4.4.6 Local currencies for labour-based services

Brief summary of the measure

The instrument entails the expansion of the use of alternative local currencies within communities for labour-based services. The alternative currency is initially distributed within the community, and then traded for local services negotiated in prices based on the currency. These services can include, for example, haircuts, cleaning, gardening, hosting, cake-baking, vegetable growing, chicken and egg rearing, child-care, care for the elderly, chauffeuring, public space improvements, equipment and auto repairs. As these trades are untaxed, this serves to make the local services more affordable, compared to products. The parts of the services that require material goods would be paid for in the usual currency.

Accumulation of the alternative currency would be made public - and so provide an alternative status metric to consumption. A person's balance of alternative currency could stand as a measure of social contribution - because it shows that they are working for the community. This provides an additional alternative to earning in the formal economy as a route to deliver status and well-being, and so gives people options to achieve well-being through reducing paid working-hours. The currency would be electronic (cf. bitcoin) to allow for an automatic update of each person’s balance of the currency.

Brief description of the design and scope

a. When would it be introduced (2020 or 2030)?

Start supporting local currencies from 2020 onwards to establish service markets and prepare the ground for citizens to get used to options for building their own service-oriented capacities and skills.

b. What is its aim?

This instrument aims to reduce the demand for products and services that require metals and other materials. Its objective is to shift the focus a) of people's time from traditional production to alternative routes to well-being, and b) from consumption of products to consumption of services, which, in general, require less material input.

c. Which economic sectors and point(s) in the lifecycle would be targeted at?

The measure targets the purchase and delivery of services to final, primarily to final consumers.

d. What requirements does it place on relevant players?

Each person would be obliged to keep track of his own accumulation of the currency, and to report errors found in the transactions.

e. Links, synergies and interlinkages with other instruments in the policy-mix

No evident link or synergy.

f. For taxes and subsidies: what is the level of the tax/subsidy?

Public support would be required to get the system up and running. This support includes both investments in the necessary technology and the management of a central system for control and administration. In addition, public finances will suffer from having no tax revenues for any of the transaction with the local currency. We assume that 0.5 % of GDP is dedicated for covering the costs and tax-revenue losses of this system.

- For tax: Who is to pay it and how are the revenues to be used?

The costs of the system will be covered by an increase in the local and national income tax on households. The distribution of the tax increase will be the same as the already existing local tax.

However, as the local currency is a voluntary system, it should be decided on the local community level (incl. the municipality) whether or not the entire municipality or only a specific part of it will be using local currencies. As the latter is the more complicated system in relation to administering a fair and just income tax increase, the local currency could be offered to entire municipalities and be decided by local councils/citizens debate and representation based on knowledge of the associated income tax increase (and what it means in numbers to all households wanting to take part) whether or not to vote for having the offer to all.

g. What physical flows (if any) are directly targeted by the policy instrument?

All products that are used for final consumption in the areas where the local currencies are established.

Governance

a. At what level scale should the instrument be deployed (EU? MS?)?

Municipal and/or Member State level

b. What stakeholders should be involved in the negotiations and agreement?

National and local authorities.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Not applicable.

d. Is it important and technically necessary is it to coordinate the instrument at EU-level?

Coordination at EU level is not important.

e. What is the perceived feasibility and acceptance among key actors?

Public acceptance is likely to be good. However, as the local currency is a voluntary system, it should be decided on the local community level (incl. the municipality) whether or not the entire municipality or only a specific part of it will be using local currencies. As the latter is the more complicated system in relation to administering a fair and just income tax increase, the local currency could be offered to entire municipalities and be decided by local councils/citizens debate and representation based on knowledge of the associated income tax increase (and what it means in numbers to all households wanting to take part) whether or not to vote for having the offer to all.

When this is implemented, likely no heterogeneous municipality would be ending up voting in favour of an offer for local currencies in order to prevent the income tax increases. Therefore, administering it on a much more confined scale, such as a sub-urb or district of a municipality, would be necessary for acceptance. But then, the income tax increase would have to apply only to those taking part in the system – requiring some form of administrative solution to the income tax levying and therefore putting a likely additional burden on public administration and raising administrative costs. Here, it could be evaluated whether linking participation in the local currency system to some sort of income tax notification so that the administration has a clear list of participants whose income tax to increase. While this would make the

burden sharing fair and just and hence increase public acceptance, it might undermine institutional and political acceptance.

Environmental impacts and effectiveness

The shift in consumption from material goods to labour-based services is likely to reduce the energy-intensive production of materials and the associated environmental impacts. The shift in focus from traditional production to alternative routes to well-being is likely to increase these environmental benefits.

Key expected economic impacts

The formal economic growth, as measured in the traditional currency, is likely to be reduced by this instrument. On the other hand the labour-based services funded by the alternative currency will add a half-informal component to the total economic activity. The volume of labour-based services is likely to increase. The production of material goods is likely to decrease due to reduced competitiveness in two ways:

- Sales of material goods in the area with local currency will be less competitive compared to labour-based services, because the latter are untaxed.
- Production of material goods in the area will be less competitive compared to production elsewhere in the world because labour taxes will be increased to cover the costs and revenue-losses associated with the local currency.

Key expected social impacts

The social impacts are difficult to predict.

4.4.7 Enabling shift from consumption to leisure

Brief summary of the measure

This strategy measure aims at exploring policies to encourage reduced working hours (either in form of part - time or as sabbaticals). Among other measures it could include examination of longer statutory vacation times, dismantling of discrimination of part-time workers, the introduction of flexible wage records and reductions of the fixed cost of labour that currently disfavour part-time posts (e.g., in employee taxation and administration).
Policies enabling part time work exist in various forms in many EU Member States, particularly in France, Germany and the Netherlands. The EU could initiate a debate by comparing effectiveness and economic impacts of these policies and setting out options in a communication.

Brief description of the design and scope

a. <u>When would it be introduced (2020 or 2030)?</u>

The measure is likely to be met with strong opposition. A first step can only be a public debate before 2020 laying the ground for voluntary labour market reform activities in Member States around 2025 (deciding on whether or not to introduce mandatory changes in the coming decades). In the 2030ies an EU framework could follow.

b. What is its aim?

One of the strongest drivers for environmentally-harmful consumption is the availability and affordability of consumption. Induced behavioural changes are unlikely to compensate for the increasing possibilities of consumption afforded by increases in productivity that reduce prices relative to average incomes (see, e.g., Jackson 2009). Another driver appears to be the sticking to unsustainable habits due to perceived lack of time to consider alternatives or acquire the skills necessary for a new, more sustainable practice and increased consumption because it is convenient or quick due to lack of time (see, e.g., Shor 2010).

Opting for increases in leisure instead of increases in income could address both drivers mentioned above. Evidence shows that on average leisure time pursuits tend to be associated with lower GHG emissions than work or consumption activities (Druckman et al. 2012). A shift from income to leisure thus holds the potential to decrease consumption levels compared to a business-as-usual scenario with continually rising incomes.

c. Which economic sectors and point(s) in the lifecycle would be targeted?

The measure would potentially affect all companies with employees in all economic sectors. In practice, reducing work time might be easier put in practice in some sectors than in others. As described above, resistance is likely across sectors and stakeholders which underlines the need of encouraging voluntary work time reductions rather than using mandatory regulation. The public sector is likely to be more affected (as the evidence from Scandinavia shows). Similarly, workers and positions lower in the hierarchy are likely to be more suited for part-time work than management positions.

d. What requirements does it place on relevant players?

Given that the measure has an exploratory character, no direct requirements would ensue before 2030. After intense debate, measures such as longer statutory vacations, longer parental leave, job protection for employees opting for sabbaticals or part-time work, schemes that allow workers to save parts of their income for later career breaks or part-time work, standards avoiding the discrimination of part-time workers or more sophisticated approaches of time rights over a work life (Pullinger 2014, 16f.) would oblige employers to comply starting in 2030. The instrument would therefore be primarily regulatory, in most cases changing existing labour legislation, preferably by harmonising it EU-wide. It could be combined with additional financial incentives, for example state support in times of parental leave or while caring for elderly relatives or tax credits.

e. Links, synergies and interlinkages with other instruments in the policy-mix

The measure has synergies with the attempts to restrict advertisement and marketing because both aim at addressing social norms and mindsets leading to continually growing levels of consumption. It would also work best in combination with economic instruments aiming at internalising environmental costs such as a resource tax, since price levels that correctly reflect environmental impacts would provide an incentive to spend the additional free time gained in activities with low environmental footprints.

f. What physical/resource flows (if any) are directly targeted by the policy instrument?

The instrument is a supporting instrument. It does not directly target physical flows. If coming to full fruition, it has however the potential to significantly reduce resource flows associated with the purchase, use and disposal of consumer goods and services.

A small body of research using household expenditure and time use survey has provided empirical evidence that on average shorter working hours correlate with lower carbon footprints (Devetter and Rousseau 2011, Nässen and Larsson 2010, Pullinger 2011, Druckman et al. 2012) and lower ecological footprints (Hayden and Shandra 2009, Knight et al. 2013). The correlation also holds when comparing total hours worked in an economy with overall energy consumption as Rosnick and Weisbrot (2006) have shown in a comparison of Europe, Australia, the U.S. and Canada. The effect is mainly due to lower affluence which correlates with lower footprints.

The environmental benefits is likely to be at least partly offset by indirect or rebound effects:

- Shorter working hours can make the labour force more productive per hour at work. This means the production, salary, consumption and emissions will all decrease less than the working hours – at least down to a certain amount of working time, beyond which productivity and hence income will reduce more significantly.
- The additional leisure time could be spent on production at home: baking, sewing clothes, carpentry etc. Since the raw materials for such activities are cheaper than the finished products, the total use of raw materials might not decrease even if affluence does.
- As the reform makes labour less abundant, producers might increase the use of machinery, electricity and fossil fuel as a substitute for labour. This could potentially offset the environmental benefits completely and even result in an increase in carbon emissions, depending on the technology used, etc.

Based on the empirical findings and the discussion on rebound effects, one could thus assume that total resource consumption by households decreases in a determined proportion, which is less than 1 to 1, to work time reduction. Based on the most conservative scenario used by Rosnick and Weisbrot (2006) for energy consumption, one could for example use the assumption that every 1 % of working time reduction per worker results in a 0.32 % reduction of resource consumption.

In addition to potentially affecting the total volume of goods and services consumed in a household, changes in working time might also alter the composition of consumption. This effect is more difficult to track and evidence is not conclusive so far (Pullinger 2014, 12). The composition of consumption could, as an approximation, be assumed to remain unchanged.

Governance

a. <u>At what level scale should the instrument be deployed (EU? MS?)?</u>

The EU can initiate a debate, but policies are most appropriate on MS level given the singularities of national work time regimes.

b. <u>What stakeholders should be involved in the negotiations and agreement?</u>

Business associations, worker unions, NGOs, social movements.

c. <u>For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?</u>

Not applicable.

d. <u>Is it important and technically necessary to coordinate the instrument at EU-level?</u>

See above.

e. What is the perceived feasibility and acceptance among key actors?

The measure is likely to get strong opposition out of fear that the Commission or national governments might limit working time via strict regulation. Also, in many Member States that still are severely affected by the economic crisis, increasing employment is the prime aim. Enabling part-time work might be perceived as being at odds with this agenda. Initially, the measure should therefore focus on public debate and exploration.

Environmental impacts and effectiveness

Initially no direct environmental impacts are to be expected. In the longer term, a substitution of additional income by leisure could reduce the consumption of consumer goods and services and reduce the associated resource flows. It has the potential to effectively address the rebound effects since it limits rises to affluences counteracting gains in available income due to efficiency improvements.

The level of effectiveness depends on many factors, such as the wage arrangements that go with the reduction in work-time and the average environmental impacts associated with the leisure activities chosen. The latter can also be affected by the policy itself insofar as it could give particular incentives to reduce working time for caring activities (for children or the elderly) or voluntary work – both of which tend to be linked to lower ecological footprints than other leisure or work activities.

Key expected economic impacts

The expected economic impacts are reduced total working hours compared to the reference case. The impact on productivity needs to be examined.

Key expected social impacts

Overall, work time reduction has the potential to positively impact wellbeing since it can be shown that the activities related to high levels of subjective wellbeing such as strong social relations, creative and meaningful activities are time-intensive (Pullinger 2014). This being said, a number of conditions need to be met. Working time reductions should not endanger appropriate living standards for any social groups. Any working time reduction accompanied with decreases in total wages should be voluntary. Historically, working time reductions have been achieved without overall wage reductions, since productivity gains (and to some extent also capital gains) have been translated into an increase in leisure time rather than higher incomes (Shor 2008, 165f.). Potentially, work time reductions could also help to distribute paid work more evenly across society, thereby reducing the negative health effects of both unemployment and overwork (Coote et al. 2010, p. 18)

Also, accompanying policies might need to enable people to use additional free time in a way that increases rather than decreases their wellbeing.

4.4.8 Step-by-step restriction of advertising and marketing

Brief summary of the measure

A rough estimate of total marketing spent in the EU is 360 billion Euro per year. By comparison, EU governments spend an estimated 0.03 billion Euro per year on campaigns for sustainable behaviour.[13] Given marketing's and advertisement's significant role in stimulating consumption levels and fostering values and norms of consumerism, it appears more promising to use regulation to introduce step-by-step restrictions on advertisement than employing limited public funds to run sustainable behaviour campaigns.
However, political opposition against marketing restrictions is likely to be strong. Therefore, DYNAMIX proposes the following step-by-step approach:

- Increasing compliance with and further developing voluntary codes of conduct, including inter alia with respect to non-declared advertisement (e.g., product placement in films and television content), advertisement strategies portraying goods as leading to status and popularity increase (for more detail see Alexander et al. 2011);
- Building on and extending existing regulation with respect to alcohol and cigarettes, marketing targeting children[14], and visual pollution in city centres[15];
- Using synergies with other societal goals, particularly the improvement of public health or the preservation of historic monuments (which can be an additional arguments against billboards in city centres) by building partnerships with policy-makers and stakeholders in these fields;
- Using existing EU law on misrepresentative claims to strengthen the commercial and environmental value associated with developing an environmentally beneficial product or service;
- Funding consumer or citizen organisations to bring legal action against misleading marketing that wrongly suggests a pro-environmental association[16];
- Moving towards restrictions of advertisement on luxury goods linked to conspicuous consumption;

[13] The second figure is based on an extrapolation of UK expenditure.

[14] Currently, five EU countries have strong restrictions on advertisement of high-sugar, salt and fat foods and drinks to children, and others have codes of conduct (e.g. EU Pledge not advertise products to children under 12 years by 15 companies, including Coca-Cola, Burger King, Ferrero, General Mills, Kellogg's, Mars, McDonald's Europe, Nestlé, and PepsiCo) with varying degrees of effectiveness.

[15] Examples include bans in Sao Paulo (Worldwatch Institute 2013) and Hawaii (Institute for Local Self-Reliance 2009), as well as restrictions and initiatives to introduce them e.g. in Los Angeles (Raza 2011) and Paris (Varela 2011).

[16] Article 6, Unfair Commercial Practices Directive, 2005/29/EC: "A commercial practice shall be regarded as misleading if it […] in any way, including overall presentation, deceives or is likely to deceive the average consumer, even if the information is factually correct, and … is likely to cause him to take a transactional decision that he would not have taken otherwise".

- In order to catalyse action on the municipal and national level, the EU could issue a communication analysing the state-of-play and suggesting measures, while at the same time providing forums or using existing institutions such as the Covenant of Mayors to diffuse best practices.

Brief description of the design and scope

a. When would it be introduced (2020 or 2030)?

Since the measure foresees a step-by-step approach building on bottom-up action from the municipal level, national legislation and EU support, its introduction would span several years. Provided that bottom-up diffusion combined with national action is fruitful, an EU regulation with minimum standards could follow starting with restricting unfair advertisement, advertising targeted a children and advertisements in city centres by 2020. Then, the focus could be expanded step-wise to sugar/fats in 2025 and to selected luxury goods linked to global social responsibility (e.g., blood diamonds) by mid 2030.

b. What is its aim?

Restricting advertisement can help to dampen the prevalence and strengths of consumerist values in society which often counteract efforts aimed at spreading sustainable consumption practices. Restrictions on marketing and advertisement targeting children would be particularly effective given the lasting impact of commercialisation of childhood on consumer choices throughout an individual's lifetime (Linn 2010).

In addition, legal action against misleading environmental associations in advertising could increase the credibility and exclusivity of green claims, which in turn my lead to a stronger association between pro-environmental attributes and positive, underlying motivational factors of social contribution, justice, social acceptance, exclusivity and status. The widespread association of these factors repeatedly portrayed by pervasive marketing could play a role in re-enforcing both pro-environmental purchasing and the underlying social norms which promote other pro-environmental behaviours.

c. Which economic sectors and point(s) in the lifecycle would be targeted?

The measure could have indirect effects on all consumer goods and a limited number of services (e.g., tourist industry). In a first phase, the sectors where advertisement restrictions might be the least controversial are sweets and sugary drinks for children, fast food, and luxury goods such as jewellery, sport cars or high end fashion. From a pure environmental perspective, it would be advisable to focus on the most resource-intensive products and services.

d. What requirements does it place on relevant players?

The food and drink industry as well as producers of luxury goods will face restrictions on where and how they can market their products.

e. Links, synergies and interlinkages with other instruments within the policy-mix

The measure has a synergy with the working time reduction measures insofar as both instruments aim to reduce interlinked pressures to consume, often describe as the work-and-spend cycle (Schor 1998). A correlation between rising per-capita spending on advertisement and working hours supply has also been shown empirically even though more detailed research is needed on the underlying causality (Alexander et al. 2011, 21f.).

f. What physical/resource flows (if any) are directly targeted by the policy instrument?

The instrument is a supporting instrument. It does not directly target physical flows. Through decreased incentives to consume, it does however aim to reduce production levels particularly of highly processed food and luxury goods and thereby reduce the resource flow associated with the production, use and disposal of these goods.

Governance

a. At what governance level should the instrument be deployed (EU? MS?)?

National- and local-level regulation appears to a promising first step which – if successful – could build the momentum for EU-level minimum standards after 2020.

b. What stakeholders should be involved in the negotiations and agreement?

Affected industries, advertisement and marketing industry, consumer protection agencies, academics, particularly psychologists, sociologists, nutrition experts, city planners, health insurance companies.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Fines are needed to ensure compliance. The level needs to be defined in the respective municipal or national regulation.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

EU action can serve as catalyst and provide the platform for best practice exchange, for example in forums like the Covenant of Mayors.

e. What is the perceived feasibility and acceptance among key actors?

The measures will face stiff opposition from the affected industries as previous debates about consumer information have demonstrated. The advertisement and marketing industry is also certain to oppose the measure since it threatens to decrease turnover. Municipalities and cities aiming for billboard-free public space will face revenue losses due to foregone lease payments.

Environmental impacts and effectiveness

The concrete environmental impacts are difficult to quantify because many factors include purchase decisions of which marketing and advertisement is only one. However, we could attempt to compare consumption levels in countries with restriction on advertisement compared to countries with liberal rules as a gauge for future impacts.

The paradigm shift away from a focus on conspicuous and ever spiralling consumption (“Keeping up with the Joneses”) can be a crucial means for enabling sustainable consumption practices to spread more widely to all societal groups.

Key expected economic impacts

The affected industries are likely to face reductions in sales. Depending on the stringency of the regulation in place, the advertisement industry’s turn-over may decrease. However, if regulation would be targeted only to the most resource-intensive goods, a mere shift in turn-over composition is more likely.

Key expected social impacts

Less pressure to consume is likely to result in better health and increased social well-being, particularly for poor people that suffer most from status competition and vulnerable consumers such as children (with respect to children see Ipsos-MORI and Nairn 2011). Moreover, higher quality of public spaces through reduced visual pollution also benefits low-income groups disproportionally since they are more dependent on public spaces for recreation than richer people.

Negative impacts for the advertisement industry, including loss of well-paid jobs, may lead to negative social consequences for employees in the field. However, this would only apply if advertisement budgets go down in absolute terms. The measures proposed are more likely to result in a shift of advertisement spending on different products or different target groups or media.

4.4.9 Minimum requirements for life-cycle performance

Brief summary of the measure

This measure would entail expanding the scope of products covered by the Ecodesign Directive and addressing a wider range of environmental impacts throughout a product's life-cycle by adding design requirements relating to material efficiency. These could be incorporated through additional criteria related to durability, recyclability, sustainable sourcing of materials and packaging requirements, etc. This measure could be achieved in the context of a revision of the Ecodesign Directive (2009/125/EC) on energy, water, and other resources' use, which is considered an important part of the EU strategy on Integrated Product Policy (European Commission 2003). As suggested in the Ecodesign Working Plan 2012-2014 proposed by the European Commission (European Commission 2012b) additional requirements will only be included in the scope as far as they are "feasible and add value".

Figure 9: Steps of a Life cycle analysis. Source: The European Platform of Life Cycle Assessment

The Eco-design Directive is already meant to cover the entire life cycle of a product, but just for energy related products. In addition, the life cycle assessment carried out only partially accounts for the impacts that arise at the beginning and at the end of the life stage (extraction of materials, depletion of resources, effects on land and biodiversity, air pollution, health

related diseases, etc.). An enhancement of the requirements for life-cycle performance would require all these aspects to be assessed rather than only the use phase of a product (European Commission 2014d).

Brief description of the design and scope

As stated above, the Eco-design Directive currently primarily covers energy-related products and their energy consumption once in use (Rohn et al. 2011), but the scope of the ecodesign could be expanded so as to:

a) Fully account for energy use throughout a product's entire lifecycle.
b) Cover a wider range of products beyond domestic energy using equipment.
c) address environmental impacts beyond energy use through the introduction of new performance criteria would be introduced in order to account more fully for the different types of environmental impacts of products across their lifecycle and ensure that they be addressed through better product design. This may include the ban on adding certain substances (e.g., phthalates and PVC in Denmark) which undermine the recyclability of products or represent a health risk (Mazza et al. 2013).

As regards b), the scope of the Eco-design directive would be expanded so as to include in particular more non-domestic equipment (which are currently excluded from the list of the Ecodesign directive) (European Commission 2014d). As the Eco-design directive has particularly focused on domestic product groups (e.g., dishwashers), a lot of potential still remains untapped for a significant range of non-domestic or Business-to-Business products such as: commercial refrigeration, motor systems (e.g., lifts or elevators) and heavy duty vehicles (Global View Sustainability Services, 2011). Table 8 below indicates commercial equipment which would be covered under the scope for the Ecodesign directive, while Table 9 indicates the potentials for additional household products which would be covered under the Ecodesign directive.

In particular, other groups of products such as heavy-duty vehicles (e.g., trucks) could yield potential improvement through labels and eco-design (European Commission 2014d). A report released in 2012 by the European Commission (2012b), highlighted an indicative list of "priority products" groups: Thermal insulation products for buildings, commercial refrigeration and heating and lighting controls systems (e.g., Smart Appliances/meters). A continuously expanding list of products should be carefully assessed, because if environmental impacts are already covered by "horizontal" rules (e.g., REACH and RoHS) the ecodesign directive should not overlap with previous directives and regulations.

Table 8: Potential commercial equipment and products which could be covered by the Ecodesign directive

Products used for commerical purposes to be covered by the Ecodesign Directive	Expected Savings	Included in the First Eco-Design Working Plan (2009-2011)	Included in the Second Eco-Design Working Plan (2011-2014)	Adopted to date	Comments
Heavy Duty Vehicles (e.g. trucks and buses)	**High*** **	NO			
Auxiliary equipment for Vehicles (e.g air conditioning and ventilators)					
Electric Bycicles	**Low*** **				Not regulated, but small environmental impact
Laundry Driers	**Low** (e.g. 0,1-0,4 TWh/year by 2020)*				
Refrigerators	**Moderate** (e.g. 12-16 TWh/year by 2020)*	YES	NO	NO	Addressed only for **Households**but not for **Commercial** users through Commission Regulation No 643/2009
Freezers					
Televisions	**Moderate** (e.g. 43 TWh/year by 2020)**			Partially	Energy requirements for Televisions were approved before the implementation of the LED Technology. Expected savings for **Commercial** and **Household** users
Thermal Insulation products for buildings	**High** (e.g. 1500 PJ/year by 2030)**	NO	YES	NO	Saving caluclated for both Households and Commercial users. Possible cross-linkages with the Energy Performance of Building Directive (2002/91/EC)
Window products for building	**High** (e.g. 785 PJ/year by 2030)**				Preparatory studies are currently ongoing. Expected savings for **Commercial** and **Household** users
Taps and Showerheads	**High** (e.g. 885 PJ/year by 2030)**				
Complex and simple set-top box	**Moderate** (e.g. 9 Twh/year by 2020)***		NO	NO	Industry VA in place
Enterprise Servers and Data centers	**Moderate** (e.g. 135 PJ\year by 2030)	NO	YES	NO	
Power cables	**Moderate** (e.g. 20 Twh/year by 2030)**	YES	NO	Partially	Preparatory studies are currently ongoing. Expected savings for **Commercial** and **Household** users

*Wuppertal Institute (2010), **VHK (2011),***Ecofys (2014)

Sources: PSI et al. (2014), Ecofys (2012), Ecofys (2014), European Commission (2012), VHK (2011), Coolproducts (2010), Ecofys (2014b),BIO et. al (2014)

Table 9: Potential additional household equipment and products which could be covered by the Ecodesign directive

Products used for household purposes to be covered by the Ecodesign Directive	Expected Savings	Included in the First Eco-Design Working Plan (2009-2011)	Included in the First Eco-Design Working Plan (2011-2014)	Adopted to date	Comments
Game Consolles	**Low†**	NO	YES	NO	Industry VA in place. However, If no action is taken, the electricity consumed by game consoles in the EU could grow as much 50% by 2020*
Imaging Equipment	**Low***	YES	NO	NO	Industry VA in place
Professional Dishwashers, dryers and washing machines	n\a	NO	NO	NO	Working Document released by the EC
Mobile Phones	**Low** (e.g. 12,8 PJ\year by 2030)**	NO	YES	NO	Difficult to calculate savings due to the changing performance of products. Expected savings for **Commercial** and **Household** users

*Wuppertal Institute (2010), **VHK (2011), †Coolproducts (2010)

Sources: PSI et al. (2014), Ecofys (2012), Ecofys (2014), European Commission (2012), European Commission (2014), Coolproducts (2010), Ecofys (2014b),BIO et. al (2014)

a. When would it be introduced (2020 or 2030)?

Article 21 of the Eco-design Directive gives the possibility to extend the scope of the directive also to "non-energy-related" products, in order to reduce the pressure on the environment (EU 2009). In the context of the EU Action Plan for the Circular Economy (COM(2015) 614 final), the Commission outlines plans to "emphasise circular economy aspects in future product design requirements under the Ecodesign Directive" (p. 4 of the Action plan). The Commission intends to systematically examine "issues such as reparability, durability, upgradability, recyclability, or the identification of certain materials or substances […] on a product by product basis in new working plans and reviews […] (ibid.). An Ecodesign working plan, foreseen for publication in 2016, will then detail further how this will be implemented. Against this background, minmum requirements for life-cycle performance should be introduced by 2020.

b. What is its aim?

The aim is to extend the scope of the Ecodesign directive in order to:

1) Expand the list of products covered by the Ecodesign Directive, in particular by including appliances beyond domestic equipment (see above) and additional product categories (also products that are not energy using).
2) Include other criteria (beyond energy use of energy using products) (Global View Sustainability Services, 2011), especially relating to banning toxic substances and to increasing material efficiency (linked to product durability, recyclability, sustainable sourcing of materials and packaging requirements, etc.).

Additional criteria better accounting for the overall lifecycle impacts could for example aim to extend the average lifetime of products by 50% by 2025 (more durable and have increased operational lives) and environmental impacts over the lifecycle (including production and discard) divided by at least two.

However, care will be given to ensuring that the criteria do not lead to inefficiencies such as disproportionate administrative burdens, unnecessarily misleading information, and policy misappropriation when other existing instruments proved to be better prepared to challenge environmental impacts (e.g., REACH, regulation on pesticides residues, IED directive, etc.).

This measure will ultimately lead to improvements to goods and services through:

- Lower environmental impacts
- Reduced resources consumption across the entire life cycle (EPLCA 2014)

c. Which economic sectors and point(s) in the lifecycle would be targeted?

The instrument applies to the entire lifecycle of a product. Therefore, it will target virgin materials extraction and transformation, manufacturing and distribution sectors, consumption and end of life through recycling, re-use, recovery and disposal (EPLCA, 2014). This suggests that, while the primary target would continue to be the manufacturing sector, the new criteria relating to earlier stages in the lifecycle (e.g., only certified/recycled/sustainably harvested materials to be used for the production of a given good) would result in possible implications across the supply chain and call for cooperation across the supply chains of targeted products in order to achieve the required increase in environmental performance (ECOFYS 2014).

d. What requirements does it place on relevant players?

Producers of a larger range of products may be requested to collect and report a larger amount of information on the environmental performance of their products across their lifecycle (linked to the new/additional performance standards set). Suppliers may be required to provide information certifying their product's conformity with material efficiency requirements as laid out in the (revised) Ecodesign Directive. When an existing legislation already envisages some of these requirements however, it may be appropriate to keep them under the previous framework legislation, unless an added value can be obtained (ECOFYS, 2014a).

Finally, public authorities may have to proactively push for the development of new/additional certification programmes and monitoring schemes in some areas order to ensure that manufacturers are provided with the necessary information allowing them to find materials in the supply chains which make it possible for their products to meet the new standards.

e. Links, synergies and interlinkages with other instruments

Setting minimum performance requirements for an increasing number of products is closely linked to boosting extended producer responsibility. Satisfying those minimum requirements on materials would require better waste management solutions, better designed products and services, recyclability and remanufacturing business models, whose emergence is also expected to be driven from the development of extended producer responsibility schemes.

f. What physical/resource flows (if any) are directly targeted by the policy instrument?

The measure would target raw and intermediate materials' flows, as well as waste flows generated, as the new requirements will cover the entire life-cycle of a product, from early stages until the end of life of a product.

Governance

a. At what governance level should the instrument be deployed (EU? MS?)?

The requirements on life-cycle performance follow a similar rationale as the development of the EU-wide Ecodesign directive, and the new requirements would be implemented in the same scales. The requirements this instrument introduces should be equally applicable to all imported products, in order to not create a competitiveness disadvantage for products manufacturers in the EU. Concerns about such requirements have risen in the WTO from developing countries; which claims that might be contrary to WTO's agreements. However, eco-labels proved to be consistent with WTO regulation in the past, as far as they are necessary for the protection of the environment or of human health. In this case requirements are considered to affect non-product related processes or production methods. Only one GATT dispute was registered in the past for eco-labelling and so far not a single WTO dispute involved the ecodesign issue (Center for International Environmental Law, 2005).

b. What stakeholders should be involved in the negotiations and agreement?

In principle the same categories of actors that have been involved in the development of the current requirements under the Ecodesign directive, most notably product manufacturers but also environmental groups. However, the extended scope of the revised directive would require the involvement of manufacturers from new sectors that so far were not involved. Depending on the criteria it may also make sense to involve the extractive industry as well as

producers of intermediate products, to investigate to which extent their environmental impacts associated with their activities could be reduced and certified.

In the case of global supply chains voluntary agreements might have to be negotiated between manufacturers and their suppliers, especially since in a global context information exchanges between producers and suppliers may not be easy to regulate.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Depending on the requirements, manufacturers may have to disclose information linked to the environmental performance of their products in order to demonstrate that their products comply with all requirements. Requirements throughout the entire life-cycle makes suppliers and potentially even organisations responsible for the end-of-life of a product responsible for ensuring the reduction in the environmental impacts of their products throughout the entire cycle. Their non-compliance could eventually lead to a ban for certain energy-consuming products in the Member States (ECOFYS, 2014a).

d. Is it important and technically necessary to coordinate the instrument at EU-level?

Given the common market harmonised standards for products across all EU MS is necessary. In order to avoid discrepancies across Member States it is important that standards are developed based on EU-wide collection of information on the current performance of products and the extent to which it could be improved. Higher requirements in one country are possible if the manufacturer takes voluntary steps and if this does not lead to import restrictions for products coming from other countries (Center for International Environmental Law, 2005). Following the model adopted by the Ecodesign directive, the creation of a new EU-level organism (e.g., the European Committee for Standardisation or the European Committee for Electro-technical Standardisation) would facilitate the implementation of new requirements.

Market surveillance on non-compliant products and fines for producers is also an important aspect that need to be taken into account for a successful implementation of the Eco-design directive (ECOFYS, 2014b).

e. What is the perceived feasibility and acceptance among key actors?

Expanding the scope of the Ecodesign directive needs an appropriate consultation between Member states, businesses, consumers, environmental NGOs and scientists in order to determine the most critical products that need to be addressed through the extension of the scope. Some sectors (e.g., motorised road transport) may be impacted particularly heavily by standardisation efforts aiming at reducing the environmental impacts throughout the lifecycle (ECOFYS, 2014a). Thorough consultation procedures will increase the enforcement capacity of the new regulations, create a momentum for investments in innovation, and increase acceptability among the business sector. Moreover, the measure will also increase consumers' choice among different types of products.

Environmental impacts and effectiveness

Environmental impacts of this policy instrument should include less greenhouse gas emissions, reduced use of natural resources and improved waste management. In addition, adding some environmentally harmful substances (e.g., phthalates and PVC in Denmark) that may undermine the recyclability of the product may be considered (Mazza et al. 2013). An fuller implementation of the Ecodesign directive to all energy using products, whether used for

domestic purposes or business to business (with requirements on energy-related products), has been estimated to potentially save up to 400 Mega-tonnes of CO_2 emissions annually-saved in 2020 (ECOFYS, 2012).

Key expected economic impacts

Life-cycle requirements should foster competition and eco-innovation on the market, as constantly improving life-cycle performances will be an ultimate goal for companies in their quest of a better position on the market through labelling pressure (Kramer, 2012). Knowledge that is built through these measures can also constitute an important capital with associated economic advantages. Besides, companies' image is improved, as they demonstrate their commitment in reducing the environmental impacts of their products (EPLCA, 2014).

According to a study released by the consultancy ECOFYS, a correct implementation of the Eco-design directive would lead to yearly savings equivalent to 600 TWh of heat and 600 TWh of electricity in 2020[17] (with the majority of the savings achieved by electric motors, tertiary sector lighting and televisions). The economic impact would also be relevant. Total gross monetary savings (in terms of saved energy bills) would be equal to €120 billion a year in 2020 for European businesses and consumers (ECOFYS, 2012).

The security of supplies of the EU would also be reinforced, with a reduction of dependency on third-country energy suppliers. By 2020 the EU would experience a total import reduction equivalent at least to 10%. In particular, imports of natural gas and coal would be reduced respectively by 17% and 28%. If we take into consideration the energy imports from Russia, the Ecodesign could (ECOFYS, 2012).

Consumers and businesses are also supposed to benefit, with savings equivalent by 2020 to € 280 per household per year and for businesses of €90 billion per year. Future jobs are expected to be created through new requirements in innovation and life-cycle management. For energy-related savings alone, the Ecodesign directive has the potential to add 1 million jobs to the EU Economy by 2020 (ECOFYS, 2012).

Key expected social impacts

A possible reinvestment of these savings could be spent in other parts of the EU economy and lead to the creation of 1 million additional jobs in 2020 (ECOFYS, 2012). The Eco-design directive on energy-related products is expected to also produce energy savings equivalent to the annual residential electricity consumption of Sweden in the period 2010-2020 (European Commission, 2008b). Further estimates show that these savings could reduce consumers' final energy bills and lead to substantial resources savings (e.g., raw materials and plastics). Moreover, a rebound effect could come from the fact that better performing products are usually associated with high premiums, and are therefore less affordable to low income households.

[17] This would be equivalent respectively to 17 % of the total electricity and 10 % of the overall heat consumption.

4.4.10 Compulsory business reporting on sustainability

Brief summary of the measure

Obliging listed companies to provide sustainability reporting alongside financial reporting enables clients, investors and suppliers to take a company's environmental and social performance into account when deciding on purchases, investments or co-operation. Well-performing companies may gain competitive advantages and have easier access to capital.

In addition, the internal management process established through the sustainability reporting will increase the company's knowledge about resource flows and efficiency potentials along its supply chain. Thus, compulsory sustainability reporting (including goal setting procedures) can exert a push effect from clients, suppliers and investors and a pull effect from within the company to identify and exploit savings potential and increase eco-innovation. Finally, the measure creates the basis for mainstreaming of ethical investments in the financial industry.

To avoid duplication of previous work and increase acceptability reporting requirements should build as much as possible on established frameworks developed, for example, by the Global Reporting Initiative (GRI 2013), the former Carbon Disclosure Project (CDP 2014) or UN Global Compact as well as standardised procedures of corporate social responsibility (CSR) reporting and environmental management (such as ISO 14001). As opposed to voluntary implementation, compulsory implementation should, however, involve third-party verification to avoid lax implementation occurring in cases of voluntary reporting (Clapp 2005).

Brief description of the design and scope

a. <u>When would it be introduced (2020 or 2030)?</u>

A compulsory reporting scheme on sustainability issues can be important for increasing the availability of reliable data and information. This allows further policy-maing to be more firmly based on evidence. A well-established system for sustainability reporting can also help shifting paradigms. For these reasons, we suggest that the obligation to report on sustainability issues would be introduced as early as 2020. Although some initial resistance can be expected, we assume this can be overcome by then.

b. <u>What is its aim?</u>

Provide solid and comparable data on companies' sustainability performance to provide clients, suppliers, investors and other stakeholders with a more complete information basis for purchasing and investment decisions. Reporting can increase transparency on external costs that result from negative environmental impacts or depreciation of natural capital and allow the financial industry to take these external costs into consideration.

At the same time, the reporting requirements prompt executives and employees to incorporate the broader and longer-term social and environmental consequences of corporate decision-making. A management system with performance goals and benchmarks enables companies to identify and tackle resource efficiency and savings potentials and the accompanying cost savings. Moreover, a corporate sustainability vision can help strengthening identity of employees and hence identification with and dedication to the company.

c. Which economic sectors and point(s) in the lifecycle would be targeted?

To maximise environmental impact, the focus should be initially on energy and material intensive industry sectors, such as automotive, chemicals, steel, aluminium, paper production, cement production, raw materials extraction. All life cycle stages from extraction via processing to manufacturing shall be targeted.

d. What requirements does it place on relevant players?

Listed companies would be required to deliver regular sustainability reporting on relevant environmental and social impacts based on one recognised standard in parallel to financial reporting and subject to similar certification procedures to guarantee quality of reporting. Depending on the company's activity indicators might include material intensity measured, waste generation, freshwater use, GHG and air pollutant emissions, eco- and human toxicity, impacts on land use, soil sealing, energy use (fossil vs. renewables), planned remediation procedures, local and regional value added generation, social impacts.

e. Links, synergies and interlinkages with other instruments in the policy mix

Sustainability reporting in companies has synergies with all instruments of the circular economy cluster since they all aim at improving the environmental performance of products, services and production processes. Additional synergies exist with skill enhancement which will increase employees' openness to and capacity of implementing the desirable changes identified through the reporting process.

f. What physical/resource flows (if any) are directly targeted by the policy instrument?

All physical flows of materials, energy, waste, biotic resources as well as impacts on land, air and ecosystems.

Governance

a. At what governance level should the instrument be deployed (EU? MS?)?

To ensure a level playing field on the common market, the requirement should be implemented by an EU regulation applying in all Member States. In addition, the EU should strive for international standardisation of standards.

b. What stakeholders should be involved in the negotiations and agreement?

Industry and business associations, workers unions, civil society organisation, academia and existing reporting initiatives.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Company's top level management (CEOs) will be required to establish sustainability departments and nominate a Chief Sustainability Officer, equipping him/her with sufficient power to get data and support from different company departments as well as with sufficient staff and top-management backing. If companies do not deliver (at a certain time of the year) according to agreed standards, a fine of 1% of the annual turnover, or in case of negative balances of at least 1% of the last positive turnover or, if lower than 1,000,000 EUR one million EUR will be levied. Fines will have to be scaled according to company size and turnover.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

To avoid market distortion EU-level regulation is desirable, even if challenging politically (particularly the UK is likely to oppose it).

e. What is the perceived feasibility and acceptance among key actors?

Acceptance may be initially low out of fear of increased administrative burden. It is therefore essential to build on existing standards and guidelines that many companies already use.

Furthermore, linking the provision of high-quality reporting to market opportunities and potentially to green public procurement criteria can gain this instrument greater acceptance due to economic benefits.

Environmental impacts and effectiveness

Indirect environmental impacts can arise from increased transparency and effective internal management allowing identifying and exploiting existing resource efficiency potentials. The reporting may also encourage companies to pursue alternative and more sustainable business models through client pull, investor push and level playing field.

Key expected economic impacts

Low increase in company costs upfront to implement monitoring system, employ reporting staff, establish monitoring routines and producing reports. On the flipside, however, companies with good sustainability reporting could benefit from easier access to capital (given the increase of ethical investment standards), higher attractiveness for clients and potential employees, and increased chances to win government procurement tenders (given the expansion of green public procurement). The internal management process can also allow companies to detect supply or resource price risks early on and address them proactively.

Key expected social impacts

Compulsory sustainability reporting will also address social impacts of production processes such as health aspects of environmentally harmful activities (in extraction, processing, manufacturing). This has the potential to reduce the impacts of such activities and hence to improve human health aspects.

4.5 Revisions after ex-ante assessment

4.5.1 Policy mix narrative

Based on the lessons learnt in the qualitative (Nesbit et al. 2015a, Bigano et al. 2015, Bukowski et al. 2015, Lucha and Roberts 2015, Vanner et al. 2015) and quantitative ex-ante assessments (Ekvall et al. 2016b, Bosello et al. 2016), the overarching policy mix would benefit from adapting some of the instruments proposed as part of the mix.

The overall narrative of the overarching policy mix seems to be robust according to the ex-ante assessment results – supporting resource and impact decoupling through fostering reduction in resource use and environmental impacts associated with resource use. According to Nesbit et al. (2015a) the eight policy instruments proposed for and assessed under the overarching policy mix likely have positive **environmental effects** because in combination the eight policy instruments will

I. Increase prices for use of materials and material-intensive products as well as for waste incineration and landfilling;
II. Increase the availability and affordability of less material-intense and more climate-friendly products and services;
III. Help integrate resource efficiency into product design through expanding EPR systems to additional waste streams (e.g., waste tyres, waste oils); and
IV. Provide enabling frameworks for reducing material consumption in businesses through skill enhancement programmes, and among households via encouraging the reduction of working hours, restricting consumption-fuelling advertising and supporting local service exchange through local currencies.

However, despite a great likelihood of the policy mix to contribute to achieving the DYNAMIX key environmental targets, the assessments by Nesbit et al. (2015a) and Ekvall et al. (2016b) show that:

a) no quantification of any exact level of contribution to the targets can be given
b) the overarching policy mix has greatest potential contributions to the two targets (I) Reducing consumption of virgin metals by 80%, compared to 2010; and (II) Limiting annual per capita greenhouse gas (GHG) emissions to 2 tons of CO2 equivalent.

Furthermore, potentially negative side-effects of the policy instruments – such as increasing compliance costs for businesses and enforcement effort for administrations or potential job losses in the advertising sector – might prevent this policy mix from being implemented or might reduce its effectiveness. Hence, the potential environmental effects may not occur or be different.

Despite an overall largely consistent and coherent design of the policy mix, the ex-ante assessment results indicate that

1. Some of the instruments will likely face significant challenges as regards political feasibility (in particular the labour market reform fostering a shift from consumption to leisure; Step-by-step restriction of advertisement and marketing; and the Circular Economy Tax trio); and
2. The policy mix will not be able to achieve the DYNAMIX environmental key targets, even if all instruments were politically feasible.

4.5.2 Revision of instruments

The ex-ante assessments did not call for any additional instruments to be added to the policy mix. However, they provided several intervention points for how to revise or adapt the instruments that were already in the mix in order to mitigate their potential side-effects and hence to improve their potential environmental impact. A selection of such pointers for revision per instrument is given below.

(1) Labour market reform fostering a shift from consumption to leisure

In order to enable positive employment effects of the labour market reform voluntary flexible labour market regulations should be introduced and part-time working arrangements empowered so that they can be applied even for a highly qualified workforce. Under such conditions, reform likely will facilitate labour market entry for:

- Students who have enough time for a part-time job, but not for a full-time job;

- Parents, who will be able to return to the labour market earlier; and
- Younger pensioners, who are still able to work part-time, but may no longer have the vitality to take a full-time job.

As part of a voluntary increase in working hour reductions, part-time working arrangements should be popularised so that they are not discriminated against in terms of taxation and that they are not associated with lower per-hour wages and easy jobs for less qualified workers.

Such popularisation could benefit from refocusing the policy instrument around a specific cause for extra time associated with a good and growing level of public acceptability and momentum, for example for parental leave or career's leave or for alleviating the effects of on-call time on key workers.

(2) Step-by-step restriction of advertising and marketing

It seems important to ensure the sequenced implementation approach starting with widely acceptable restrictions (unfair marketing and marketing targeted at children) and then successively making efforts to win public support for later, more contentious measures. This could be aided by framing the dialogue on restricting advertising around protection of social space and targeting misleading or unfair advertising, which receives strong public support across many Member States, particularly Spain, Germany, UK, France, Netherlands, and Portugal.

(3) Boosting EPR

Returning of end-of-life products should be incentivised (as with bottle deposits) by offering money-back and easy availability of returning options (a good example includes the return of mobile phones to recycling schemes).

(4) Circular Economy Tax Trio

The taxes should be:

- Announced as and made part of a larger-scale tax reform process;
- Agreed on a cross-party consensus and consulted on extensively with the affected sectors to recycle revenues in the way that mitigates potential losses and fears of leakage.
- Coordinated to include options for border tax adjustments (tax imports and exempt exports from taxation) to ease pressure on competitiveness and thus increase public support.

(5) EU-wide introduction of feebate schemes

The schemes should encourage that within each targeted product category (in terms of car size, inter alia small, large, luxury, mini vans, SUVs) several options with varying efficiency and hence differing costs are available to choose from. Thus, it would avoid that needed product categories (e.g., a larger car for a larger family) become on average more expensive, hence minimising discriminatory effects.

While thus a potential discriminatory effect could be reduced, the feebate design should still ensure that environmental benefits can be generated – for instance through increasing the fees and rebates according to magnitude of sustainability effect of a product or service. In the above case of cars, rebates for hybrid and electric cars should provide an incentive to shift from internal combustion engine cars to alternative engine and not just to slightly more efficient internal combustion engine cars.

(6) VAT reductions

In order to limit potential rebound effects triggered by VAT reductions, the instrument should be complemented by a tax on least efficient products, thus minimising the risk that saved household money from the purchase (and use) of more efficient products and services is employed to consume other, less efficient products and services. Including the VAT reductions and taxation on least efficient products and services into a wider VAT reform could avoid such a potential income effect. However, this would not limit rebounds in terms of using more of the same products and services (direct rebound effect) having received VAT reductions.

A wider VAT reform would address the same drivers as a feebate scheme and should be coordinated with it. The feebate schemes would be implemented for selected product categories, for example consumer electrical goods. The VAT reform would work alongside it, potentially fostering incentives to manufacturers to continuously improve energy-efficiency (or other relevant environmental parameters) in order to benefit from the reduced VAT rate in addition to the rebate at point of sale from the feebate scheme.

In addition, the instrument should be accompanied by an adequate information campaign because if properly communicated, this instrument could have an impact on consumer demand beyond the financial advantage it confers – the so-called signalling effect.

Furthermore, the taxation rate should not be uniform, but could be tailored to the different products and services targeted to differentiate according to national context. Given Member States' discretion in the area of indirect taxation, implementing VAT reductions at Member State level appears more promising. A Member State introducing such reduced tax rates would have to meet certain minimum requirements stemming from the VAT Directive (2006/112/EC), which sets the standard rate at no less than 15 % and reduced tax rates at no less than 5 %. This would significantly reduce concerns regarding compatibility with EU law.

(7) Skill enhancement

State actors will face difficulties in identifying future qualification needs in a Circular Economy. This will complicate the setting up of appropriate skilling programmes to align supply and demand on the future labour market, and potentially cause inequalities. Therefore, private enterprises should be actively involved in the development (and also encouraged to participate in the provision) of skill enhancement programmes as they are in a better position to gauge which sort of skills are needed.

(8) Support for local currencies

In the design and implementation of the local currency scheme(s) issues of tax avoidance should be transparently communicated and tackled by increasing the income taxation for those taking part in the local currency scheme in order to cover costs for the state of income taxation revenue foregone. Therefore, participation to the scheme should not be made mandatory, but decided democratically on the level of municipalities or parts of municipalities.

4.5.3 Implementation of the policy mix

By adjusting the potentially contentious policy instruments so that the potential negative side-effects are minimised, the political feasibility of the overarching policy mix could be fostered.

Furthermore, strengthening a smart and effective time-sequencing (roadmapping) of the policy instruments can further help to improve political feasibility. A sequenced implementation approach for the overarching policy mix could look like the following:

1. Introduce the Circular Economy Tax Trio, the feebate schemes, the VAT reductions and the boosted EPR schemes around 2025;
2. Introduce the skill enhancement programmes around 2020 (prepared by a transdisciplinary advisory body comprising business sectors that are going to be affected by the above four measures) to develop the capacities to provide the skills necessary when the above four instruments take effect;
3. Start supporting local currencies from 2020 onwards to establish service markets and prepare the ground for citizens to get used to options for building their own service-oriented capacities and skills;
4. Introduce voluntary labour market reform aspects around 2025 (deciding on whether or not to introduce mandatory changes in the coming decades later on); and
5. Restrict unfair advertisement, advertising targeted a children and adver-tisements in city centres by 2020; step-wise expanding the focus to sugar/fats in 2025 and to selected luxury goods linked to global social re-sponsibility (e.g., blood diamonds) by mid 2030.

5 Developing a policy mix for land-use

This policy mix aims to reduce the EU agricultural land footprint and its related environmental impacts, whilst assuming that EU agricultural production will remain stable or continue to increase slightly to 2050. It focuses on both the consumption and the production side, in order to be able to address the main drivers related with the use of land and the environmental impact of agricultural activities.

As regards consumption, this policy mix's objective is to reduce the global agricultural land use due to EU consumption by addressing three key drivers:

1) Consumption habits, and in particular overconsumption of meat, dairy products and eggs, which have a much higher land consumption per calorie than any other kind of food
2) Food waste
3) Bioenergy, and in particular first-generation biodiesel

As regards production, the policy mix aims to decrease the environmental impacts of agricultural activities in the EU and globally, which can be influenced by the EU and Member State policies. In particular, it focuses on three key categories of environmental impacts:

1) Biodiversity loss
2) Deteriorating water quality and overconsumption of water for irrigation
3) Reduced carbon storage in soil

In order to select a set of policies that have an impact on the consumption and the production side, first of all the authors defined the current situation and foreseeable future trends in land use and environmental impacts of agricultural activities. Also, they aimed to identify the main drivers that are at the root of the current situation and trends

As a second step, the authors established targets and objectives for this policy mix . When possible, quantitative targets have been indicated, but when the issues were too complex and the uncertainty too high to allow quantifying targets, qualitative statements have been used.

This policy mix has a double objective. It aims to decrease the land footprint at the global level due to European consumption of food and bioenergy; and it aims to reduce the environmental impacts related to agricultural land use in the EU, and to reduce the wider global impacts that can be influenced by the EU and Member State policies. The second objective is important because the agricultural sector is responsible for many environmental impacts at the global and European level, in terms of soil erosion, pollution, eutrophication and loss of biodiversity (IAASTD, 2009; PBL, 2010). Focusing on consumption alone would miss significant opportunities to reduce those impacts.

As with other areas of resource use in the EU economy, EU consumption drives environmental impacts at a global rather than a European level; there is no neat symmetry between EU consumption changes and the impacts of production in the EU. At a global level, we could conceptualise the respective contributions of consumption and production as follows: increased efficiency of production leads to a reduced requirement for additional

land[18]; reduced consumption (or, more accurately, greater efficiency of consumption in meeting nutritional needs) leads to a reduced requirement for production, and again leads to reduced requirement for land. However, this assumes that there are mechanisms available which would allow EU policy-makers, acting with counterparts in other economies, to direct production to the optimal land use. In practice, this option is not available; and would in any case be prohibitively complex to exercise. A shift in EU consumption patterns, while it would reduce the EU's overall global footprint, might not be accompanied by reductions in environmental impacts from EU agriculture. Conversely, an approach to the delivery of improved environmental outcomes from the EU which relied on reduced production, would, if it were not accompanied by an equivalent reduction in consumption, simply displace the environmental impact of EU food consumption to other economies, with long-term impacts on the provisioning of ecosystem services on which the EU relies. A reduction in EU production, even if there were an equivalent reduction in consumption, is not unequivocally beneficial in environmental terms; given the increased global demand for agricultural products linked to a growing global population, and the potential for significant impacts on ecosystem services of meeting that additional demand, the environmental opportunity cost of reduced production in the EU (compared to marginal environmental impacts elsewhere) needs to be considered.

The overall impact of the EU's consumption and production in relation to agricultural land can, in principle, be assessed, even if policies are developed separately; and we recommend below the development of an indicator showing the EU's net land use impact (that is, the land use impact of EU agricultural consumption minus the land use impact of EU agricultural production); however, we lack the data to set precise targets at this stage. There is also scope for some policy measures on the consumption side – particularly on information and labelling of agricultural products - to begin to have an impact on production, both within the EU and beyond.

One further point distinguishes agricultural production from many other fields of resource efficiency: dematerialisation of food production has clear biological limits. While food waste, over-consumption leading to obesity, and high levels of consumption of livestock products (which tend to have significantly higher environmental impacts per calorie, or per gramme of protein), can be reduced, we take as given the importance of meeting the nutritional needs of the EU and global populations.

5.1 Production

The production elements of the policy mix focus on EU agricultural land; there is limited scope for an impact of EU policies on agricultural land in other economies (although it should be noted that some EU member states have taken steps to encourage more sustainable agriculture in developing countries, as part of their overseas development aid). The consumption policies described can be expected to have impacts in the EU and beyond; and some mechanisms, particularly on labelling or improved information for final consumers, will

[18] However, at a more local scale, or if we assume that consumption increases in response to increased production, there is evidence that the Jevons paradox (resource efficiency increases leading to increased consumption of a resource) can apply to agricultural land. See, for example, the amalysis in Rudel et al. (2009).

in principle have an effect beyond the EU (although that effect is partly linked to the accuracy of information supplied by exporters to the EU).

This policy mix therefore focuses on agricultural land use and its related environmental impacts, particularly on biodiversity, soil and water. In line with the EU Thematic Strategy on the sustainable use of natural resources and the Roadmap for a Resource-Efficient Europe, agriculture-related resources are defined as encompassing:

- abiotic resources, including minerals, metals, and fossil fuels, including their use for fertilisers, pesticides, plastics, machinery, and buildings (inputs),
- biotic resources, including timber, agricultural products and all other types of biomass as well as land, water and soil (inputs),
- environmental media and the ecosystem services linked to them: land, water, air, soil, biodiversity (impacted by outputs such as waste or emissions).

The key biotic and environmental resources on which agricultural production depends are: land, water, soil, and agricultural biodiversity (including crops and animals, pollinators, and soil biodiversity). The key abiotic resources on which agricultural production depends are: fossil fuel energy, fertilisers, pesticides, and materials both for production and for infrastructure.

This policy mix focuses only on the agriculture-related resources whose use plays a role as principal, direct contributors to environmental impacts on biodiversity, soil and water. It does not therefore directly consider reductions in the use of some abiotic resources or of direct greenhouse gas emissions from agriculture (as distinct from net carbon sequestration from land use). This could be revised at a later stage of the project if required.

Land taken out of agriculture for built development, energy and transport infrastructure and recreation is also important, and in some cases this has implications for agricultural use (for example, there is an element of competition between land use for renewable energy sources such as onshore wind, and land use for agricultural production). However, this is outside the scope of this policy mix. While they are outside the scope of this policy mix, broader land use choices of this kind need to be considered carefully as part of the overall EU approach to sustainable resource use.

The next three sections will summarise the current situation as regards both agricultural land use and the related environmental impacts, and the most important drivers.

5.1.1 Current situation, trends and drivers

Agricultural land use

According to Bringezu et al. (2012), in 2007 the EU-27 used about 0.31 ha per capita of cropland at the global level, which represents one third more than the cropland that is globally available in per capita terms. Von Witzke and Noleppa (2010) found that the EU's virtual land exports (i.e., the land used to produce exported agricultural commodities) have declined by 17% between 1999 and 2008, whereas virtual land imports (i.e., the land used to produce imported commodities) have increased by 15%. The authors found that in 2007-8 the EU-27's virtual land export and imports were respectively 14 and 49 million ha (about 0.03 and 0.1 ha per capita), and the land footprint (i.e., imports minus exports, including virtual flows) amounted to about one third of the EU-27's utilised arable area.

Cropland accounts for 25% of the rural land in the EU, grassland for 20%, and forest and scrubland for 43%. In contrast to global trends of agricultural expansion and forest loss, the area of agricultural land in the EU has declined by around 2 Mha over the period 1990-2006, including 1.1 Mha converted to urban land and 0.2 Mha converted to forest . In addition, agricultural surveys show that around 7% of agricultural land is not currently being used (Hart et al. 2013). Within the agricultural area, the proportion of permanent grassland continues to fall in relation to the arable area, but at a much slower rate than two decades ago (EEA 2010a).

As regards the future use of agricultural land at the EU level, even with stable demand levels within Europe, significant changes in trade as a result of rising global demand for agricultural products create uncertainty in any forecasting of EU land use. The future balance of agricultural land use and environmental services provided will depend on individual decisions taken by millions of farmers across the EU. They will be heavily influenced by the future trajectories of supply side drivers, such as market prices and production costs for crops and livestock products and timber as well as by public policies, including the deployment of subsidies and incentives under the Common Agricultural Policy.

A recent review of land use modelling studies (Tucker et al. 2014) drew the following key conclusions on the future land use in the EU. Agricultural land is likely to decrease in area at a rate of between 0.2% and 0.7% per year up to 2020. This land is largely taken up by urban development which is expanding by around 0.6% – 0.7% per year. Differences are observed within agricultural land use categories, with greater losses of rain fed agricultural land and natural grasslands (both to urban expansion and natural succession). Forest areas are expected to increase by 0.25% - 0.4% per year with significant fluctuations between transitional woodland scrub communities and high forest. Intra land use and management variations are expected to match existing trends to 2020 but with greater uncertainty to 2050. However, agricultural specialisation and intensification is expected in some areas, with pressures for conversion of grassland to cropland on the more productive soils, whereas a trend of extensification, marginalisation and abandonment is expected in those areas operating at the margins of profitability.. Forest management is also likely to intensify in some areas, particularly regarding the removal of forest residues. Although the recent economic crisis in the EU may mean that some model projections are no longer completely valid, such effects are not expected to have substantial impacts on agriculture and forestry as they are more influenced by global market forces (Hart et al. 2013).

At the EU level, increases in farming's productivity have, in principle, and for a given level of consumption, at least ensured that the EU's net land footprint is smaller than it would otherwise have been. However, farming is overusing finite resources (for example water for irrigation), and does not perform to the standard demanded by targets at EU level for biodiversity and clean water, or achieve levels of soil protection which would ensure sustainable future provision of ecosystem services from farmland. These public goods are generally undersupplied because neither society nor markets provide sufficient incentive for land managers to provide environmental goods and services, leading to failure to meet key public policy objectives.

The adverse environmental impacts of EU agricultural land use are in part linked to processes of change in farm structures and farming systems that began in the mid-twentieth century and continue in parts of the EU. The drivers of these processes of change in EU agriculture are complex, inter-related and changing over time. They include technological advances in plant

and animal breeding, crop cultivation, pesticides and herbicides, mechanisation of agricultural management (and hence reduced labour requirements), availability of capital (until recently a major constraint in some EU Member States) and access to global markets. Further increases in productivity associated with some of these changes could contribute to meeting increased demand for agricultural products without excessive increases in the land footprint of production.

There has been increasing specialisation and intensification of production on the better quality agricultural land, in which mixed farming has been replaced by arable farming or livestock farming; increasing size of farms and production units within them, made possible by increasing mechanisation; a trend to housed livestock, and use of industrial units for pig and poultry production, relying on imported feed (with associated land use and other resource use implications elsewhere) and producing manure for disposal elsewhere; increased use of chemical fertilisers and plant protection products that have made it possible to replace crop rotations with almost continuous cultivation of a limited number of arable crops; intensification and concentration of livestock production (especially dairy and beef beef) on heavily fertilised lowland grasslands. These changes have taken place largely (but not exclusively) on potentially more productive agricultural land.

Intensification of agricultural and husbandry practices are not the only sources of the adverse impacts on soils and water and the increasing biodiversity loss caused by the agricultural sector. A different process is at work in marginal agricultural areas (e.g., mountains, areas with poor soils or remote locations) where extensive traditional mixed farming systems are no longer economically viable because they cannot achieve the economies of scale or the intensity of production that are possible elsewhere. These marginal areas tend to be mostly semi-natural habitats with very high biodiversity values, and are degraded and eventually lost in the process of agricultural abandonment (Keenleyside and Tucker, 2010).

These changes are still actively in progress in parts of the EU. In the next decades, a polarising process of greater intensification of more productive agricultural land and further abandonment of marginal land is expected, especially in some of the newer Member States, which currently hold a high proportion of high-quality semi-natural habitats (IEEP et al. 2012).

In order to reduce the environmental impacts and resource use related to the agricultural sector, this policy mix will therefore need to stimulate a decrease in the use of chemical fertilisers and pesticides (including through better management of use to ensure nitrogen is used efficiently in production, and not wasted in air or water pollution), and a reduced use of water for irrigation (e.g., through the choice of crops adapted to local climate conditions and more efficient irrigation systems), while at the same time encouraging the employment of more traditional agricultural practices to improve soil fertility (e.g., crop rotation). Also, the policy mix will aim to halt land abandonment in those areas with high nature value which depends on low-intensity farming systems.

This will call for a combined strategy of land sparing in some areas and land sharing in others. Land sparing is a term which is used to describe sustainable intensification of agricultural/husbandry activities in well-delineated areas only, with innovative practices aimed at increasing yields, while at the same time containing the environmental impacts. Land sharing indicates a management strategy aiming at delivering non provisioning ecosystem services (e.g., carbon storage, water retention, recreation activities) together with food/biomass production through extensive agriculture and husbandry practices (see for example Rey Benayas and Bullock (2012) and Tscharntke et al. (2012)).

Finally, carbon sequestration from agricultural land use, and emissions particularly of nitrous oxide and methane, will become an increasingly important issue in climate mitigation policy as progressive decarbonisation of the EU energy supply, industrial and transport sectors, leads to agriculture and land use representing a more significant proportion of remaining emissions. In addition, policy on emissions reductions in other sectors will have implications both for demand (including for biomass for energy purposes) and the costs of inputs to agricultural land use (including land itself, energy, fertilisers, and labour).

Biodiversity

Numerous studies have shown that, in general, the diversity and abundance of characteristic species declines with increasing agricultural improvement and intensification, and this is particularly relevant for threatened species (Poláková et al. 2011), as also shown in Table 10. As a result, the current farming systems with highest relevance for biodiversity maintenance are the remaining traditional low-intensity farming systems that maintain semi-natural habitats, especially those with diverse habitats and landscapes. Such farming systems are often referred to as High Nature Value Farming systems (HNV) (Baldock et al. 1993, Baldock 1999, EEA 2004, Veen et al. 2009), and they still make up around a third of the EU agricultural area, i.e., 75 million hectares (Paracchini et al. 2008).

Many semi-natural farmed habitats and their associated species are of European conservation importance and therefore the subject of conservation measures under the EU Habitats and Birds Directives, including through the protection of 10% of farmed land within the Natura 2000 network. But despite this, a particularly high proportion of these habitats have an unfavourable conservation status compared to non-agricultural habitats (EEA, 2010b). Indeed, their loss and degradation is the most serious threat to agricultural biodiversity in most of the EU (Billeter et al. 2008). Such impacts are now mostly attributable to partial or complete abandonment of agricultural management, in particular in traditional extensive livestock systems, as a result of their low economic viability and social and agronomic change (IEEP and Veenecology, 2005; Keenleyside & Tucker, 2010). Overall, the EU lost 2.4% of semi-natural farmland since 1990, 40% of which has become scrub or forest, and a fifth converted to more intensive farming (EEA, 2010b).

Most other important threats to biodiversity within semi-natural farmland habitats result directly or indirectly from agriculture, and include eutrophication as a result of airborne deposition of nitrogen, primarily ammonia originating from intensive livestock (Dise, 2011), over-grazing of sensitive habitats in some areas, such as tundra by reindeer in Finland (Kumpula et al. 2006, Raunio et al. 2008) and inappropriate burning management (Poláková et al. 2011). Practices such as drainage, the frequent use of fertilisers and reseeding effectively destroys semi-natural habitats and turns them into agriculturally improved habitats, but this practice is relatively uncommon at the moment due to the marginal economic value and lack of investment in such areas. But this could change, particularly in the longer term, as a result of increasing demand, impacts of climate change (reducing productivity in some areas) and policy drivers such as requirements for bioenergy. A greater potential threat under current EU policies is the risk of afforestation of semi-natural farmland habitats because of CAP policies for greening and climate mitigation, and possibly LULUCF accounting.

Table 10: Agricultural habitats in the EU, their importance for selected threatened habitats and species, and their overall importance for biodiversity maintenance

Key: HD = Habitats Directive, BD = Birds Directive. Note: Habitat divisions for each taxa group reflect the habitat types distinguished in the available data.

	Permanent grassland and other habitats grazed by livestock					Crops					
Habitat types	Natural habitats	Semi-natural habitats		Improved grassland		Cultivated			Permanent		
		Pastures	Meadows	Organic	Conventional	Extensive	Organic	Intensive	Extensive	Organic	Intensive
HD Annex 1 habitats[*1]	63			0		0	0		0	0	
BD Annex 1 birds[*2]	54			32					5		
HD Annex II butterflies[*3]	9	25		0	0	0	0	0	0	0	0
European threatened amphibians[*4]	3	5		0		1	0		0	0	
European threatened reptiles[*5]	1	4		0		0	0		4	0	
Overall biodiversity importance	Very high, many species are restricted to such habitats	Very high, these habitats tend to be species-rich and declining; some species are restricted to such habitats and dependant on specific agricultural practices		Moderate, species diversity is much reduced compared to natural and semi-natural habitats, but some species of conservation importance use such habitats, sometimes in important numbers		High, such habitats are now rare and support some threatened species (esp birds)	Low, especially in intensive farmland dominated landscapes, but biodiversity levels can be enhanced by appropriate measures		Moderate - High, such habitats are declining and support some threatened species	Low, especially in intensive farmland dominated landscapes, but biodiversity levels can be enhanced by appropriate measures	

Sources: Adapted from Poláková et al. (2011), 1 Halada et al. (2011); 2 adapted from Tucker and Evans (1997); 3 adapted from van Swaay et al. (2006) using updated an annexes available from Butterfly Conservation Europe (http://www.bc-europe.org/upload/Butterfly%20habitats%20-%20Appendix%201.pdf): 4 (Temple and Cox 2009a); 5 (Temple and Cox 2009b)

Although the focus on biodiversity conservation in farmland is rightly on semi-natural habitats, it is important to remember that agriculturally improved ecosystems and even intensively managed systems, support significant biodiversity. Many of the remaining species are widespread generalists, but they are frequently encountered by people and therefore often of high cultural value. In contrast to semi-natural farmland the main threats to biodiversity within agriculturally improved systems relate to the impacts of further agricultural improvement, intensification and specialisation. Poláková et al. (2011) reviewed such impacts, and identified a range of practices which had the greatest impact.

Agricultural practices with negative impacts on biodiversity have become widespread over much of the EU over the last 30-50 years, especially in the north-west. Consequently this has resulted in widespread and significant populations declines, which have been well documented for birds and butterflies , but also affect a wide range of farmland species.

These trends are undermining the EU's ability to meet its biodiversity conservation targets (and those of the Convention on Biological Diversity). Biodiversity loss also threatens the long-term sustainability of farming in some areas as a result of soil degradation (see below), declines in pollinators, increased outbreaks of pests and diseases, and the degradation of other ecosystem services (Underwood et al. 2013b).

In addition, agriculture in the EU has indirect impacts on biodiversity outside the EU, most notably as a result of feed imports to sustain many intensive livestock systems (AEA, 2008; Lugschitz et al. 2011). Soybeans and maize are the main imported feeds, and it is estimated that EU soy imports account for 12 million hectares of soybean cultivation outside Europe (Westhoek et al. 2011), nearly all in Brazil and Argentina. This results in very high biodiversity impacts, because semi-natural habitats high in biodiversity (e.g., Cerrado in Brazil, Chaco in Argentina) are often converted to soy plantations (Kessler et al. 2007, Mann et al. 2010, Smaling et al. 2008, Zak et al. 2008). Soybean cultivation also causes indirect deforestation through the displacement of livestock farming into forest (FAO 2010, Nepstad et al. 2006). The net embodied deforestation associated with EU-27 imports of crop and livestock products between 1990 and 2008 was calculated at 7.4 million ha (European Commission 2013b), equivalent to 4% of the EU's forest area.

EU biofuel targets also result in significant biodiversity impacts outside the EU, because most of the demand is met by imports, mainly from North and South America, and to a lesser extent Southeast Asia. This is leading to frequent overlap between the sources of supply and areas with high biodiversity and weak protection regimes (Schmidt et al. 2012), consequently leading to high external biodiversity impacts.

Soil functionality

Society has an interest in maintaining functioning soils now and for future generations, not just as the basis for food production, but also to underpin the provision of carbon sequestration and storage, biodiversity and water management. The functionality of agricultural soils is threatened by a number of different pressures including:

- Decline in soil biodiversity; compaction by heavy machinery (around one third of soils are susceptible).
- Erosion by water (it is estimated 1.3 million km^2 are affected in the EU-27) and also by wind.
- Landslides triggered by agricultural land abandonment or land use change.

- Decline in organic matter (45% of soils in Europe have low or very low organic matter).
- Salinization through inappropriate management of irrigated land.
- Soil sealing by change of land use to built development and infrastructure (Jones et al. 2012).

In general, any form of agriculture is less favourable to soil functionality, compared to an undisturbed environmental state. However, impacts on agricultural soils can be mitigated through appropriate management practices. Although it is in the farmer's interest to manage the soil resource in an environmentally sustainable way, this is often overridden by the short-term economic incentive to maximise productivity.

Common management practices such as heavy pesticide and fertiliser use and inappropriate cropping methods lead to longer term degradation (Cooper et al. 2009). Conversion of grassland, wetlands and forests to cropland results in a degradation of organic matter and organisms in the soil, and loss of carbon sequestration potential, and makes the soil more vulnerable to erosion, particularly in the case of permanent grassland (Turbé et al. 2010). Soil carbon content depends on the balance between the addition of carbon from plant growth against the rate of removal through cropping, and by the decomposition of organic matter, leaching and other soil related processes such as disturbance and erosion; the extent to which carbon is stored depends on factors such as soil type, moisture conditions, vegetation patterns and cultivation practices (Trumper et al. 2009).

Water quality and quantity

Overall, 30-40% of European water bodies are under significant pressure from diffuse water pollution, and 22% from point sources (EEA 2012b). The map in Figure 10 illustrates the scale of the problem across the EU.

The main substances causing diffuse pollution are nitrogen compounds and phosphates and the principal source of these pollutants is run-off from agricultural fields resulting from fertiliser use and livestock manure. Such pollution extends beyond the area of land managed by individual farmers, and leads to eutrophication, with phosphorus generally having most impact on freshwater ecosystems, and nitrogen in marine and transitional waters (Bringezu et al. 2014). It may affect not just surface waters but also long-term groundwater stores too (for example through nitrate leaching).

The causes of diffuse pollution include:

- Continuous arable cropping and conversion of grassland to cropland (especially on sloping land).
- Grazing with high stocking rates during wet conditions (causing poaching – i.e., vegetation loss and soil disturbance).
- Over-grazing (e.g., through high stocking rates, or inappropriate stock types), particularly on sensitive natural or semi-natural vegetation.
- Poor soil management and cultivation techniques (such as leaving soil bare in winter and ploughing up and down slopes) leading to increased run-off.
- Application of fertilisers and plant protection products at rates higher than the crop requires.

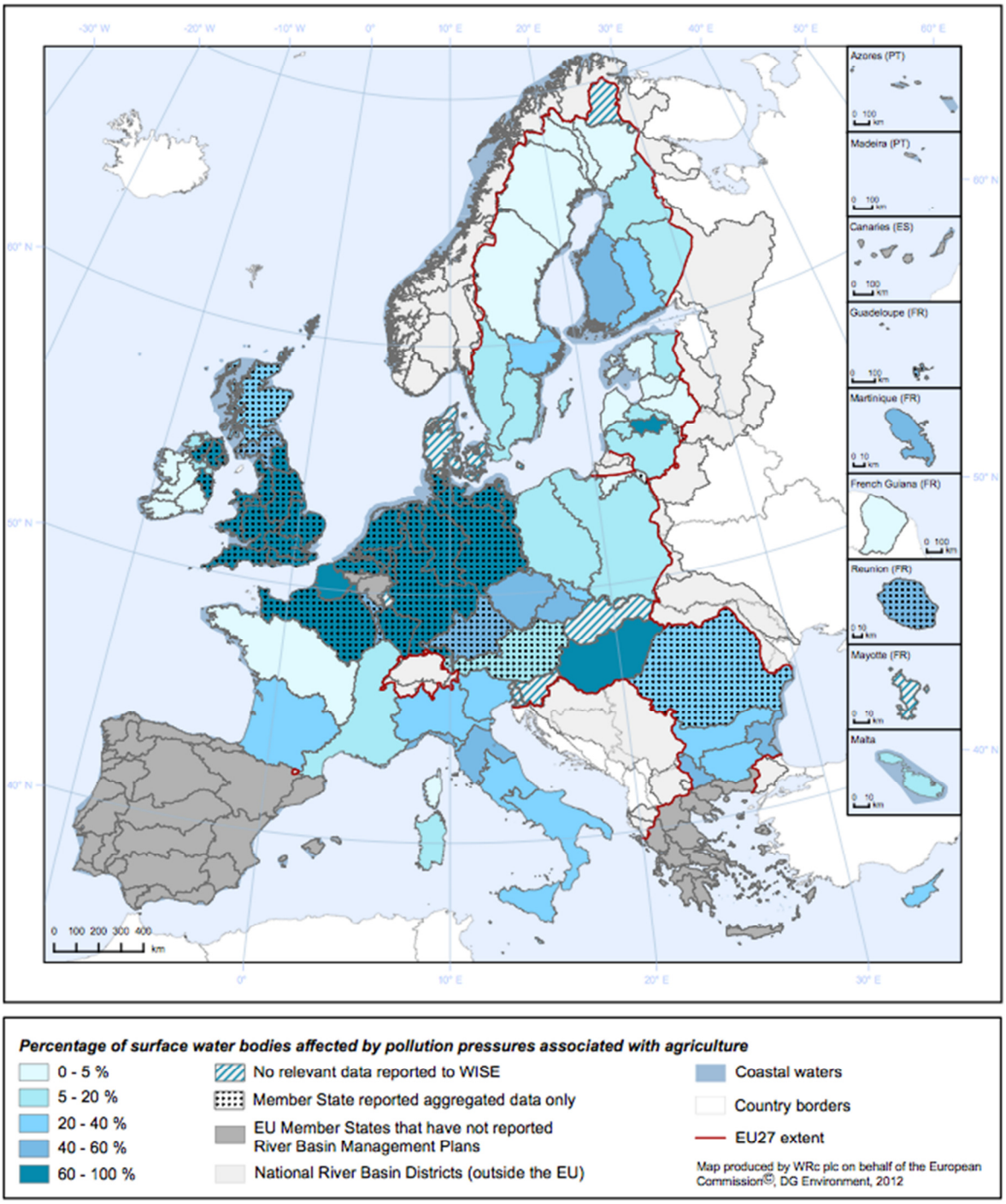


Figure 10: Map of surface water bodies affected by pollution pressures associated with agriculture. Source:http://ec.europa.eu/environment/water/water-framework/facts_figures/pdf/Agricultural_pressures2012.pdf (version 29 October 2012)

EU agriculture uses water both for crop irrigation and livestock production, supplied by natural precipitation stored in tanks and reservoirs and by abstraction from ground waters (aquifers) and surface waters. Agriculture accounts for 24% of total water abstraction in Europe, with only about a third of the abstracted water returned directly to the water body (EEA 2009). In some parts of southern Europe, agriculture accounts for more than 80% of water abstraction and typically this occurs mainly in the summer when water is least available (Cooper et al. 2009). Some irrigation systems make inefficient use of the abstracted water, for example spray irrigation during daylight (when there are significant losses to evaporation) compared to trickle irrigation of crops at night. The risk of over-exploitation of finite water resources is likely to be exacerbated in the future, particularly in southern Europe, as climate change leads to more intensive periods of drought.

Agricultural production also involves significant resource inputs. In addition to land (effectively a finite resource, and with high environmental costs of conversion to agricultural use) it also involves significant energy inputs (transport, production of fertilisers); in the case of livestock, significant inputs of agricultural commodities as feed; water; key nutrients, such as phosphorus and potassium, with associated extraction costs; and labour.

5.2 Consumption

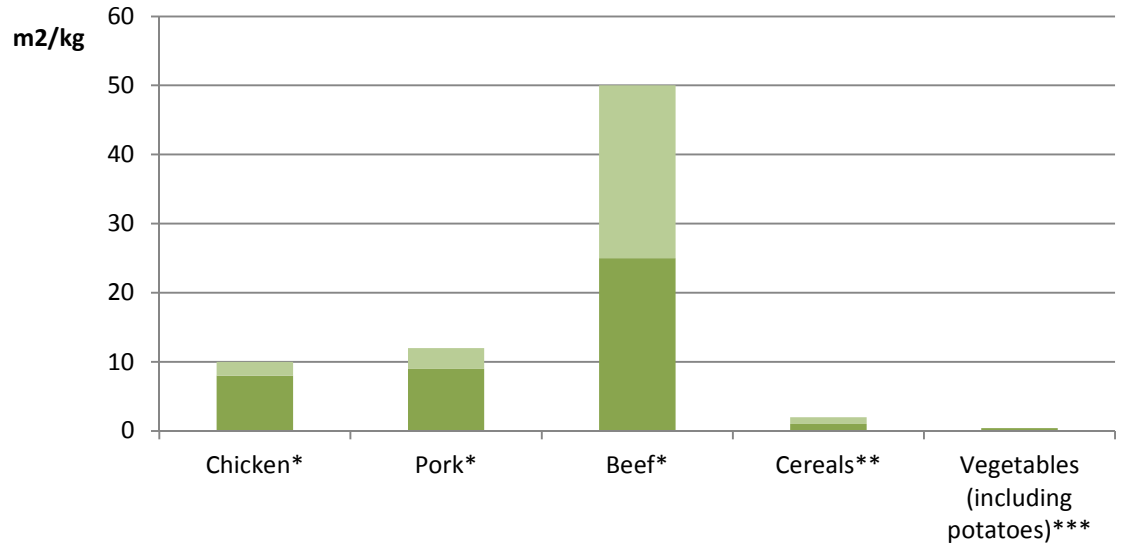
5.2.1 Current Situation, trends and drivers

A recent UNEP report (2014a) identifies three factors as the main drivers for the current increase in the use of land for agriculture at the global level: changing diets –especially increasing consumption of meat (Herrero et al. 2013, Herrero et al. 2009) -, food waste and the increasing consumption of first generation biofuels (see also Underwood et al. 2013a).

Dietary habits

The European per-capita consumption of animal food products increased by 50% between 1961 and 2007. The consumption of meat and dairy products in Europe corresponds to two and three times the world average respectively. The total per-capita protein consumption (including vegetable sources) in Europe is about 70% higher than recommended by the World Health Organisation (Westhoek et al. 2011).

Available life cycle assessment (LCA) studies show that production of meat requires more land than the production of vegetable based agricultural products per amount produced. However, equivalence of land use impacts is difficult to determine; one important factor is that extensive grazing of ruminants on poor-quality pastureland is likely to be the only viable means of producing protein from that land. Figure 11 gives an indication of the differences in land use based on different LCA studies.



* de Vries and de Boer (2010) cited by Hallström et al. (2011)
** Gerbens-Leenes and Nonhebel (2002) cited by Hallström et al. (2011)
*** Wakamiya (2011)

Figure 11: Land requirements for the production of different agricultural products. The light green areas indicate the span of land use in different LCA studies.

Compared with soybean production, land requirements are roughly 6 to 17 times larger for meat protein production (Pimentel 1982, cited in (Reijnders & Soret, 2003)). Also by comparing land impacts using calories as a baseline, meat and dairy products have higher land impacts than vegetarian alternatives, see

Table 11.

Table 12 illustrates the current protein supply quantities (in g/capita/day) in the EU. The protein intake from bovine, pork and poultry meat, milk and eggs correspond to 48% of total protein intake (FAO, 2014).

According to the Panel on Dietetic Products, Nutrition and Allergies (NDA) of the European Food Safety Authority (EFSA), the average daily protein intakes in European countries vary between 67 to 114 g for men adults and 59 to 102 g for female adults. NDA (2012) uses 0.66 g/kg body weight as the average daily requirement for healthy adults. Average adult body weight in the EU is 70.8 kg (Walpole, Prieto-Merino, Edwards, Cleland, Stevens, & Roberts, 2012).

NDA (2012) uses 0.83 g/kg body weight as the daily population reference for intake of protein for healthy adults.

Typical drivers for a high consumption of meat and dairy products are illustrated in Figure 12. The scope for change of the identified drivers for high consumption of meat and dairy products is indicated in Table 13.

Table 11: Land use requirements of food.

Food product	Land requirement (m^2/MJ)
Beef	2.09
Pork	0.79
Cow milk	0.72
Eggs	0.60
Poultry	0.54
Vegetables (open land)	0.34
Bread	0.19
Apples	0.16
Crop/ cereals	0.12
Potatoes	0.11

Source: Bringezu and Schütz 2009 (p. 139), cited and corrected in SRU 2012 (p.106), land requirements calculated for German consumption considering international land requirements due to global trade of agricultural products

Table 12: Protein supply quantities in the EU

		2005	2009
Protein from animal sources (livestock and fish)	g/capita/day	61.2	61.8
Protein from vegetable sources (crops)	g/capita/day	43.6	43.3
Total protein	g/capita/day	104.8	105.1
Proportion of protein from bovine, pork and poultry meat, milk and eggs compared to total protein	%	48	48

Source: Based on data from (FAO, 2014)

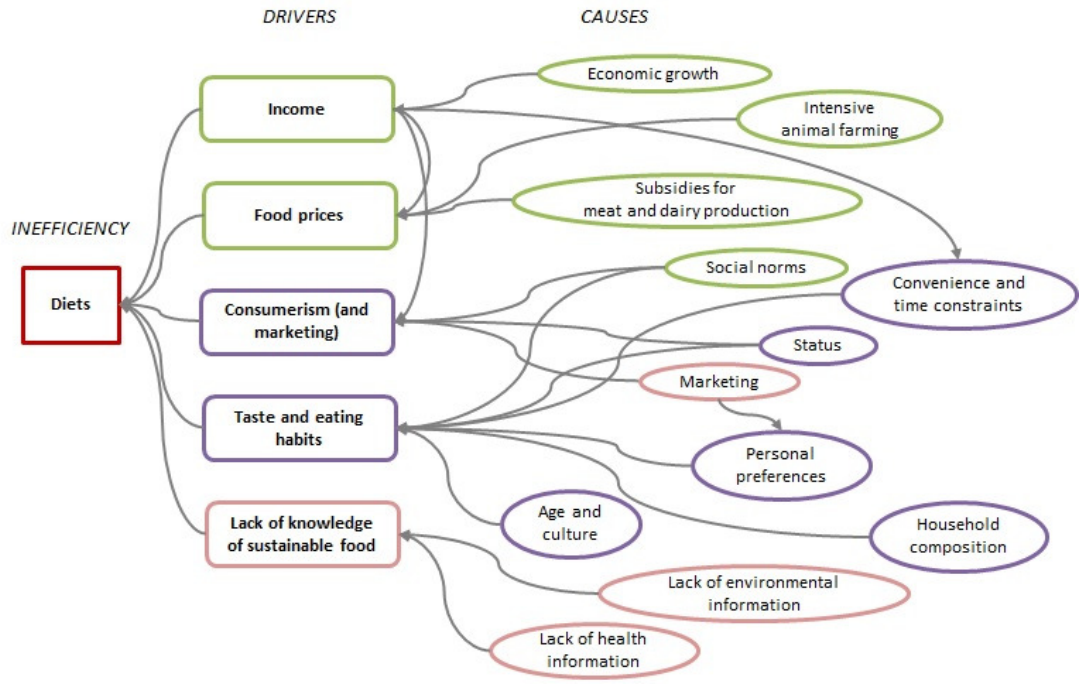


Figure 12: Drivers for high consumption of meat and dairy products; adapted from Tan et al. (2013)

Table 13: The level of change regarding drivers for high consumption of meat and dairy products

Drivers	Scope for change	
Preference for high protein diets that promote weight loss and builds muscle	Some scope for change	Short to medium term
Low prioritisation of the negative impacts on health of overconsumption of meat and dairy products		Medium term
Low prioritisation of animal welfare and the environmental impact of intensive husbandry		Medium term
Personal tastes and habits (e.g., influences by marketing and generational desire for meat due to post-war shortages)		Long-term
Consumerism (e.g., due to social norms, status and marketing)	Lower scope for change: Embedded into the reference scenario	
Food prices (e.g., due to global markets & production efficiencies from intensive animal farming)		
Increasing income and wealth (allowing for an increased share of high-price food products; e.g., meat and dairy products)		

There appears to be a hierarchy of drivers, where the drivers at the top of Table 13 are to a large degree enabled by the drivers lower down the table. So for example, dietary preferences are enabled by low prioritisation of health, environmental and animal welfare concerns, which are in turn enabled by personal tastes, which are enabled by the underlying consumerism paradigm. This is further enabled by the structural affordability drivers of increasing production efficiencies and incomes. Policy in this area has typically targeted the drivers at the top of this hierarchy, challenging dietary choices and knowledge levels. To achieve significant changes called for in the long term targets will require policy mixes which additionally tackle the drivers underling preference formation, and ultimately the drivers which link consumption to affluence.

Food waste

A significant proportion of the food produced for consumption ends up as food waste. In the EU27 around 90 million tonnes of food waste is generated annually (agricultural food waste and fish discards not included), corresponding to approximately 179 kg per person and year (European Commission, 2010a).

Food waste is generated throughout the food value chain, from agricultural production (farmer's field) to household consumption (consumer's plate) as illustrated in Figure 13. In medium- and high-income countries a higher proportion of food is wasted in the consumption stage. In the EU27 42%, of the food waste is generated in the household sector, 39% in the manufacturing sector, 14% in the food service/catering sector and 5% in wholesale/retail (European Commission 2010a). Evidence shows that up to 60% of the food waste is avoidable, i.e., could have been consumed as food (WRAP, 2013). Food waste inevitably implies an inefficient use of land and other resources used in food production.

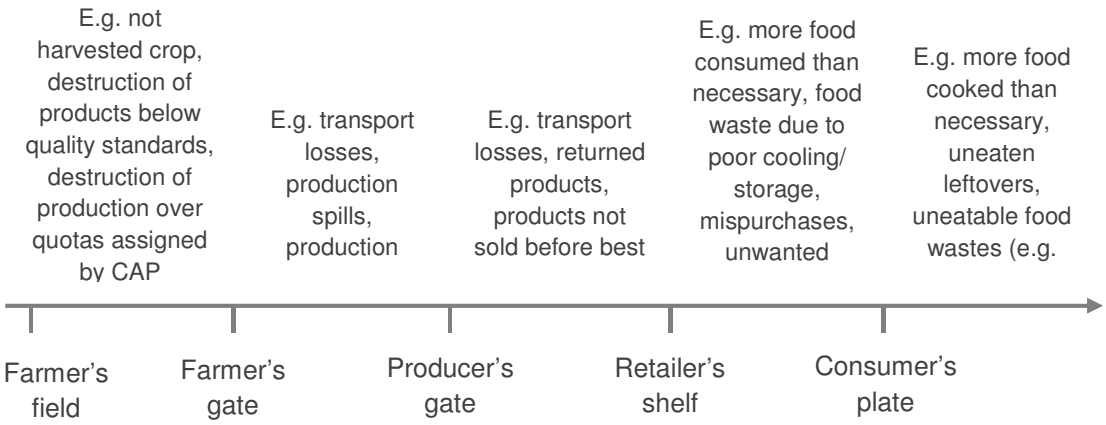


Figure 13: Overview of food waste generated at different steps in the food value chain (Source: own elaboration)

Overall, on a per-capita basis, more food is wasted in the industrialised world than in developing countries (Wunder et al. 2013). The FAO (2011) estimates that the average per capita food waste by consumers in Europe and North-America is up to 19 times higher than in Sub-Saharan Africa and South/Southeast Asia.

Typical drivers for generation of food wastes in households are illustrated in Figure 14.

The issues associated with the identified drivers for generation of food waste in households as well as possible areas of response are indicated in Table 14.

Figure 14: Drivers for generation of food waste in households. Source: own elaboration, based on Tan et al. (2013)

Table 14: Associated issues with and possible areas of response to the identified drivers for generation of food waste in households

Driver	Associated issue	Possible area of response
Packaging issues (e.g., use of packaging not suitable to protect the product during transportation)	Cost trade-off	Innovation
Storage issues	Storage infrastructure	Regulation
Socio-economic and demographic factors	Socio-economic	-
Attitudes	Cultural	Multiple responses
Personal preferences	Cultural	Multiple responses
Portion sizes (e.g., not adjusted for small households)	Habit	Labelling
Planning issues	Option values	Price of food
Labelling issues (e.g., misinterpretation and/or confusion over date labels)	Knowledge	Reform/information
Lack of knowledge (and interest) on the amounts of food waste as well as of the corresponding costs and environmental impacts	-	Information

Some of the drivers in Table 14 are more easily influenced within the scope of the policy mix than others. The drivers most readily influenced within the scope of the policy mix are storage issues, planning issues, labelling issues and lack of knowledge of food waste. More challenging drivers which will require influencing if these targets are to be archived include attitudes and personal preferences. The drivers least easily influenced within the scope of the policy mix are socio-economic and demographic factors.

Barriers for changing consumer behaviour

A main barrier for changing consumer behaviour regarding food consumption and food waste generation is inertia in consumer patterns and habits. As the head of food product chains, consumers potentially offer a powerful point of intervention for change. However, there are a number of factors particular to the choice of foods which diminish the potential for present consumers to initiate change. Unlike any other product type, food consumption choices are strongly determined by cultural, emotional and biological factors. Food is deeply anchored into many cultural identities.

Different (food) cultures pose a challenge for an EU wide policy mix with the objective of reducing consumption of meat and dairy products. A briefing note produced on behalf of the

European Commission[19] explored why consumers make certain food purchasing decisions (PSI, 2009). It found that once formed, food preferences are resistant to change: so long as we are not aware of a food making us unwell, our desire for a particular food will often increase with consumption. In addition, as a regularly purchased range of products, food purchases are particularly prone to habit formation and other short-cut decision making processes. The briefing note also found that biological aversion to hunger, and the associated emotional response, can explain the emergence of some apparently irrational and unhealthy eating patterns. For example, when people go to buy food hungry they will tend to shop differently and buy more. Also, on a physiological level, simply viewing or smelling food can act as a reminder of an experience and can induce the release of hormones which stimulate appetite. When experienced in combination, these factors can act to 'lock-in' food preferences in the long term, potentially on a generational basis.

Geographical and climate aspects might serve as barriers for decreased amounts of food waste. For example long transport routes (e.g., of fresh fruits and vegetables from Southern Europe to Northern Europe) might cause increasing amounts of food waste as could insufficient cooling chains in particularly warm countries. Generally, the increasing affordability of food represents a challenging context to implement policies intended at decreasing amounts of food waste.

Bioenergy

Bioenergy is the energy produced by biomass, including agricultural and forestry produced goods/commodities and waste/residues, and also natural vegetation available for harvesting. Biofuels are liquid fuels made from the processing of plant material or waste food products[20]. The use of biofuels has risen significantly over recent years, and in the EU it has increased by over twenty times between 2000 and 2011 (AEBIOM, 2013). According to a study from Ecofys et al. (2013), in 2010 5.7 million ha of land was needed to cover the demand for biofuels, out of which 3.2 million ha was within the EU (approximately 5% of total cropland) and 2.4 million ha outside.

Our policy analysis considered bioenergy primarily as a consumption issue; in other words, we made a simplifying assumption that the nature of production impacts on the environment are largely indifferent to the source of demand, and it is therefore the total quantity of demand for land use that matters[21]. The EU policy has been a major driver for the increased use of land for the production of biofuels and bioenergy in general. In 2003, Directive 2003/30/EC set a standard of 5.75% for biofuels over the total energy used in the transport sector. In 2009 this target was substantially increased, as Directive 2009/28/EC on Renewable Energy (RED) established that by 2020 10% of the energy used in the transport sector should be derived

[19] A project under the Framework contract for economic analysis ENV.G.1/FRA/2006/0073 – 2nd

[20] There are two main types of liquid biofuel: bioethanol, produced from the fermentation of plant biomass; and biodiesel extracted from oil-seed crops (e.g. maize, rapeseed, sugarcane).

[21] In practice, of course, there are specific environmental issues associated with production of some bioenergy crops (for example, miscanthus), but it would have significantly expanded the scope of our work to address them.

from renewable sources, which in practice means from biofuels, as these represent the most important share of renewable sources used in the transport sector.

Also, the Emission Trading Directive (ETS) establishes that CO_2 emissions from the combustion of biomass are to be considered zero. This makes biomass combustion a very interesting option for installations covered by the ETS scheme, as bioenergy is relatively cheap and can be mixed with existing fossil fuels easily.

The future trends of land use for biofuels will heavily depend on the policy targets and public support to the sector, and on the competitiveness of biofuels with other sources of energy (which in turn will be influenced by wider policy decisions on decarbonisation of energy supply) and is therefore difficult to forecast at this stage. In fact, the targets on biofuels set by the RED have been debated in the last years, because of their large land consumption and related environmental impacts.

Biofuels are not the only bioenergy that is having an important impact in terms of land use. Currently, 43% of total demand of forest feedstock is used for energy purposes and the use of wood for energy generation continues to increase in Europe. The demand for woody biomass will increase in the future to reach the 20% target for renewable energy in 2020 established by the RED. In fact, the RED is playing an important role in the increased use of bioenergy in general, as 68% of renewable energy used in Europe in 2011 is obtained from biomass (Eurostat, 2013a). Based on the NREAPs, it has been calculated that the use of EU woody biomass for electricity production and for cooling and heating will double between 2010 and 2020 (Hart et al. 2013, Hewitt 2011, UNECE and FAO 2011).

5.3 Targets

This section proposes policy targets for 2030 that are relevant to agricultural land use and consumption of agricultural products. There is a link between the rising demand for biomass products, intensification of agricultural practices and increasing environmental impacts of the agricultural sector, including loss of biodiversity (Haines-Young, 2009; Millennium Ecosystem Assessment, 2005). For this reason, this policy mix will simultaneously tackle both the consumption side, including food consumption, food waste and use of bioenergy, and the production side of the agricultural sector (focussing on minimising the impact of agriculture on biodiversity, water quality and quantity and soil quality), in order to progress towards a more sustainable use of land both at the European and at the global level. An overall target, expressed in terms of the EU's net land use impact (that is, the land use impact of EU agricultural consumption minus the land use impact of EU agricultural production) should be developed in due course, with the 2030 figure showing an improvement on the current figure, and a more ambitious approach for 2050; however, we lack the data to set precise targets at this stage.

5.3.1 Targets relating to production

Targets related to biodiversity

Targets for 2030:

The EU has existing targets for biodiversity and ecosystem services in place, which were endorsed by the European Council in March 2010. The immediate EU target, stated by the

EU Biodiversity Strategy, is to '*halt biodiversity and ecosystem service loss by 2020, to restore ecosystems in so far as is feasible, and to step up the EU contribution to averting global biodiversity loss*'.

The policy mix should also take into account the relevant targets and associated actions included in the EU Biodiversity Strategy, which was developed by the Commission to support the achievement of the EU's biodiversity targets. The targets of most relevance to this policy mix are listed in Box 5.

Box 5: The EU 2020 Biodiversity Strategy targets

Target 1: To halt the deterioration in the status of all species and habitats covered by EU nature legislation and achieve a significant and measurable improvement in their status so that, by 2020, compared to current assessments: (i) 100% more habitat assessments and 50% more species assessments under the Habitats Directive show an improved conservation status; and (ii) 50% more species assessments under the Birds Directive show a secure or improved status.

Target 2: By 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15% of degraded ecosystems.

Target 3:

A) Agriculture: By 2020, maximise areas under agriculture across grasslands, arable land and permanent crops that are covered by biodiversity-related measures under the CAP so as to ensure the conservation of biodiversity and to bring about a measurable improvement in the conservation status of species and habitats that depend on or are affected by agriculture and in the provision of ecosystem services as compared to the EU2010 Baseline, thus contributing to enhance sustainable management.

B) Forests: By 2020, Forest Management Plans or equivalent instruments, in line with Sustainable Forest Management (SFM)21, are in place for all forests that are publicly owned and for forest holdings above a certain size (to be defined by the Member States or regions and communicated in their Rural Development Programmes) that receive funding under the EU Rural Development Policy so as to bring about a measurable improvement in the conservation status of species and habitats that depend on or are affected by forestry and in the provision of related ecosystem services as compared to the EU 2010 Baseline.

Target 6: By 2020, the EU has stepped up its contribution to averting global biodiversity loss.

Progress with implementation of the existing Biodiversity Strategy and achievement of the 2020 target is uncertain. The 2020 target was always considered to be ambitious, and political commitment to it is now probably weaker given the recent economic crisis and the resulting focus on stimulating economic growth.

For example a recent study of the costs of restoring 15% of degraded ecosystems (i.e., Target 2) has indicated that, although many existing measures and funding instruments are contributing to the maintenance, restoration and re-creation of ecosystems in the EU, a substantial increase in funding will be required to achieve the target if the principal approach used is an expansion of incentive measures (Tucker et al. 2013). The costs of achieving

Target 2 could be reduced by adopting new and more ambitious EU level regulations, for example expanding the range of mandatory cross-compliance standards, but recent CAP reforms have not resulted in regulations that will give much stringer protection to biodiversity. Member States could also reduce costs further by establishing regulations beyond areas of existing EU competency (for example relating to spatial planning and forest management measures), but this appears to be opposite to the current political de-centralisation agenda.

For these reasons the 2020 biodiversity headline target and sub-targets 1, 2, 3 and 6 are adopted for this policy mix study as being the targets for 2030 under the assumption that they will either not be fully achieved by 2030 or they will require further actions to maintain their progress in the face of growing pressures, such as climate change.

Targets for 2050:

The longer term vision of the EU Biodiversity Strategy is that '*By 2050, EU biodiversity and the ecosystem services it provides – its natural capital – are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential contribution to human wellbeing and economic prosperity, and so that catastrophic changes caused by the loss of biodiversity are avoided.'* This is similar to the vision for biodiversity in 2050 adopted by the Convention on Biological Diversity (CBD) in its Global Strategy at its 10th meeting of the Conference of the Parties (held in Nagoya in October 2010), which is that by 2050 '*biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people*'. This will be the target of this policy mix in terms of biodiversity conservation and improvement.

Targets related to soil functionality

Targets for 2030:

As regards soil functionality, this policy mix aims to reduce the area of EU soils at risk of soil erosion and salinisation; causing soil sealing; halt and then reverse the loss of carbon through oxidation of organic (peat rich) agricultural soils (i.e., increase sequestration rate/ carbon stores of these soils); increase the proportion of EU agricultural land under organic production methods and close the gap in productivity between organic and conventional agriculture in the EU to avoid displacement of production to other parts of the world.

In 2006 the EU developed a Thematic Strategy for Soil Protection and a proposal for a framework Soil Directive, setting out common principles for protecting soils across the EU and establishing a ten-year work program for the European Commission[22]. The intention was that within this common framework, the EU Member States will be in a position to decide how best to protect soil and how use it in a sustainable way on their territory. Since then progress on EU legislation has failed to achieve support of the Member States.

The following proposals for targets for 2030 are based partly on the draft Soil Directive.

[22] http://ec.europa.eu/environment/soil/index_en.htm

- Using common guidance criteria developed by Commission services, to identify by 2020 and thereafter every 5 years in each EU Member State/region the area and location of agricultural and forest land where soils are at risk from:

  (a) erosion by water or wind, and in the case of organic (peat) and organo-mineral soils by drying out and oxidation;

  (b) organic matter decline brought about by a steady downward trend in the organic fraction of the soil, excluding undecayed plant and animal residues, their partial decomposition products, and the soil biomass;

  (c) compaction through an increase in bulk density and a decrease in soil porosity;

  (e) salinisation through the accumulation in soil of soluble salts;

  (f) landslides brought about by the down-slope, moderately rapid to rapid movement of masses of soil and rock material

- To prioritise the risks and areas identified at Member State/regional level and prepare national soil action plans (the relative significance of the different risks varies across the EU because of variation in soil types, climate, topography and land use)
- To prevent ploughing, drainage, burning of (vegetation on) or afforestation of peat soils.
- To convert all arable land on drained organic (peat) soils to land management which will halt losses of soil carbon.
- To increase the proportion of agricultural land in the EU under organic production methods

Targets for 2050:

The targets of this policy mix for 2050 are the following:

- To implement national soil action plans at Member State/regional level.
- To convert all agricultural land on drained organic (peat] soils to land management which will ensure these soils function as long-term carbon sinks, including by rewetting.
- To increase further the proportion of agricultural land in the EU under organic production methods.

Targets related to water quality and water quantity

The EU has a well-established policy framework for improving water quality and the sustainable use of water resources in the Water Framework Directive (WFD)[23]. The WFD introduced a new focus for water management by putting the protection of the aquatic environment and ecological targets at the heart of an integrated water management approach

[23] Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy

at the river basin scale[24]. The WFD's objective is that all EU water bodies achieve good status by 2015, which includes the objectives of good ecological and chemical status for surface waters and good quantitative and chemical status for groundwater. This is necessary to ensure long term availability of sufficient water of good quality, to allow aquatic ecosystems to recover and to deliver the ecosystem services that are necessary to support life and economic activity that depend on water.

The targets related to the fulfilment of the WFD objective of good status depend on the specific characteristics and conditions of each water body, and need to be defined by the River Basin authorities in the River Basin Management Plans (RBMPs). For this reasons it is impossible to set general quantitative targets. The WFD's Annex 5 establishes the key parameters that should be used to assess the status of water bodies.

It is important to underline that the WFD's article 4.4 establishes that MS can benefit from exemptions if achieving a good status within the set timescale is technically infeasible or disproportionately costly, and are allowed to extend the deadline up to 2027 or beyond. This is because it is unlikely that all EU water bodies will reach a good status within such a limited timeframe.

Targets for 2030:

The WFD requirements are proving difficult to achieve in practice and to schedule. As clarified by the last Commission report on the implementation of the WFD (European Commission, 2012d), a good status will not be reached in 2015 for a significant proportion of water bodies. This policy mix aims to ensure a good ecological and chemical status for most surface water bodies and a good quantitative and chemical status for groundwater bodies in all river basins where agriculture is the main land use and currently the main source of diffuse pollution.

This target implies:

- To ensure that agricultural abstraction rates from aquifers are less than replenishment rates, and that abstraction rates from surface waters are kept within sustainability limits. Achieving this target will require to eliminate the use of inefficient irrigation inefficient irrigation methods[25] and to encourage the choice of crops adapted to the local climate.

[24] Other relevant EU Directives are the Groundwater Directive (2006/118/EC) and the Nitrate Directive (91/676/EEC). The first one establishes that nitrate concentration in the EU groundwater bodies should not exceed the minimum level of 50mg/l (however several MS have set higher limits). The second one requires MS to establish action programmes for farmers, which include measures contained in the Codes of Good Agricultural Practices and other measures, such as limitations of fertilizer application and a maximum amount of livestock manure of 170 kg nitrogen/ha/yr. The Nitrate Directive is expected to contribute to a 14% reduction of ammonia (NH3) with respect to 2000 levels by 2020.

[25] However, it must be kept in mind that more 'efficient' methods that have lower losses have actually been shown to sometimes lead to increased consumption of water and have even been associated with causing artificial droughts. For this reason, it is important to ensure that when installing more efficient irrigation systems, the water 'saved' has to go back to nature.

- To ensure that the nutrient concentration in each water body is compatible with the conservation of ecosystems. This will require the adoption of precision farming techniques, where fertiliser use is closely tailored to crop needs.
- To limit the use of chemical pesticides in order to ensure that they do not have a negative impact on water ecosystems. This will be allowed by employing alternative methods for pest control, including improved cultivation methods, employment of natural antagonists to pests and crop rotation.

Targets for 2050:

It is to be expected that not all water bodies will achieve a good status by 2030, because for the most polluted or exploited ones this may be extremely expensive, difficult or impossible from a technical point of view, or politically unfeasible.

Also, as regards fertilisers, time lag between the reduction of the discharge of nitrates and phosphates and the reduction of their concentration in the water is often observed, due to hydrological dynamics and ecosystem functions of natural water purification. This implies that policies aiming at reducing water pollution may take a long time to result in lower pollution levels.

For this reason, this policy mix aims to reach a good status for all EU surface and groundwater bodies by 2050, including the ones that have not managed to reach the target by 2030. This implies:

- From a quantitative point of view, to ensure that water abstraction of groundwater do not exceed the recharge levels and that extraction of surface water is not above the thresholds needed for ensuring sustainability of aquatic ecosystems.
- From a qualitative point of view, to ensure that the nutrient cycle in agriculture is closed, ensuring no leaking of nutrients into water bodies, and that pesticides are only used within sustainability limits.

5.3.2 Targets relating to consumption

Targets regarding dietary habits (food consumption)

This policy mix focuses on policy instruments that aim to generate a shift in the consumption of agricultural food products towards less consumption of meat, dairy products and eggs, as the land use related to these commodities is higher than for other products (see

Table 11). The scope of the policy mix is limited to human consumption of these products (i.e., excluding animal feed and pet food).

The scope for meat consumption is limited to the consumption of beef, pork and chicken, since these correspond to 98% of total meat production in the EU (Eurostat, 2014a). The scope for milk consumption is limited to the consumption of milk from cows since this corresponds to 98% of total milk production in the EU (Eurostat, 2014b).

The targets for 2030 and for 2050 defined in the following are milestones on the road to change dietary habits with the objective to reduce the impacts on land use from food consumption, focussing on the consumption of meat, dairy products and eggs.

Targets for 2030:

The Roadmap to a Resource Efficient Europe sets out a 20% reduction target for the resource inputs within the food chain by 2020 (European Commission 2011a).

This policy mix adopts the following targets that are set according to expert judgment:

- **Reduction of the total protein consumption:**
  EU-wide a 20% reduction in the per capita intake of protein for adults compared to the level of 2009.
- **Reduction of the proportion of protein intake from meat, dairy products and eggs:**
  In the EU not more than 35% of the total per capita protein intake should come from bovine, pork and poultry meat, milk and eggs.
- **Shift towards consumption of meat with lower land requirements:**
  Beef should not exceed 10% of total meat consumption.

Targets for 2050:

NDA recommendation is daily intake of 0.66 g protein/kg body weight.

This policy mix proposes the following targets, also derived from expert judgment:

- **Reduction of the total protein consumption:**
  The EU-wide total per capita intake of protein for adults should not exceed the recommended levels (0.83 g protein / kg body weight).
- **Reduction of the proportion of protein intake from meat, dairy products and eggs:**
  In the EU not more than 25% of the total per capita protein intake should come from bovine, pork and poultry meat, milk and eggs.
- **Shift towards consumption of meat with lower land requirements:**
  Beef should not exceed 5% beef of total meat consumption.

Tables 15-17 give an overview of the specific targets for 2030 and 2050. The targets mentioned above are highlighted in bold. Further figures for 2030 and 2050 are also included, either as interim indicators or as extrapolations of progress, but are not highlighted in bold.

Table 15: Targets regarding reduction of the total protein consumption

	Unit	2009*	2030	2050
Total protein intake	g protein/ kg body weight/ day	1.48	1.19	**0.83**
Reduction compared to 2009 level	%	-	**-20**	-44

Source: *(FAO, 2014)

Table 16: Targets regarding reduction of the proportion of protein intake from meat, dairy products and eggs

	Unit	2009*	2030	2050
Protein from animal sources (livestock and fish)	g/capita/day	61.8	-	-
Protein from vegetable sources (crops)	g/capita/day	43.3	-	-
Total protein	g/capita/day	105.1	84.5	46.7
Proportion of protein from bovine, pork and poultry meat, milk and eggs	%	48	**35**	**25**
Reduction compared to 2009 level	%	-	-27	-48

Source: *(FAO, 2014)

Table 17: Targets regarding shift towards consumption of meat with lower land requirements

	2012*	2030	2050
Proportion of bovine meat (from total bovine, pork and poultry)	18%	**10%**	**5%**
Proportion of pork meat (from total bovine, pork and poultry)	54%	**40%**	**20%**
Proportion of poultry meat (from total bovine, pork and poultry)	28%	**50%**	**75%**
Total	100%	100%	100%

Source: *(Eurostat, 2014a)

Targets regarding food waste from households

At the top of food product chains, consumers potentially offer a powerful point of intervention for change. Furthermore, the single largest share of food waste (42%) is generated in households (European Commission, 2011a). Therefore all food waste generated in households are considered within the scope of the policy mix.

In addition, consumers can indirectly influence food waste from the food production chain (e.g., by accepting wonky fruit and vegetables). To the extent consumer behaviour can influence the generation of food waste before final consumption (retailer's shelf), such food waste is considered within the scope of the policy mix.

Policy instruments reducing the generation of waste are assumed to impact wastes from all types of food. Therefore, all types of food wastes (e.g., meat, bread, vegetables etc.) are included in the scope regarding the generation of food waste. The objective of this policy mix is to eliminate the avoidable ("lifestyle based") food waste (e.g., careless buying, poor portion size etc.).

The Roadmap to a Resource Efficient Europe sets out a 50% reduction target for edible (avoidable) food waste for 2020 (European Commission, 2011a). A 50% prevention target on avoidable food waste for 2025 was proposed by the European Parliament in 2012 (European Parliament, 2012).

Targets for 2030:

The targets for 2030 of this policy mix are the following:

- EU-wide a 60% reduction of avoidable food waste compared to 2010 levels. This figure represents an increase with respect to the above mentioned EU targets and corresponds to 1-2% reduction per year between 2020/2025 and 2030 (a yearly reduction of 3-5% per year will be needed between 2010 and 2020/2025 if the 50% targets are to be achieved).
- Maximum 30% higher generation of food waste per capita than the EU-wide average in all Member States.

Targets for 2050:

The long-term targets aim to:

- EU-wide a 85% reduction of avoidable food waste compared to 2010 levels
- Maximum 15% higher generation of food waste per capita than the EU-wide average for all Member States

Targets related to bioenergy

Targets for 2030:

This policy mix aims at drastically reducing the EU consumption of conventional biofuels, i.e., those obtained from food or feed-based feedstock like maize, rapeseed and sugarcane. This will require phasing out the EU and MS support to conventional biofuels, and also avoiding setting new targets after 2020.

Even though not supported by public policies, conventional biofuels will still play a role in the EU transport sector in 2030, due to the legacy of past policies and a possible increase in the prices of fossil fuels. Therefore, this policy mix will aim to mitigate the environmental impacts associated with conventional biofuels.

Another objective of this policy mix is to favour biofuels from more sustainable sources over conventional biofuels, like for example agricultural and forest waste and residues. However, the potential use and related environmental benefits of using an increasing share of these materials in the energy sector should be carefully analysed against other potential uses, as for example agricultural and forest residues are partly needed on the ground to maintain soil fertility and biodiversity. Also, energy and economic costs related to the collection and processing phase needs to be carefully analysed before setting quantitative standards.

For these reasons, this policy mix aims at ensuring that bioenergy is used as to maximise the benefits of bioenergy in terms of GHG savings (estimated over the entire life cycle), while considering possible alternative uses of potential feedstocks and taking into account the environmental impacts of alternative options.

Targets for 2050:

The policy mix aims at a sustainable and holistic management of European bio-resources, i.e., the biomass used for food, feed, energy and materials. This will ensure that biomass is used in order to deliver the highest GHG savings possible and that waste and residues are employed in an appropriate way to meet a range of objectives (e.g., reducing GHG emissions and maintaining soil fertility). Also, a cascading use of bio-resources needs to be promoted, instead of focussing on only one use like energy production.

5.4 The proposed policy mix for the production side

The EU has a relatively comprehensive environmental policy framework, compared to other world regions (IEEP, 2011) and therefore a number of policy instruments can contribute to the achievement of the targets outlined above for biodiversity, soil functionality and water. Of particular importance within an agricultural context are the:

- Birds and Habitats Directives,
- Environmental Liability Directive,
- Nitrates Directive,
- Sustainable Use of Pesticides Directive,
- Water Framework Directive, and
- National Emissions Ceilings Directive.

These set standards, identify objectives and include legislative requirements for certain actions. They are supported by the Strategic Environmental Assessment (SEA) Directive and Environmental Impact Assessment (EIA) Directive, which set out procedures for assessing potential impacts, although they do not per se require impacts to be avoided or limited. The Common Agricultural Policy (CAP) is the most important instrument in terms of supporting the achievement of the aims of the Directives listed above, through its own regulations (which directly link to obligations in some of the environmental directives) and especially through the funding of measures that provide environmental benefits above and beyond those required under regulations (i.e., the reference level).

The policies selected for detailed assessment in work packages 5 and 6, building on the legislative framework set out above, are the following:

1. Stronger and more effective environmental and climate dimension for EU land management in future CAP reforms – GHG emissions, soil quality, water quantity and quality, biodiversity.
2. Revised emissions levels in the National Emissions Ceilings Directive (NECD) to reduce eutrophication; measures for better management of the nitrogen cycle on farmland (higher fertiliser use efficiency, improved crop and manure management that reduce emissions, low-protein animal feeding, improved manure storage).
3. Strengthening of the pesticide reduction targets under the Pesticides Directive, and provision of guidance to farmers on integrated pest management.
4. Promotion of PES programmes financed by private actors to reward farmers for producing ecosystem services.
5. Development of a LULUCF regulation setting targets for net carbon emissions from the land use sector.

While these primary instruments are the most significant, we recommend that they should be supported by a range of accompanying measures, which will not be subject to the same level of detailed assessment. These include:

- Increased irrigation water prices to cover at least full supply costs.
- Improved implementation of the Environmental Impact Assessment Directive on changes in agricultural or forestry land use.
- Improved and increased management plans and measures for Natura 2000 areas dependent on agricultural activity.
- The establishment of an EU soil legislation which mandates cost-effective action to tackle soil problems and to protect soil functions.
- The promotion of research, monitoring, and data collection and surveillance.

The following sections therefore set out in more detail the 5 production policies selected for more detailed assessment. That assessment will work on the assumption that the accompanying measures referred to above are also implemented.

5.4.1 Stronger and more effective environmental and climate dimension for EU land management in the CAP.

Brief summary of the measure

The Common Agricultural Policy is one of the key drivers of agriculture in the European Union because it provides direct subsidies to farmers and also subsidises a range of agricultural activities that involve farmers. To a lesser extent it also influences forest management in the European Union because it provides the only significant source of EU funding for forests. This instrument contributes to achieving the policy mix targets for biodiversity, soil quality and water quality through targeted implementation of the Common Agricultural Policy measures.

Brief description of the design and scope

a. <u>When would it be introduced?</u>

The actions for the 2014 to 2020 period (aimed at achieving the 2020 targets) depend on Member States' decisions on the design and planning of their Common Agricultural Policy

implementation, particularly in the definition of cross-compliance rules and other eligibility and targeting criteria, and in the design and implementation of rural development programmes. For the post 2020 Common Agricultural Policy (aimed at achieving the 2050 targets) actions must begin in the lead up to the 2020 policy reform, by influencing regulatory reform, and continue during the implementation phase of the 2021-2027 CAP. A further opportunity is provided by the 2027 CAP reform and the following implementation periods up to 2050 (2028-2035, 2036-2041, 2042-2049), although the impacts will weaken the closer to the target year of 2050 (because of the increasing lack of time for measures to have an effect).

b. What is its aim?

This instrument contributes to achieving the policy mix targets for biodiversity, soil quality and water quality through targeted implementation of the Common Agricultural Policy measures. In order to achieve these targets, the agricultural authorities of Member States will need to design their agricultural programmes to enhance the long-term protection and management of permanent grassland and pastoral semi-natural habitats, and other High Nature Value farming systems and their species.

c. What economic sectors and point(s) in the lifecycle would it be targeted at?

The actions for the 2014-2020 period must primarily be taken by Member State governments and agricultural authorities, but will also require the active participation of farmers, shepherds, forest managers, and other groups involved in land management. The actions for the post 2020 period will need to be taken by the European bodies and the Member States during the negotiation of the next Common Agricultural Policy package, and then by the same stakeholders as above during the implementation phase.

d. What requirements does it place on relevant players?

During 2014 to 2020, Member States governments and agricultural authorities will need to:

- Define eligibility of agricultural land; minimum agricultural activity; requirements for the compulsory greening payment; and GAEC requirements within the cross-compliance regime so as to enhance the long-term protection and management of permanent grassland and pastoral semi-natural habitats (including all Habitats Directive Annex 1 habitat types that depend on agricultural use), riparian buffer strips, and farmland features, as well as soil protection, water and nitrogen use efficiency.
- Increase funding and targeting of agri-environment-climate and other support measures to semi-natural ecosystems (especially with Natura 2000 sites), and other areas of High Nature Value Farmland.
- Increase support and investment in traditional agricultural management techniques and systems alongside the development of new approaches and adaptation to changing socio-economic conditions (e.g., organic farming, improved crop rotations, integrated weed and pest management, intercropping, better nutrient management, conservation tillage, unfarmed flower-rich buffer strips, and reduced livestock densities).
- Ensure that agri-environment-climate and agro-forestry and forest conservation and protection schemes and habitat restoration initiatives maximise synergies between biodiversity, flood management and ecological status objectives at local and catchment scales.

In the lead-up to the post 2020 period, Member States government representatives and the European bodies (Commission, Parliament and Council) will need to:

- Integrate a stronger and more effective environmental and climate dimension for EU land management in the CAP 2020 reform, including sufficient budget allocations, targeted rural development programmes, and measures that encourage farmers to identify and take appropriate actions to use water, soil, energy and waste resources more efficiently. Overall, it is unlikely that CAP expenditure will increase in real terms; however, even within a declining real-terms budget, a significant recfocusing of expenditure on the delivery of environmental objectives is capable of providing an adequate budget.
- Define cross compliance standards that protect semi-natural habitats (especially grassland and peat-rich soils), contribute substantially to achieving WFD objectives, and improve soil protection.
- Ensure the CAP and other EU funds supporting agricultural development fully integrate requirements relating to biodiversity and ecosystem services and are subject to biodiversity and climate proofing procedures.

e. Links/synergies/interlinkages with other instruments in the policy-mix

This policy instrument will have synergies with the policy instruments to reduce nitrogen emissions, pesticide and irrigation water use, and to improve soil quality, which will rely heavily on cross-compliance standards and advice and measures financed under the Common Agricultural Policy. The policy instruments on research (e.g., as regards innovation in agriculture) and on Natura 2000 management planning will support the implementation of this policy instrument.

f. For subsidy: How would it be financed?

The actions are financed through the Common Agricultural Policy funds (the European Agricultural Guarantee Fund EAGF and the European Agricultural Fund for Rural Development EAFRD), and Member State co-financing for rural development. It is expected that the policy changes proposed would not lead to a net increase in public expenditure, but to better targeting of funding on the delivering of public benefits, particularly environmental outcomes.

g. What physical flows (if any) are directly targeted by the policy instrument?

None directly, but the policy instrument interacts closely with the other policy instruments that target soil, water, and pesticide flows.

Governance

a. At what level scale should the instrument be deployed (EU, MS, etc.)?

At Member State and regional level for the 2014 to 2020 period; at EU and Member State plus regional level for the post 2020 period and subsequent policy reforms.

b. What stakeholders should be involved in the negotiations and agreement?

Agricultural authorities, farmers, farmer organisations including cooperatives, other land managers including shepherds and commoners, conservation authorities, conservation land management groups, environmental groups, forest managers and forest organisations, consumers, stakeholders in rural development such as agriculture-related tourism and recreation.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Farmers must comply with the cross-compliance obligations and the greening payment conditions, and can be sanctioned with removal of part or all of their direct farm payment if they do not comply. These include:

- Compliance with any defined conservation objectives and measures in Natura 2000 areas.
- Compliance with any defined restrictions or management obligations with regard to nutrient management in nitrate vulnerable zones.
- Follow groundwater protection rules.

Farmers and other agricultural land managers must also comply with any conditions attached to payments they receive under rural development programme measures. Forest managers must implement a sustainable forest management plan if the forest area is above a threshold size.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

Coordination at the EU level will be important, as the CAP reforms will be carried out at the EU level

e. What is the perceived feasibility and acceptance among key actors?

Farmers are currently hardly affected by actual fines for non-compliance as the current inspection rate for cross-compliance rules is low. However, compliance is also enforced through self-reporting and other administrative mechanisms, and farmer's perception of restrictions also plays a very important role. There may be administrative barriers to change in public agricultural administration authorities, which mean that advice and enforcement are weaker than they should be.

Environmental impacts and effectiveness

Effectively protecting and managing semi-natural agricultural habitats (grassland, scrub and wetlands) through agricultural policy would have a large positive impact on the biodiversity value of European agricultural land. The policy changes would need to be supported by an effective system of mapping and recording all semi-natural habitats and landscape features on agricultural land. Improving productivity on intensively managed land will reduce the land requirement for agricultural activities elsewhere.

Specific targets for a more effective CAP from 2020 onwards could be envisaged, and could include:

- A 10% reduction in greenhouse gas emissions by 2020.
- No net loss of biodiversity from the farmed environment, with progressively more demanding targets for improved habitat management.
- Reduced inputs of inorganic fertiliser, and of pesticides, in line with the policies included in this mix, and facilitated by an increased focus of rural development funding on improved and more targeted management of nutrients and pesticides.

Key expected economic impacts

Farmers' increased compliance with environmental standards on air, water and soil-related pollution is expected to have significant economic benefits, for example associated with increased water quality. See the nitrogen measure for some quantified estimates. However, achieving higher environmental standards and also investing in high nature value farming will

require agriculture significant shift of funding away from instruments which have a significant benefit for farm incomes (because the funds provided significantly outweigh the costs of compliance with the criteria) and towards instruments which have a less direct benefit for a farm's profitability. Overall, this would be likely to lead to a decrease in farm profitability and farm incomes, compensated for in part by market adjustments to input costs such as land prices, and costs of fertiliser and pesticides.

Key expected social impacts

An improvement in the management of semi-natural habitats will improve the livelihood of farmers owning high nature-value land, thereby reducing land abandonment and preserving the cultural identity and sense of community of rural areas. Many of the environmental measures required for an improved environmental focus have significant positive employment impacts. However, the reduction in incomes noted above is likely to lead to a consolidation of land holdings, and a reduction in the total level of employment in agriculture.

5.4.2 Revised emissions levels in the National Emissions Ceilings Directive (NECD) and additional measures for better management of the nitrogen cycle on farmland

Brief summary of the measure

The instrument aims to establish revised emissions levels in the National Emissions Ceilings Directive (NECD) to reduce eutrophication; and implement measures for better management of the nitrogen cycle on farmland (higher fertiliser use efficiency, improved crop and manure management that reduce emissions, low-protein animal feeding, improved manure storage). The policy would involve (i) more ambitious targets for Member States in the National Emissions Ceilings Directive, with implications for emissions from the land use sector; (ii) possibly enhanced regulation at Member State level, or cross-compliance requirements at EU level (cross-compliance represents the minimum requirements a farm must meet to qualify for CAP payments); (iii) public funding in the form of CAP rural development programmes to subsidise or incentivise compliance; and potentially (iv) tax instruments introduced at the discretion of Member States.

Brief description of the design and scope

a. <u>When would it be introduced?</u>

Emission reduction targets for key airborne pollutants from agriculture apply to 2030, but will require measures to be introduced as soon as feasible if they are to be met. Further targets from 2020 onwards may be set if the National Emission Ceilings Directive is revised this year.

b. <u>What is its aim?</u>

- Review and revise emissions levels in the National Emission Ceiling Directive (NECD) so that they would reduce eutrophication to below critical levels, and integrate necessary measures into the CAP to reduce agricultural sources of nitrogen deposition to acceptable levels.
- Ensure compliance with the Nitrates Directive and other EU legislation that reduces environmental emissions from farmland to water.

- Increase public funding to help overcome barriers to environmental action by farmers, particularly through modest support to upfront environmental investment costs and start-up costs where needed. For example, improvements in farm infrastructure or machinery to minimise ammonia emissions, increase energy efficiency & renewable energy use, reduce water use.
- Encourage better management of the nitrogen cycle on farmland (maintaining yields while reducing pollution loads including greenhouse gas emissions), for example through more balanced fertiliser use, improved crop and manure management, precision farming techniques; low-protein animal feeding; and improved manure storage.

c. What economic sectors and point(s) in the lifecycle would it be targeted at?

The agricultural sector is a key source of nitrogen emissions to the air, water (surface water and groundwater) and soil. The main sources are intensive animal rearing facilities (livestock, poultry, pig and other intensive rearing units), fertiliser use on arable crops, and manure/slurry storage on livestock farms. The measure is therefore primarily targeted at farmers with intensive animal production systems and arable farmers. Additionally, tighter nitrogen pollution emission targets will affect the transport sector.

d. What requirements does it place on relevant players?

Farmers with intensive animal production systems will be required to invest in farm infrastructure and processes such as air filtration units, sealed slurry pits, biomass units to process slurry/manure. Farmers will also need to invest in more efficient feed conversion rates, for example through better feed materials and mixes (e.g., lower protein), better feeding practices, different animal breeds and husbandry practices. Arable farmers will be required to improve their fertilisation planning and management practices, through farm nutrient plans, soil quality mapping, better monitoring and crop practices (e.g., crop rotation and use of cover crops), as well as through more targeted and balanced fertiliser application (e.g., using precision farming techniques).

e. Links/synergies/interlinkages with other instruments in the policy-mix

The policy measure provides synergies to the soil measure, as it stimulates a demand for better arable farming practices that will benefit both nitrogen and soil targets. It provides benefits for the Natura 2000 measure, as it will reduce the pressure of eutrophication on Natura 2000 habitats and species, making restoration of favourable conservation status easier.

f. For taxes and subsidies: what is the level of the tax/subsidy?

Subsidies are provided under Rural Development Programmes for farmers to invest in better nitrogen management. There is a key role for more targeted subsidies to farmers to address the key barriers to the most beneficial but costly investments, such as slurry storage (Cardenas et al. 2011). These could be accompanied by tax instruments on inorganic fertiliser.

- For tax: Who is to pay it and how are the revenues to be used?

Some Member States have applied a fertiliser tax, paid by the farmers who purchase the fertiliser (Withana et al. 2013). There is scope for hypothecation of revenues to services including enhanced advice to farms on fertiliser use; however, given state aid constraints and other administrative barriers, this may not be attractive.

- For subsidy: How would it be financed?

Rural Development Programme subsidies are financed half by EU funds and half by Member State public funding; as noted in the CAP fiche above, an improved targeting of existing funding could provide an adequate contribution to this policy objective. Additional funding is potentially available to farmers through payments for ecosystem services (for water quality).

g. What physical flows (if any) are directly targeted by the policy instrument?

Nitrogen (energy use is indirectly targeted as fertiliser manufacture is a significant user of fossil fuel).

Governance

a. At what level scale should the instrument be deployed (EU, MS, etc.)?

Primarily at the level of the Rural Development Programmes (in some cases this is national, in some Member States it is regional) and of the River Basin Management Plans (local). The National Emission Ceilings Directive is currently under discussion for revision at the EU level, and there is also currently an opportunity to set further strategic goals on air pollution at the EU level. In the longer term, there is scope at the EU level for reform of other key policies affecting nitrogen emissions, including the Nitrates Directive, the Water Framework Directive, and the Common Agricultural Policy.

b. What stakeholders should be involved in the negotiations and agreement?

Livestock farmers and companies and private persons involved in intensive animal rearing are primarily affected, and should therefore be consulted. Fertiliser production companies and animal feed companies could make investments in products that allow more optimum use of nitrogen, as well as more support to farmers regarding good practices, but could also slow down change if they do not cooperate with higher standards.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Farmers, primarily livestock farmers and companies and private persons involved in intensive animal rearing, are responsible for meeting minimum targets at the farm level. Fines for nitrogen pollution have so far not been heavily used, but this may change in future.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

Action to reduce nitrogen emissions from the agricultural sector will require a combination of subsidies, advice and capacity building, regulatory targets, and enforcement. Otherwise the necessary actions will not be taken, as although some on farm actions can bring cost savings, others will require substantial investments and may reduce the profitability of intensive animal production systems (van den Broek, 2007; Schoumans et al. 2011).

e. What is the perceived feasibility and acceptance among key actors?

The farming sector is currently wary of the possible consequences of tightening air pollution targets at the EU level. However, some Member States, notably The Netherlands, have set up action programmes for their agricultural sectors with ambitious aims, and have improved the acceptance of measures to reduce nitrogen emissions. Feedback on monitoring results to farmers in accessible and appropriate formats would help motivation and learning, as well as support enforcement.

Environmental impacts and effectiveness

The strict and uniform implementation all over the EU of 1) balanced fertilisation (fertiliser use that does not lower crop yields but that decreases N leaching losses to less than 50 mg NO3-l-1), combined with improved crop and manure management; 2) low-protein animal feeding, combined with improved herd management; and 3) ammonia emissions abatement measures, including improved manure application and storage, would increase Nitrogen Use Efficiency by 25 per cent, while ammonia emissions would decrease by 31 per cent and N leaching by 41 per cent (Oenema et al. 2009). This would bring substantial benefits for biodiversity both on farmland and in freshwater and marine habitats in Europe; however, the nature and rate of recovery of biodiversity from nitrogen pollution is still poorly understood

(Dise et al. 2011). Actions to achieve balanced fertilisation may, however, introduce an increased risk of reduced yields under particularly favourable growing conditions when the N demand of crops is relatively high (Oenema et al. 2009).

Key expected economic impacts

A cost-benefit analysis estimated the total annual Nr-related damage in EU27 at between 70 and 320 billion Euro, equivalent to 150-750 euro/capita, of which about 75% is related to health damage and air pollution (Brink & van Grinsven 2011). It also estimated that internalising the environmental costs of N-fertilisation would lower the optimal N-rate for profitability of arable production in North-West Europe by at least 50 kg/ha. One baseline scenario calculated that strict implementation of balanced fertilisation in nitrate vulnerable zones, as defined in the Nitrates Directive, decreases total farmers' income in EU-27 by 1.7 billion euros per year (Oenema et al. 2009). Implementation of all three measures decreases farmers income by 10.8 and total welfare by 17 billion euros per year, without valuing the environmental benefits. Livestock farming measures may be relatively more costly in the most intensive farming regions in the EU.

Key expected social impacts

Reduced nitrogen pollution in both air and water is expected to bring substantial long-term health benefits. The Commission's policy impact assessment estimated the health benefits of the proposed Clean Air Package as around €40 billion per year to 2030. The European Nitrogen Assessment estimates that at least ten million people in Europe are potentially exposed to drinking water with nitrate concentrations above recommended levels (Sutton et al. 2011).

There may also be some social impacts within the farming sector, if poorer farm businesses find it more difficult (notwithstanding support from rural development funding) to finance necessary investment; and if higher costs lead to consolidation of farm businesses, there could be initial localised impacts on employment which may require accompanying measures.

5.4.3 Promotion of "Payment for Ecosystem Services" programmes

Brief summary of the measure

The measure consists in encouraging the establishment of PES programmes aiming at reducing the environmental impact of agricultural activities and financed by private actors (e.g., water companies, tourist operators). The development of new PES programmes will be financed by private companies, but public authorities will play a key role in the increased use of this kind of measures by offering 1) fiscal incentives and 2) support, including mediation, control activities, and also, when appropriate, guarantees to ensure a long term planning (e.g., guaranteeing the payment even in case the company goes bankrupt or cannot afford to pay). Sectors with potential for making such payments include the water sector (to encourage farms to avoid practices which lead to diffuse water pollution); energy undertakings or other businesses with an interest in offsetting carbon emissions; and tourism businesses which rely on high levels of landscape value and biodiversity.

Brief description of the design and scope

a. When would it be introduced?

We suggest this policy measure is introduced in 2020, as it is relatively easy to implement.

b. What is its aim?

The policy aims to increase the sustainability of agricultural practices, and in particular to preserve or improve water quality (e.g., PES financed by water companies that are willing to remunerate farmers to reduce the use of fertilisers and pesticides, and thereby maintaining or improving water quality) and biodiversity/landscapes (e.g., PES financed by tourist companies that pay farmers to maintain biodiversity-rich semi-natural areas). Involving the private sector will increase the funding available for the maintenance/enhancement of the ecosystem services provided by the agricultural land, in order to complement regulation and public incentives.

c. What economic sectors and point(s) in the lifecycle would it be targeted at?

The measure will be targeted at private companies in order to encourage them to finance the provision of ecosystem services. The establishment of information and support programmes run by public authorities will be key to extend the use of PES private PES schemes, and will be both targeted at the providers and buyers of ecosystem services - i.e., at farmers and private companies.

d. What requirements does it place on relevant players?

The fiscal incentive would take the form of tax reliefs on payments for ecosystem services, and would require the beneficiaries (i.e., the private companies) to put in place PES programmes to qualify. As regards the support activities, the provision of information and mediation will not entail specific requirements, as they are they are meant to encourage interested stakeholders to engage in PES programme.

e. Links/synergies/interlinkages with other instruments in the policy-mix

PES programmes will help to improve the sustainability of agricultural activities, thereby contributing to meet many of the objectives of the policy mix. The links and synergies with other policies of the same policy mix are only indirect though, for example, PES measures could be included in the Rural Development Programmes of the future CAPs, and thereby can present synergies with the policy measure “Stronger and more effective environmental and climate dimension for EU land management in future CAP reforms”. Also, PES can be used to encourage a better management of the nitrogen cycle on farmland, a reduction in the use of pesticides and the employment of integrated pest management, an improvement of soil quality and carbon storage in soil, which are the aim of some of the other policies in the policy mix.

f. For taxes and subsidies: what is the level of the tax/subsidy?

This will depend on the targeted ecosystem services, and the available budget.

- For subsidy: How would it be financed?

A variety of financing sources can be used to encourage the development of payment schemes, and to facilitate farm participation them, including CAP rural development expenditure, EU research programmes (e.g., FP8), Life+ projects, Structural and Cohesion Funds, together with MS-specific sources of financing.

g. What physical/resource flows (if any) are directly targeted by the policy instrument?

The policy mix will target crops, dairy products, meat, food waste and bioenergy.

Governance

a. At what level scale should the instrument be deployed (EU, MS, etc.)?

At the MS level for the fiscal incentives and the guarantees; at the local level for the information/mediation activities. The latter could be financed using EU and/or MS funds

b. What stakeholders should be involved in the negotiations and agreement?

Representatives of famers and industry (e.g., water companies, tourism operators), and also the public authorities in charge of the mediation/controlling activities.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Not applicable.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

This is not key, as the programmes established in different countries and location will vary according to a variety of environmental, institutional, social and economic factors.

e. What is the perceived feasibility and acceptance among key actors?

If well designed, the instrument should be well accepted by companies (as it will allow them to benefit from ecosystem services with some public support) and by farmers (as it will represent an additional source of income for them). Criticisms could come from some environmental NGOs and researchers, as the measure could be seen as leading to a privatisation of the natural capital.

Environmental impacts and effectiveness

The use of PES programmes can improve the ecosystem services provided by the agricultural sector by encouraging more sustainable agricultural practices, including the adoption/maintenance of extensive management in High Nature Value areas. However, PES programmes need to be intended as complementary to other kinds of environmental policies based on regulatory instruments or public subsidies. In fact, they will be put in place in specific locations where the environmental, institutional and socio-economic conditions allow, but will not provide EU or country-wide solutions.

Key expected economic impacts

Encouraging new PES measures can ensure new sources of financing for farmers, thereby improving the economic sustainability of their activities. It may also prove a way to increase profitability of some specific stakeholders (e.g., tourist operators; mineral water companies), by increasing their market share or reducing their costs. In some cases, PES may even ensure the survival of their business in the long run (e.g., by preserving the quality of the water sold by mineral water companies or the beauty of a landscape that attracts tourists).

Key expected social impacts

The measure can improve the livelihood of farmers carrying out more sustainable agricultural practices, including low-intensity farming in biodiversity-rich areas, thereby avoid land abandonment and preserving the cultural identity and social cohesion of rural areas.

5.4.4 Regulation for Land Use, Land Use Change and Forestry

Brief summary of the measure

Develop a Regulation for Land Use, Land Use Change and Forestry (LULUCF) setting targets for carbon emissions and removals related to forest management, cropland management, grazing land management and revegetation, ensuring that this incorporates protection of farmed semi-natural habitats.

Brief description of the design and scope

a. When would it be introduced?

We suggest this policy measure is introduced in the early 2020s, as part of the EU's implementation of internationally agreed climate mitigation goals, provided that relevant conditions are met. Significant preparatory work will be necessary to ensure that Member States are all capable of reporting on LULUCF emissions to the degree of precision necessary to avoid perverse outcomes or perverse incentives; and it may be necessary first to ensure that adequate coverage of the EU's land use by satellite or other aerial technology.

b. What is its aim?

To provide incentives for additional mitigation in the LULUCF sector (land use and forestry).

c. What economic sectors and point(s) in the lifecycle would it be targeted at?

Agriculture, forestry, and other land use sectors.

d. What requirements does it place on relevant players?

Will depend on policy design: but likely to involve a set of targets for Member States forming an overall EU target for LULUCF net mitigation of GHG emissions; leading Member States to create incentives (funding, or offsetting mechanisms) for carbon sequestration.

e. Links/synergies/interlinkages with other instruments in the policy-mix

There are synergies with policies which involve incentives to convert land to pasture, or to maintain pasture; and with policies which encourage afforestation.

f. For taxes and subsidies: what is the level of the tax/subsidy?

It is too early to determine how Member States are most likely to aim to meet LULUCF commitments. It is likely that subsidy will be the main mechanism chosen, in which case the impact of the measure will depend on the level of funding made available, which in turn will depend on the extent to which Member States individually and the EU collectively wish to see their climate mitigation ambitions being delivered through land use policy, rather than through emissions reductions in other economic sectors.

- For subsidy: How would it be financed?

Either from Member State budgets, or through incentive payments under the Common Agricultural Policy

g. What physical/resource flows (if any) are directly targeted by the policy instrument?

It may have a (marginal) positive impact on use of fertilisers, on production of timber within the EU, and on extensive production of milk and dairy.

Governance

a. At what level scale should the instrument be deployed (EU, MS, etc.)?

An EU level decision facilitating/requiring the use of LULUCF emissions (both positive and negative, i.e., sequestration), as an integral part of the EU's delivery of its wider UNFCCC commitments on mitigation of greenhouse gas emissions.

b. What stakeholders should be involved in the negotiations and agreement?

Farmers, foresters, NGOs, other sectors affected by GHG emissions targets

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Will depend on MS choices in relation to implementation; but competent authorities would be responsible for accurate monitoring, reporting and verification of emissions; and may choose either to impose regulatory obligations on land managers, or to make subsidies available to encourage improved carbon management.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

Essential to coordinate at EU level, to ensure a common level of stringency in acceptance of LULUCF emissions, and common standards for fungibility with emissions reductions from other sources (e.g., ETS or non-traded sector).

e. What is the perceived feasibility and acceptance among key actors?

Particular issues to be resolved will include: accuracy of measurement of LULUCF mitigation; the difficulty of combining LULUCF mitigation with non-temporary mitigation from avoided emissions; and limited understanding of the best approaches to delivering carbon sequestration in soils.

Environmental impacts and effectiveness

Unclear at this stage; there is potential to encourage land use changes which will have a positive impact on both climate change (by broadening the range of mitigation which can be encouraged by policy) and soil quality. However, there are also risks that, unless the design of an instrument is carefully managed, it will lead to mis-reporting (or over-generous reporting) of LULUCF emissions; and risks that if full fungibility is allowed of LULUCF emissions sequestrations (which are by their nature non-permanent) with emissions reductions in other sectors, the long-term impact on GHG concentrations in the atmosphere will be harmful.

Key expected economic impacts

Some costs of land conversion, including opportunity costs (e.g., from reduced production on marginal arable land); potential costs for infrastructure and building development on greenfield sites, although limited to internalising existing external costs; and an improved cost effectiveness of mitigation, leading either to more ambitious targets, or to reductions in the cost of mitigation for other sectors.

Key expected social impacts

Relatively limited social impacts, mostly occurring as a result of the economic impacts noted above, although potential health impacts from increased afforestation, and some employment impacts from shifts in the balance of the land use sector.

5.4.5 Strengthened pesticide reduction targets under the Pesticides Directive, and provision of guidance to farmers on integrated pest management.

Brief summary of the measure

Existing Member State National Action Plans under the Sustainable Use Directive could be strengthened; with more demanding requirements in terms of reduced use of pesticides, and improved pest management.

Brief description of the design and scope

a. When would it be introduced?

In the absence of further measures on a voluntary basis by Member States, the policy would need to await the 2018 review of the Directive, to be accompanied by any necessary proposals. This indicates that new measures can come into force in 2020.

b. What is its aim?

Strengthen pesticide reduction targets in national pesticide action plans under the Sustainable Use of Pesticides Directive

Improve pesticide licensing regimes to encourage full implementation of integrated pest management

Ensure Farm Advisory Services provide all farmers with advice on integrated pest management; and improve the incentives for uptake of integrated pest management, including through links to the policy on a stronger environmental dimension to the CAP.

c. What economic sectors and point(s) in the lifecycle would it be targeted at?

Agriculture, and upstream supply industries.

d. What requirements does it place on relevant players?

Reduction in the use of active substances in pesticides; and improved provision of advice and guidance on integrated pest management.

e. Links/synergies/interlinkages with other instruments in the policy-mix

Links to the policy on stronger environmental measures under the CAP.

f. For taxes and subsidies: what is the level of the tax/subsidy?

Potential for more Member States to introduce fiscal instruments in order to secure a reduction in pesticide use, and to remove VAT exemptions on pesticides.

- For tax: Who is to pay it and how are the revenues to be used?

Tax instruments would be likely to involve a simple volume tax on active ingredients in pesticides placed on the market, graded according to an environmental impact index. Pesticide taxes are currently in place in Belgium, Denmark, France, Italy, Norway and Sweden. Taxes were in place in the past in Finland, the Netherlands and Switzerland but

were abolished). The Denmark pesticide tax has been applied since July 2013 using a Pesticide Load Indicator to grade the tax for each pesticide on the market, so that farmers are taxed according to the environment and health toxicity of pesticides used rather than their nominal value (Withana et al. 2013). Some scope for hypothecation of revenues to deliver improved advice/guidance for land managers in integrated pest management; although in practice receipts are unlikely to be at a sufficiently high level to justify the administrative costs of such an approach.

- For subsidy: How would it be financed?

Accompanying measures, including provision of information through Farm Advisory Services, are capable of being funded through rural development programmes as part of the improved environmental focus of the Common Agricultural Policy in the policy mix. As noted in the relevant fiche, this is achievable through reallocation of existing expenditure to new priorities.

Governance

a. At what level scale should the instrument be deployed (EU, MS, etc.)?

EU level, with some flexibility allowed on Member States' implementation decisions.

b. What stakeholders should be involved in the negotiations and agreement?

Manufacturers of pesticides; farm businesses; environmental stakeholders; apiculturists.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Regulatory authorities, farmers and land managers, and pesticides manufacturers will be responsible for implementation. Consequences will depend on Member State choices on implementation, but could involve fines, or the compulsory withdrawal of some products from the market. The European Food Safety Authority has an ongoing programme to review pesticide active substances for their human and environmental safety according to the Plant Protection Products Regulation 1107/2009, which might result in the withdrawal of some active substances with proven or likely toxicity through, e.g., endocrine disrupting effects, by 2020. The Water Framework Directive could also trigger the de-approval of active substances that are an obstacle to achieving good water status, such as metaldehyde.

d. Suggestions for high legitimacy decision-making and optimal involvement of Member States

Careful ex ante evaluation of potential impacts on production would be a valuable contribution to securing wider acceptability within the industry. Continued research into the impact of pesticide use on pollinators could also help to build legitimacy.

Environmental impacts and effectiveness

Increased availability of invertebrates as food source for wildlife in arable environments; potentially, increased pollination services; leading to agricultural systems which are more capable of maintaining or increasing productivity with reduced inputs.

Key expected economic impacts

Decrease in use of pesticides; increase in provision of advice to farm businesses on approaches to pest management that are less dependent on heavy use of pesticides. Some

potential risk of countervailing short-term pest damage to crops; if this turned out to be particularly significant, there could also be impacts on food prices and price volatility.

Key expected social impacts

Limited; some potential employment benefits from a shift from provision of plant protection products to provision of plant protection services.

5.5 The proposed policy mix for the consumption side

5.5.1 Context of the policy mix

Changes in both consumption and production are important to ensure more sustainable food consumption patterns. To date, EU regulatory policy in the food and drink sector has largely focused on the production/process side of the chain, including in particular legislative requirements under the Common Agriculture Policy (CAP), the Common Fisheries Policy (CFP), and provisions relating to food processing under the Industrial Emissions Directive (previously the IPPC Directive).

Interventions on the consumption side of food have been restricted to soft measures like education and awareness- raising activities, labelling schemes, as well as various voluntary and local-level/community- based initiatives. Although helpful, to date these initiatives have not been undertaken on a sufficient scale to trigger the substantial shift in consumption behaviour that is required to stimulate dietary change towards more sustainable patterns. Therefore, further efforts relating to the consumption side are needed, to strengthen, revise or complement initiatives already underway. In addition, it is important to note that there are very few, if any EU and national policies that address diets in terms of reduction of animal products.

The policy mix addresses consumption of meat and dairy products and the reduction of food waste, which are the main drivers for the current increase in the use of agricultural land at the global level (see Section 5.2). In this context, diet and sustainability are closely connected, as reducing the consumption of meat and dairy products, the demand for bioenergy and the production of food waste will reduce the land requirement associated to agricultural products, thereby indirectly reducing the environmental impact of the agricultural sector.

The section below describes a selection of policies that could contribute to meet the mid-term 2030 targets (see Sections 5.3.1 and 5.3.2).

5.5.2 Development of the policy mix

To the extent possible, the policy mix for the consumption side has been developed based on evidence available such as case studies of similar policy measures indicating success and lessons learned, and current research findings through a literature review and findings from ongoing large research projects such as FUSIONS and FOODLINKS, and on-going results from this current DYNAMIX research project (for example conclusions from Dynamix WP3).

In a first step, a list of possible policy instruments was developed and included in a table that provides information on the aim, scale (geographic scale of application; i.e., EU level, Member State (MS) level and/or local level), type(s) of tool used, drivers addressed by the policy option (see Section 5.2), potential cross cutting sectors or other policies to consider

and key actors involved/impacted and their role. In a second step, this list was evaluated according to the four criteria: effectiveness, sustainability, cost-efficiency and feasibility. In a final step, the top 4 policy options that received the highest scores based on the scoring exercise were selected as the most promising instruments for the policy mixes.

5.5.3 Priority policy options and selection of policy mixes

A selection of priority policy options to fulfil the objectives set out for food consumption for 2030 was developed, based on the four main criteria described in WP1 in the common approach report: Effectiveness, Sustainability, Cost-efficiency, and Feasibility.

Based on those criteria, the policy instruments that seem the most promising were chosen for assessment in the DYNAMIX WPs 5 and 6:

1. A targeted information campaign on changing diets, and on reducing food waste.
2. The development of food redistribution programmes.
3. VAT on meat products.

Again, a range of accompanying and supporting measures is assumed to be put in place alongside these policies; these supporting measures will not be assessed in WPs 5 and 6, but include:

- Public canteens supplying recommended dietary limits, and operating vegetarian days.
- A sectoral agreement with large food retailers to display recommended healthy dietary limits for meat and dairy products.
- A review of eat-by labelling.
- Clear guidance on how to store products in the retail sector.

The following sections therefore set out in more detail the 3 consumption policies selected for more detailed assessment. That assessment will work on the assumption that the accompanying measures referred to above are also implemented.

5.5.4 Targeted information campaign to influence food behaviour towards: reducing food waste and changing diets

Brief summary of the measure

This measure is an awareness campaign that aims to encourage and achieve reduction in food waste and change in diets. The measure would provide information on the serious issue of food wastage in order to increase respect for food and promote healthy and more environmentally friendly/ less resource intensive diets. Advice and guidance could also be provided to consumers on how they could more efficiently consume food by providing information and tips on shopping, shelf life, storage, preparation, recovery and disposal options.

Brief description of the design and scope

a. When would it be introduced?

This policy option could be introduced immediately.

b. What is its aim?

This policy instrument has a double aim: (1) to reduce the generation of food waste by raising awareness on the negative impacts of food waste and (2) promoting more environmental and health conscious diets by making transparent the environmental impacts and resources requirements of certain dietary patterns and food choices. The rationale behind this measure is that the provision of information and advice to consumers will create awareness and foster behaviour change.

Given the comparably much larger resource requirements of meat and other animal products (dairy products, eggs) this will be one focus. However, other issues such as import/ regional production, food waste, production practices etc. should also be included in order to make it a comprehensive campaign about food. The campaign will actively need to take into account knowledge about behaviour change, as change in food practices does not rely on information only, but is largely influenced by habits and social/ cultural backgrounds. In this context, it would be important to ensure that information campaigns are tailored to the target audience in terms of the language used, visual design, modes of communication television, radio, press, etc. and location. In other words, nutrition campaigns that pay attention to the specific behavioural goals of the intervention, target populations, communication activities and channels, message content and presentation, and techniques for feedback and evaluation should be able to change nutrition behaviours (Snyder, 2007). Furthermore, due to the limitations of using only information campaigns to achieve behaviour change , combining information campaigns with some of the other policy measures included in the fiches could produce more significant changes in behaviour.

c. What economic sectors and point(s) in the lifecycle would it be targeted at?

This measure would be targeted at consumers as well as relevant actors of the food industry. It would target the food consumption phase, as the measure would seek to encourage changes in diet to reflect reduced environmental impact and encourage food waste reduction.

d. What requirements does it place on relevant players?

As an information and action campaign, this instrument would not put into place any particular requirements, apart from encouraging the relevant actors (e.g., food retailers, schools, transport authorities, etc., based on the target audience) to participate in the campaign by displaying posters, carrying out animations, running TV ads, competitions, creation of food apps. etc.

The type, complexity and amount of information provided, and the way in which it is presented, all have a significant impact on the likelihood of people reading, understanding and ultimately influencing their behaviour. Therefore, it is important to strike a balance between providing enough information to inform discerning consumers, while also meeting regulatory requirements (on information that has to be provided) and ensuring that less concerned consumers are not overwhelmed by information. The actors running or sponsoring the campaigns are also essential. For example based on the characteristics of the target audience, independent and high-reputed NGOs may be more trusted than industry or government.

e. Links/synergies/interlinkages with other instruments in the policy-mix

This measure could be linked with any of the other proposed measures in the consumption cluster for agricultural land use. This measure could be linked with the sectorial agreement with retailers, the measure on reviewing and harmonising eat-by labelling to reduce food waste and the measure on applying VAT on meat products. Retailers have an important role to play in food campaigns because of the retailer's direct interaction with consumers. Synergies could be developed by also including a commitment by retailers to abandon quantity based marketing strategies such as buy one get one-free offers on perishable products, address food waste in the retail part of the product chain through establishing or supporting initiatives such as food banks or displaying recommended dietary information in their stores. Suppliers could be encouraged to develop healthy convenience foods with less packaging through the setting of relevant standards. Best practices on how to reduce or avoid food losses could be shared and new initiatives supported.

f. For taxes and subsidies: what is the level of the tax/subsidy?

Not applicable.

g. What physical flows (if any) are directly targeted by the policy instrument?

Not applicable.

Governance

a. At what level scale should the instrument be deployed (EU, MS, etc.)?

It would be important for national governments or the EU to initiate the campaign in order to maximise the potential to reach a wide audience, and in close cooperation with retailers and key actors in the eating out and catering sector. Therefore, this measure could be deployed at all levels – local/MS/EU level – due to the diversity of the target audience, which in this case would be the general public. Food behaviour – in terms of what foods we buy, how much we buy, and how it is consumed is influenced by a number of factors – economic, educational, cultural, etc. therefore information campaigns should seek to address the diversity of the population groups concerned.

b. What stakeholders should be involved in the negotiations and agreement?

- Advertisers
- NGOs/civil society organisations
- Public authorities at MS, regional and municipalty level (depending on pliot region/ target group)
- EU level actors
- Consumer associations
- Retailers

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Those providing the information in the campaigns are responsible for ensuring that the information communicated is accurate, relevant, comprehensible and trustworthy. In the case that information in the campaigns is misleading or provide incorrect information, there is a risk of mistrust that could result from target audiences. Such reactions could discourage consumers from following the guidance communicated through such campaigns.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

This measure would be enhanced and technically supported if coordinated at the EU level as it would help to ensure more widespread dissemination and visibility of the campaign. Many of the relevant attitudes and cultural practices are in common across EU and therefore a harmonising of strategy across the EU offers the possibility of a cultural consensus forming on some of the underlying attitudes.

e. What is the perceived feasibility and acceptance among key actors?

This measure would most likely be accepted by the general public as long as they are clearly aware of the objectives and benefits of the measure. On the other hand, meat producers and other food industry stakeholders may be more hesitant about accepting food campaigns that encourage consumers to eat less meat – even if aimed at promoting healthier diets and reduced environmental impacts. Public acceptance is crucial for the success of public health interventions. According to the EATWELL project, public acceptance of nutrition policies is influenced by age, economic wealth, political views, obesity attributions, and the willingness to pay for such policies. Some of the main findings of the project indicate that the two policy actions most accepted are the improvement of nutritional education in schools and nutrition labelling measures. In contrast, the least accepted policies are the control of the nutritional content of workplace meals and the introduction of food and drink advertising bans for adults .

Environmental impacts and effectiveness

Depending on the scope and quality of the information campaign, for example how well the campaign is disseminated in terms of the number of people it reaches, environmental impacts related to the reduction in food waste and changes in dietary habits could be expected. The successful implementation of this initiative would depend to a great extent on the scope and magnitude of the campaign, as well as on the quality of the design of the campaign. Audiences must for example understand the information that is being communicated and/ or attracted to change their behaviour by other means of the campaign. The more people that the information campaign reaches, the greater chances that awareness will be raised on the importance of changing diets.

Several studies have been carried out to evaluate the effectiveness of public health campaigns and initiatives. Some relevant findings can be extrapolated from the EATWELL project, an EU funded FP7 project that evaluated a range of the actions undertaken and identifying gaps, success and failure factors for these public health campaigns. For example, the project found that in general, information measures have a small but positive effect on healthy eating and, because they are relatively cheap, they are generally cost-effective. In particular, the project evaluated a Five-a-day campaign which was launched in 2003 by the British Government with the aim to increase awareness of the health benefits of fruits and vegetables consumption. The program has been providing a consistent message supporting the consumption of 5 portions of fruit and vegetables each day. Using data from the Consumer Attitudes Survey, findings show that from 2004 (a year after the campaign was launched), there was a sustained yearly reported increase of 0.32 units of portions eaten, which could be attributable to the campaign (EATWELL, 2012).

Further evidence can be drawn from a research paper that evaluated the effectiveness of health communication campaigns to inform future nutrition campaigns. Findings from the research show that in the United States, on average health communication campaigns that

include use of the mass media and avoid coercion have an average effect size of about 5 percentage points (Snyder, 2007). Nutrition campaigns for fruit and vegetable consumption, fat intake, and breastfeeding, have been slightly more successful on average than for other health topics. Thus, if 60% of people were doing the target behaviour before the campaign, about 65% can be predicted to do the health behaviour after the campaign.

Regarding food waste, based on the UK Love Food Hate Waste campaign's the food waste prevention potential of a targeted waste campaign can be estimated at 1.8% of total food waste or 3% of avoidable food waste, (BIO, 2010).

Some environmental benefits include for example:

- Reduction of methane from landfills.
- Reduction of resource use associated with food production.
- Recycling food waste and turning it into compost or into renewable energy and a soil amendment through anaerobic digestion.

Key expected economic impacts

In terms of funding it would be necessary that enough funds are available to carry out the campaigns enabling it to reach the widest scope of the target audiences as possible. The campaign could be funded by the EU (e.g., through LIFE + funds) or through the revenue generated from VAT on meat products (see policy fiche on VAT for meat products).

The measure would result in less food waste from households, which could result in some of the following economic impacts:

- Lower disposal costs - by decreasing the amount of food wasted, businesses pay less to dispose of their trash.
- Reduce Over-Purchasing and Labour Costs - businesses can reduce costs by purchasing only the food that will be used, or decreasing improperly prepared foods. Reducing food waste can also increase staff efficiency and reduce energy and labour associated with disposing of food.
- Receive Tax Benefits by Donating Food - By donating wholesome and edible food to food banks or food rescue organisations, businesses can claim tax benefits as well as feed those in need.

The cost of a similar targeted waste campaign for the EU was estimated at between €90,000 and €180,000, based on the website and network costs of the Green Spider Network (BIO, 2010). The cost for MS campaigns is estimated at €0.04 per inhabitant, based on the WRAP Love Food Hate Waste campaign, approximately € 20 million for EU27. In terms of macro-economic impacts the campaign can have valuable side effects, as healthier diets save costs in the healthcare system.

Key expected social impacts

The measure would raise awareness and encourage behavioural change in diets and issues around food waste. Audiences will be more informed about the possible environmental and health benefits associated with changing their diet as well as receive guidance on how to change their diets.

Several social impacts could be expected through the measure, such as contributing towards food security. A food waste campaign could encourage households and organisations to

reduce food sent to landfills and feed those in need. The campaign could also help to improve sanitation, public safety, and health because food waste deposited in residual waste containers can generate bad odours and attract vermin. Placing food scraps in a closed, leak-proof, durable, and reusable container, and having it frequently emptied for donation or composting can significantly reduce such sanitation problems. It can also form an important part of increasing awareness among consumes about the amount of waste food that they generate and highlight that it is in issue taken seriously by the authorities.

Finally, as the EATWELL project highlighted, it is important to recognise that informed choices are not necessarily healthy choices due to multiple other factors that can influence what people choose to eat. Therefore, a perfectly informed and fully educated populace will still impose social costs of unhealthy eating because diet-related ill health raises health care costs and causes lost economic output.

5.5.5 Development of food redistribution programmes/food donation

Brief summary of the measure

This policy instrument aims to reduce the generation of food waste through the development of food redistribution programmes. Food donation provides a crucial support for the most deprived and is an important tool for the reduction of food waste in Europe. There is no common EU policy on food donation; policy frameworks in Member States (MS) vary, enabling donation to greater or lesser degrees.

Brief description of the design and scope

a. When would it be introduced?

We suggest this policy measure is introduced in 2020, as it is relatively easy to implement.

b. What is its aim?

This policy instrument aims to reduce the generation of food waste by developing food distribution programmes.

c. What economic sectors and point(s) in the lifecycle would it be targeted at?

This measure would be targeted at the retail (including food restaurateurs) and food supply chain sector. It would target the retail/use and disposal phase of food products.

d. What requirements does it place on relevant players?

This measure would encourage households, retailers and other relevant food stakeholders to donate eligible food products to food distribution programmes.

e. Links/synergies/interlinkages with other instruments in the policy-mix

This measure could be linked with the other proposed measures on a food waste information campaign and work with retailers through a voluntary agreement to reduce food waste.

f. For taxes and subsidies: what is the level of the tax/subsidy?

Not applicable.

g. What physical flows (if any) are directly targeted by the policy instrument?

Not applicable.

Governance

a. At what level scale should the instrument be deployed (EU, MS, etc.)?

This measure should be deployed at the MS level due to the specificities of organising food donation programmes, which more often takes place at the local and national level for example due to logistical aspects such as transportation and storage.

b. What stakeholders should be involved in the negotiations and agreement?

Food banks play a key role in the food donation process, recovering food from donors (food manufacturers, distributors, the restauration sector, retailers, or individuals) and redistributing it to civil society organisations and social services that support the most deprived. They operate using a variety of models and may be run by organisations such as charities, community groups and churches as well as individuals.

Further, all manufacturers involved in the different life cycle stages of food products should be involved as food waste also occurs during the production phases (e.g., unharvested and overproduced products). Retailers and other relevant actors involved during the distribution and marketing phase of food products would also need to be involved because of the food left unsold at stores and markets. The interest of retailers are crucial as their support through participation in food donation programmes is vital. It is likely commercial donators will want to ensure that the schemes that they donate do not impact on their sales, particularly among their high-value consumers. Eligibility or restricted access therefore might be sought.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

The measure would entail a voluntary system for those donating food. Those coordinating the food donation programmes (e.g., charities, NGOS or government agencies) would be responsible for setting criteria (e.g., health and safety criteria) for the food that is donated. Those donating the food (whether it be from households, restaurants, retailers or other food businesses) would be responsible for donating food and ensuring that it corresponds to the rules set out. Finally, food banks would be responsible for the distribution, storage, and organisation of the distribution of the food donations.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

This measure would less important and technically necessary to coordinate at the EU level as most of the successful examples of food donation programmes are currently coordinated at the MS level. Nonetheless, issues such as transportation and storage would need to be carefully considered. The EU could coordinate in parallel a forum for the exchange of best practices and knowledge sharing. Guidance on funding opportunities and organisation support could be provided to participating MS.

e. What is the perceived feasibility and acceptance among key actors?

A key barrier to overcome in terms of gaining acceptance and feasibility of the measure is that food donors may be driven to discard surplus food instead of distributing it to food banks or charity organisations in order to avoid risks associated with liability for donated food (BIO, 2014). Therefore, governments could encourage the participation of manufacturers and retailers to participate in food redistribution programmes by providing financial incentives to stimulate the establishment of food banks or tax incentives for food donations. For example, in France, fiscal instruments have been used such that it is more expensive for companies to send unmarketable food to anaerobic digestion than to donate it to food banks. Food donors

qualify for a tax credit equal to 60% of the value of the food donated, to a limit of 5/1000€ of revenue of companies subject to corporate income tax. In the UK, VAT on food is generally zero-rated, as a consequence of the negotiation process prior to EU accession. Other fiscal tools that are being used successfully in the EU to support food donation, include the use of corporate tax credits for donated food. Another option is to consider the value of donated food as fairly low or zero for tax purposes, however this may negatively impact Member States that offer a (percentage) corporate tax credit to companies on the value of food they donate, nullifying the value of that tax credit. Therefore, it may be preferable to "abandon" VAT or significantly reducing VAT on donated food, rather than valuing donated food at zero, would be a more effective incentive, given its compatibility with other (potentially more significant) fiscal incentives such as tax credits.

In countries such as the US and Italy "Good Samaritan" laws, such as the Bill Emerson Good Samaritan Act, protects food donors from civil and criminal liability if the product they redistributed in good faith to a charitable organisation later causes harm to the needy recipient. In Italy, the Good Samaritan Law identifies the food bank as the final consumer of donated products. Thus, food donors are liable for food safety and hygiene conditions only to food banks, rather than to individual consumers of food bank provisions.

Environmental impacts and effectiveness

Food donation is an important tool in reducing generated food waste. It can be redirected for human consumption through donations to food banks and food charities or redistribution organisations.

In the EU, according to the first pan-European study on food waste conducted in 2010 (BIO, 2010), an estimated 89 million tonnes of food is wasted each year or about 180 kg per person, excluding the primary agricultural and fisheries production phases of the supply chain. The FAO study "Food Wastage Footprint. Impacts on Natural Resources" estimated that the global carbon footprint of food produced and not eaten is 3.3 billion tonnes of CO_2 equivalent: as such, food loss and waste ranks as the third top emitter of greenhouse gas emissions after USA and China. Moreover, around 250km3 of water and 1.4 billion hectares of land used annually to produce food are lost or wasted. In the EU, food production and consumption generate an estimated 20% to 30% of all EU environmental impacts.

In the UK, around 3.4 million tonnes of food in manufacturing, distribution and retail is considered to be wasted each year . In 2013, FareShare one of the largest food redistribution charities in the UK received and redistributed 7, 150 tonnes of food which would otherwise have gone to waste. This amount only represents about 1.5% of the 300,000 to 400,000 tonnes of surplus food believed to be available in the UK annually (BIO, 2014).

In 2013, the European Federation of Food Banks (FEBA), which brings together 256 food banks in Europe, distributed 402 000 tons of food, equivalent to 804 million meals, to 5.7 million people in partnership with 31 000 charitable organisations and social centres in Europe . Instead of being lost or wasted, the food donated was redistributed.

Key expected economic impacts

Besides its environmental cost, food loss and waste also represents a loss of economic value. On a global scale, the economic cost of the overall amount of food loss and waste in 2007 totalled to around USD 750 billion. In the UK, WRAP estimated in 2009 that avoidable food

waste costs the average household £480 (€595) per year. In Sweden, there is only one food bank/social enterprise, Allwin in operation, which connects surplus food generated by producers and retailers with those in need via its own infrastructure. Allwin charges the same amount as the public waste management service (100 euros/tonne of surplus food on average) to recover surplus food from different sources and deliver it to charities. Edible food is thus redirected to people who need it rather than being disposed of.

Food donation programmes currently lack funds for the organisation of logistics (e.g., transportation and storage), which is one of the most limiting factors in food redistribution. Tax legislation offers an opportunity to incentivise donation. According to the VAT Council Directive 2006/112/EC, food donations are taxable if the donation is made by a taxable person and if the VAT on acquisition of the goods is fully or partially deductible (BIO, 2014). The further donating to food banks represents an increase in social capital, and therefore society's ability to tackle other challenges.

Key expected social impacts

The measure would raise awareness of the issues around food waste. Further, food donation provides a crucial support for the most deprived segments of society.

5.5.6 Value added tax on meat products

Brief summary of the measure

This policy option would require national governments to implement and enforce the tax measure. Relevant actors from the meat industry would need to comply with VAT regulation by applying Value Added Tax (VAT) to their meat products. Currently, most MS apply a reduced VAT rate for meat products, with the exception of six MS (Bulgaria, Denmark, Estonia, Hungary, Romania and Slovakia). There could be possible exemptions for certain types of meat products that promote environmental protection and health: e.g., organic meat products or meat that has been produced following very strict environmental criteria, meat being donated to charities and food donation programmes, etc. VAT on meat products would follow the already established rules on VAT – it applies more or less to all goods and services that are bought and sold for use or consumption in the Community, therefore goods which are sold for export are normally not subject to VAT. Conversely imports are taxed (to ensure competitiveness and a level playing field). This measure could influence consumer purchasing decision on meat products because of the increased price of meat.

Brief description of the design and scope

a. <u>When would it be introduced?</u>

In principle, the measure could be introduced in 2020, assuming resistance at Member State level can be overcome. Our assessments are prepared on that basis.

b. <u>What is its aim?</u>

This policy instrument aims to change dietary habits by reducing meat consumption through the application of VAT on meat products. This would raise the price of meat products in most MS as they currently apply a reduced VAT rate on meat products.

c. What economic sectors and point(s) in the lifecycle would it be targeted at?

This measure would be targeted at the food retail sector that sale meat. The measure would directly affect its sales price.

d. What requirements does it place on relevant players?

The measure would require retailers to price their meat products in accordance with the VAT regulation by applying applicable VAT rates based on national and/or EU agreements. Suppliers of goods and services subject to VAT are normally subject to a standard rate of at least 15%.

e. Links/synergies/interlinkages with other instruments in the policy-mix

This measure could be linked with a targeted information campaign on the importance of changing diets and information to consumers on why VAT has been increased for meat products. Campaigns would try and encourage public to change their level of meat consumption by clearly explaining the policy objective and societal advantages. Any such move should be accompanied by a wider awareness raising and educational campaign, promoting the health as well as the environmental benefits of consuming less meat. Given low consumer awareness of the issue, it is likely that the VAT change will be as important in its signalling effect as in its price effect.

f. For taxes and subsidies: what is the level of the tax/subsidy?

As a consumption tax, increased prices (through VAT) are ultimately paid for by the final consumer. The equivalent revenues of the tax could be hypothecated for a purpose deemed to support the objective of the policy and therefore increase public trust. Tax revenues from VAT on meat products could go the MS environmental funds to finance environmental protection initiatives and associated education and public campaigns. For example, tax revenues could be used to finance the information awareness campaigns on food waste reduction and changes in diet described in the first policy fiche above.

g. What physical flows (if any) are directly targeted by the policy instrument?

Not applicable.

Governance

a. At what level scale should the instrument be deployed (EU, MS, etc.)?

This measure is best deployed at the EU level.

b. What stakeholders should be involved in the negotiations and agreement?

- Meat producers and retailers and any other industry actors involved in the meat production process
- Public authorities at both the national and EU level
- Consumer associations
- Health professionals

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

The main responsible stakeholders would be Member States and the retailers of meat. As a Directive, each Member State is responsible for the transposition of the VAT Directive's provisions into national legislation and their correct application within its territory. As such, MS can set up their own VAT collection, recovery and penalty schemes. Failure to comply with an

amended VAT Directive on meat products could result in financial penalties being incurred and exposure to additional VAT costs which will directly affect profitability. There could also be problems with customer relationships if VAT is not accounted for correctly as companies will have to spend valuable time resolving issues. The Commission is currently working on amended measures to better enforce VAT requirements due to a recent report on the VAT gap, which estimates that €177 billion in VAT revenues was lost due to non-compliance or non-collection in 2012 .

d. Is it important and technically necessary to coordinate the instrument at EU-level?

Because VAT is set and regulated at the EU level, it is important and technically necessary to coordinate the instrument at the EU level to avoid fragmenting the internal market, to maintain a level playing field and to avoid the development of excessive tans-boundary purchases.

e. What is the perceived feasibility and acceptance among key actors?

There could be concerted political resistance to such a VAT increase on meat products, argued on the basis that meat is nutritionally important. Further, the meat sector is economically important and subject to considerable price competition. Applying the standard VAT rate for meat products may also be opposed by consumer groups who may see the measure as government interference in the dietary and lifestyle choices of individual consumers. However, public acceptability of a tax on meat can be increased if the tax is part of a well-designed (green) tax reform, which implies that it is not perceived as an additional burden but it helps reducing existing taxes. Public acceptability would also be supported if the health grounds of the tax were highlighted.

A possible approach to overcome the above mentioned barriers is to apply the measure to a pilot set of MS where the measure is more likely to achieve success. Most Member States have reduced rate VAT on all basic food products, with some having zero rates (UK, Ireland, Cyprus, Malta) and others taxing food at the standard rate (Bulgaria, Denmark, Estonia, Hungary, Romania and Slovakia). As there are also variations in the standard rates of VAT, the differential between the standard rate and that applied to meat products varies from 0% (Bulgaria, Denmark, Estonia, Hungary, Latvia, Romania and Slovakia) to 21% (Ireland). Therefore, in Bulgaria, Denmark, Estonia, Hungary, Romania and Slovakia meat products may already be subject to higher rates compared to the MS which have reduced rates for most food products. Further research could be carried out to determine how the standard VAT rate effects meat production and consumption in these six MS compared to those who use reduced MS. Furthermore, pilot testing could be performed for those MS whose price changes would be less significant should they apply standard VAT meat products. According to Table 18, such MS could be Finland, Greece, Spain and Austria as the price change would be from 1 to 10% maximum compared to larger meat markets which would experience price changes of more than 10%. The logic behind this is that a less significant price change may be more acceptable to producers and consumers compared to much higher price changes.

Table 18: Predicted price change from imposing standard rate VAT on meat and dairy products (IVM 2008).

Price Change	Member States
0%	Bulgaria, Denmark, Estonia, Hungary, Latvia, Lithuania, Romania and Slovakia
<5%	Finland
5-10%	Greece, Spain, Austria
10-15%	Belgium, Czech Republic, Germany, France, Luxembourg, Netherlands, Slovenia, Sweden
>15%	Ireland, Italy, Cyprus, Malta, Poland, Portugal, UK

Environmental impacts and effectiveness

Demand for meat and dairy products is price inelastic. According to the IVM study, a 12% price increase would be expected to reduce demand for meat in the EU between 2% and 7%, and for dairy products between 2% and 5%. This could bring about a gross reduction in greenhouse gas emissions of between 9.2 and 27.5 million tonnes CO_2 equivalent for meat and between 3.4 and 6.9 million tonnes CO_2 equivalent for dairy products (IVM, 2008). It should be noted that there is just one set of estimates on the impact of meat production and consumption on climate change and that other estimations and sources exist. Other environmental benefits of reduced consumption would include reductions in eutrophication and acidification, and reduced pressure on land use.

Key expected economic impacts

Increasing the VAT rate on environmentally harmful products that are currently taxed at a reduced rate could steer demand and supply in a more sustainable direction. The measure could also generate significant revenue and represent a tax harmonising measure (though it would introduce differences in VAT treatment of meat and other food products). The health benefits would reduce the burden on the health systems supported by Member State's public finances.

Key expected social impacts

A VAT increase on meat could yield health benefits if there is an overall reduction in meat consumption. On the other hand, lower income consumers would probably have difficulty in adjusting their diet in response to a price change and there might be a regressive impact of the measure including a shift towards cheaper product types (IVM, 2008).

5.6 Revisions after ex-ante assessment

The ex-ante assessment reveals a number of areas where the policy mix could be strengthened. It also points at some proposed policies as having a limited impact on delivery of the targets in comparison to the challenges associated with their implementation.

A key gap in the policy mix is a general absence of quantified objectives for the individual measures, particularly on the production side – for example, on reform of the CAP, on the introduction of a land use, land use change and forestry (LULUCF) regulation, on revised limits under the National Emissions Ceilings Directive. The absence of quantified objectives for the individual consumption measures, on the other hand, reflects their largely uncertain impact on actual behaviour. This challenge of quantification at an individual policy level in part reflects the lack of an overall metric focused on resource-efficiency issues in respect of land use. The development of an indicator to reflect the EU's net land use impact is proposed as an accompanying measure to the policy mix; but should instead be treated as a key element in the policy mix itself, as a mechanism for focusing policymakers' attention on resource efficiency in this sector.

5.6.1 Production-side policies

The production side policies we suggested appear to require a strengthening through clearer numerical targets. Accompanying this, we recommend an increased focus on accompanying measures for agricultural businesses and the agricultural workforce, in order both to ensure that environmental impacts are addressed in ways which improve resource use efficiency, and to address potential social impacts of the transition. Moreover, the assessments, and the conclusions we draw from them below, point to the need for an integrated approach to land as a resource, given competing pressures for services (energy, food, recreation, and biodiversity). We recommend that the EU (insofar as its competences are affected) and its Member States address this need through the development of an integrated long-term strategy for land use.

Particular changes to individual instruments that could be introduced include:

Stronger and more effective environmental and climate dimension in the Common Agricultural Policy - Clear, quantified objectives should be developed for relevant environmental impacts of agriculture, and the allocation of funding under the CAP should be linked to the delivery of those objectives, broken down at national and regional level as appropriate. Objectives could cover issues such as (i) net greenhouse gas emissions; (ii) a reduction in emissions of key air and water pollutants; and, potentially, (iii) the sustainable productivity of agriculture, in order to ensure that other environmental objectives are not met at the expense of an increase in the EU's net land use.

Revised National Emissions Ceilings Directive targets - In principle, clear targets for the agriculture sector under the National Emissions Ceilings Directive would be valuable. The Directive's approach is to apply targets across sectors; however, for ammonia, the main source for emissions is the agriculture sector, particularly from fertiliser and manure application. The Commission proposal in its package of measures for revision of the Directive is for a 27% reduction, which seems to the policy mix authors to be appropriate, although greater ambition is also possible. Translating the NECD into clearer expectations of the need for reduced emissions from the agriculture sector in individual Member States would help to

create the conditions in which individual farmers, and the upstream supply chain in terms of manufacturers of fertiliser and other inputs, can plan and innovate.

Payment for ecosystem services – the lack of precision in the policy as described makes it difficult to assess its potential impact. Indeed, it seems likely that in the relatively limited and voluntary approach set out, while it helps to avoid public acceptability risks, and also helps to avoid potential perverse incentives of a regulatory approach to payment for ecosystem services, limits its potential to effect change. While no changes are required to this policy instrument, further work to identify approaches which enable it to exert more leverage over environmental outcomes could be explored – for example, whether water undertakings might be required to develop such payment systems in certain circumstances. It also looks unlikely that the instrument would be capable of contributing significantly to improved resource efficiency.

Regulation for Land Use, Land Use Change, and Forestry – the key finding from the qualitative assessment is the importance of careful design of this instrument to ensure that it delivers additional climate mitigation, rather than simply being used to offset the requirements for emissions reduction in other sectors of the economy. While, as noted by the social assessment, there are potential benefits in terms of reduced costs from broadening the scope of EU climate action, this would negate the contribution of a LULUCF regulation to increased mitigation ambition. Recent reports and policy papers (e.g., Nesbit et al. 2015b) have noted the importance of LULUCF action contributing to an increased level of EU mitigation ambition. The policy proposal therefore needs to be understood in this sense.

Strengthened Pesticide Reduction Targets – The reliance on targets, combined with flexibility for implementation of supporting instruments at Member State level, means that it proved difficult to assess this instrument with precision. However, it seems likely from the economic, social and environmental assessments that the more effective element of the policy combination to support targets would be the provision of advice to farm businesses on improved pesticide management using significantly lower volumes of active ingredients. An enhanced emphasis on this aspect would therefore be valuable, as could improved integration into the separate measure for a stronger and more effective Common Agricultural Policy.

5.6.2 Consumption-side policies

A clear distinction emerges from the assessments between policies which are more constraining, or likely to increase prices (such as the imposition of VAT on meat products), and those which are based on voluntary measures (such as the information campaign). The former are likely to provoke significant public opposition. The physical and environmental component of the quantitative assessment, which (it is important to note) assumed that the policy instruments were fully effective in driving change, underlines the potential contribution to achieving environmental objectives, particularly climate change mitigation, of action on food consumption. The social assessment notes the potential benefits for health. However, it is clear from other areas of the qualitative assessement that significant shifts in behaviour are unlikely to be provoked by information instruments alone. The instruments in this policy mix should therefore be considered as a sequenced approach, ensuring, first, that there is an improved public understanding of the impact of food consumption on resource efficiency, land use, and climate change; using this improved understanding to drive voluntary change; and then allowing for the progressive introduction of more constraining measures (including

taxation) once a sufficient shift has occurred in public opinion. A parallel can be drawn to the shift in attitudes (and regulatory approaches) to tobacco consumption over recent decades.

However, this is an optimistic scenario, and alternative approaches need to be considered in the event of delays in the paradigm shift. Approaches which, as explored below in relation to tax instruments, make clear the trade-off between action on food (including meat and dairy consumption and food waste) and increased action in other areas of the EU's overall climate and resource use footprint, could be considered in this context.

Targeted information campaign to influence food behaviour – The context of the findings from the assessments need to be considered carefully: for example, differences in approach explain the difference between the optimistic findings of the physical and environmental assessment, which considered the potential impact of this instrument *assuming* it was fully effective in driving a shift in consumption patterns, and the results of the qualitative assessments, which note that the provision of information is unlikely, on its own, to provoke a significant change in behaviour. The information campaign is therefore best considered as a contribution to progressively changing the terms of political debate, with the added benefit of an impact, in the short term, on behaviour. Moreover, it should best be considered as a range of targeted campaigns, using the techniques informed by a careful understanding of heuristics applied to purchasing, cooking and eating habits, targeted on individual countries, regions, and consumer groups.

Development of food redistribution programmes - This instrument is viewed positively by all the assessments, although differences emerge in assessment of the scale of the impact. It should be noted that the relatively high impacts noted in the qualitative environmental assessment (Besbit et al. 2015a) are based on consideration only of the food currently wasted in retail, rather than in relation to food consumption as a whole. A key element in improving the impact of such programmes emerges from the economic assessment as the need for a favourable VAT regime. Finally, the recent introduction of legislation in France[26] requiring food shops to make available unsold food for charitable redistribution suggests that a more direct approach may be possible – it will therefore be important for policymakers at EU level and in other Member States to take advantage of policy evaluations of the French legislation as its implementation progresses.

Value added tax on meat products – the assessments suggest that this instrument is at the same potentially highly controversial, difficult to secure at EU level, regressive in its social impacts, and unlikely to be fully effective in shifting consumption patterns. It is therefore unlikely to be a good candidate for early implementation. However, it is the only constraining instrument in our policy mix, and (in the absence of signs of a voluntary shift in consumption behaviour) may need to be considered further; paradoxically, however, its introduction would be politically more challenging in the absence of a shift in attitudes to meat products. Adaptations including a progressive introduction focusing first on ruminant products with the highest greenhouse gas impacts could be considered as a means of facilitating its implementation. Policy work could also consider (given the need for progressively reduced hard limits on global greenhouse gas emissions, and the likelihood that food consumption will, in the absence of significant consumption shifts, take up an increasingly significant share of

[26] LOI n° 2016-138 du 11 février 2016 relative à la lutte contre le gaspillage alimentaire

the available budget for anthropogenic emissions) an approach which explicitly addressed the currently implicit trade-offs between mitigation action on food consumption and mitigation action in other areas of the economy. For example, targets could be set for a gradually declining level of consumption emissions from food, with a commitment to introduce taxation measures if consumption significantly exceeded those targets, and a recycling of the products of any such tax to social payments to compensate poorer households and/or the purchase of emissions reductions from other sectors of the economy in the form of emissions trading system permits.

6 A policy mix for metals and competing materials

This policy mix aims to reduce the use of virgin metals, without significantly increasing the use of other resources or other environmental impacts. It aims to do so through an increase in materials recycling, improved material efficiency, the substitution of metals for other materials when this is environmentally justified, and environmental improvements in the processes and systems involved. The policy mix takes metals use as a starting point; however, in order to avoid burden-shifting, it accounts also for the use of other materials and, to some extent, for environmental impacts in general. The scope of the policy mix becomes so broad it resembles the scope of the overarching policy mix. However, there are important differences in the selection and design of the individual instruments.

The aim to reduce the use of virgin metals relates directly to one of the overall targets for the DYNAMIX project: to reduce the consumption of virgin metals in the EU by 80 % compared to 2010 levels, measured as tonnes of raw material consumption (RMC) (Umpfenbach 2013). The RMC is the quantity of material that is extracted anywhere in the world for producing products that are consumed in the EU, i.e., domestic extraction plus imports minus exports. For metals, the material extracted is the gross ore extracted from mines. This means that the policy mix does not primarily address the extraction of metal ores in the EU, but the use of metals and metal products within EU.

It should be noted that the methodology for calculating RMC is still being developed and currently limited by the availability of data on trade flows. Trade statistics mainly track the economic value of products. Calculation of the RMC requires data on the mass flows, and the weight of materials is often estimated using average commodity prices that are typically not constant.

6.1 The current problem situation, drivers and barriers

Modern society uses a large number of metals in countless products: from buildings and infrastructure to electronics. Although often recyclable, metals are a finite resource. Some metals, like iron (the main component in steel) and aluminium, are abundant and used in very large quantities. Many metals are rare, however. They might be available only in very low concentrations and require resource intensive mining that causes severe pollution (Bringezu et al. 2009). Mineable ores might also exist at only a few locations globally, which can make them the driver of armed conflicts and other social problems.

The production of metals from ores requires large quantities of energy resources. The metals industry is responsible for more than 6% of the global energy demand (IEA 2015). Much of this is coal for the iron and steel industry and electricity for aluminium production. Metals smelters are also important point sources for emissions of heavy metals.

Making the use of metals more efficient could allow society to maintain or increase the well-being while saving not only metals resources but also energy resources and reducing environmental impacts.

6.1.1 Current trends in primary metal use

The current RMC of metals in the EU-27 is 600-800 Mt/year (see Figure 15). It is dominated by iron, copper, and gold. Gold and copper are used in smaller quantities compared to, for

example aluminium. They are still important for the RMC total because the indicator is measured not by the weight of the finishes metal but by the weight of the gross ore. Large quantities of gold ore (in particular) are extracted to produce the gold used in Europe, because of the very low metal content in gold ore.

This is apparent with gold. As gold is used for investment and to physically 'store' wealth, gold stocks in countries are constantly traded and not 'consumed' as such in an economy. Gross gold imports and exports can vary significantly from one year to another, due to fluctuations in central bank reserves, exchange traded funds and speculation. This results in a net import (shown in Figure 15) that is sometimes large and sometimes slightly negative.

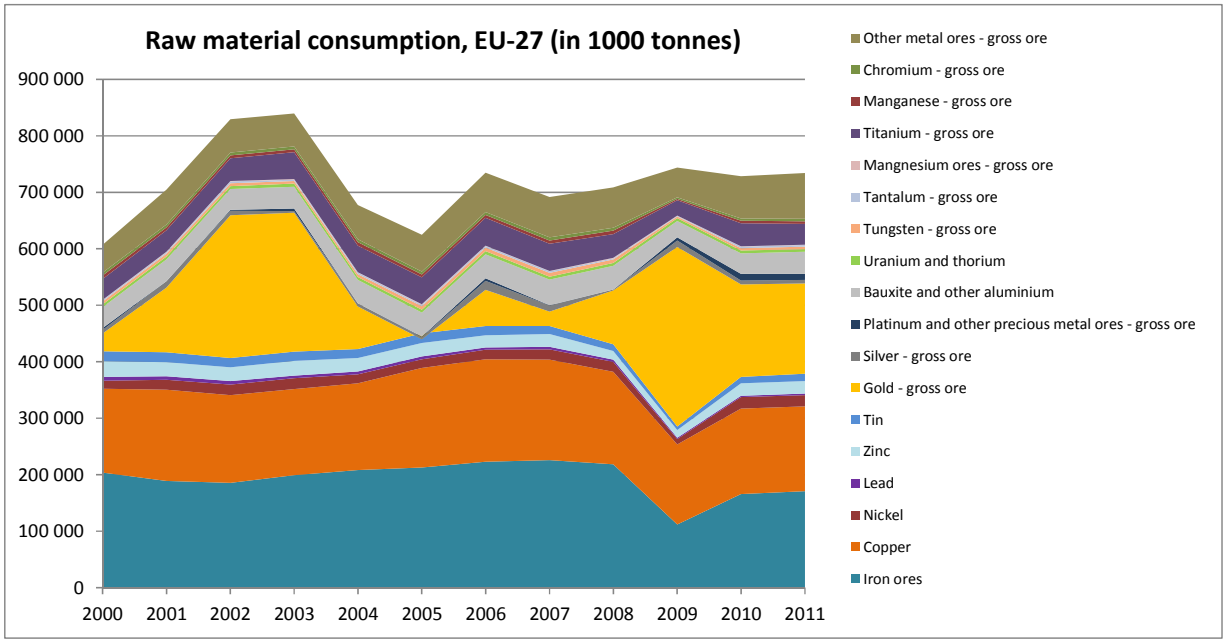


Figure 15: Metal use in the EU-27 (Eurostat 2013b).

Over the rather short time period in Figure 15 (2000-2011), there was a general increase in metal ore consumption: +2.3% annual average growth. The consumption of almost all metals declined temporarily during the economic crisis. However, the net import of gold increased at the same time, keeping the total RMC of metals almost constant through the crisis.

Figure 16 below shows a crude estimate of the metal uses and stocks in the EU-27 in 2003 as well as projections for 2035. In 2003 the EU had accumulated about 3200 Mt of metal products. Besides the metals in use, estimates are also given for the amount of metal resources in society that are wasted and stored in landfills that potentially could be used. In 2003 this unused metal stocks in landfills represented about 2250 Mt. With continued virgin metal consumption the metal stocks in society and landfills are expected to continue to increase (by almost 50% in 2035 compared to 2003).

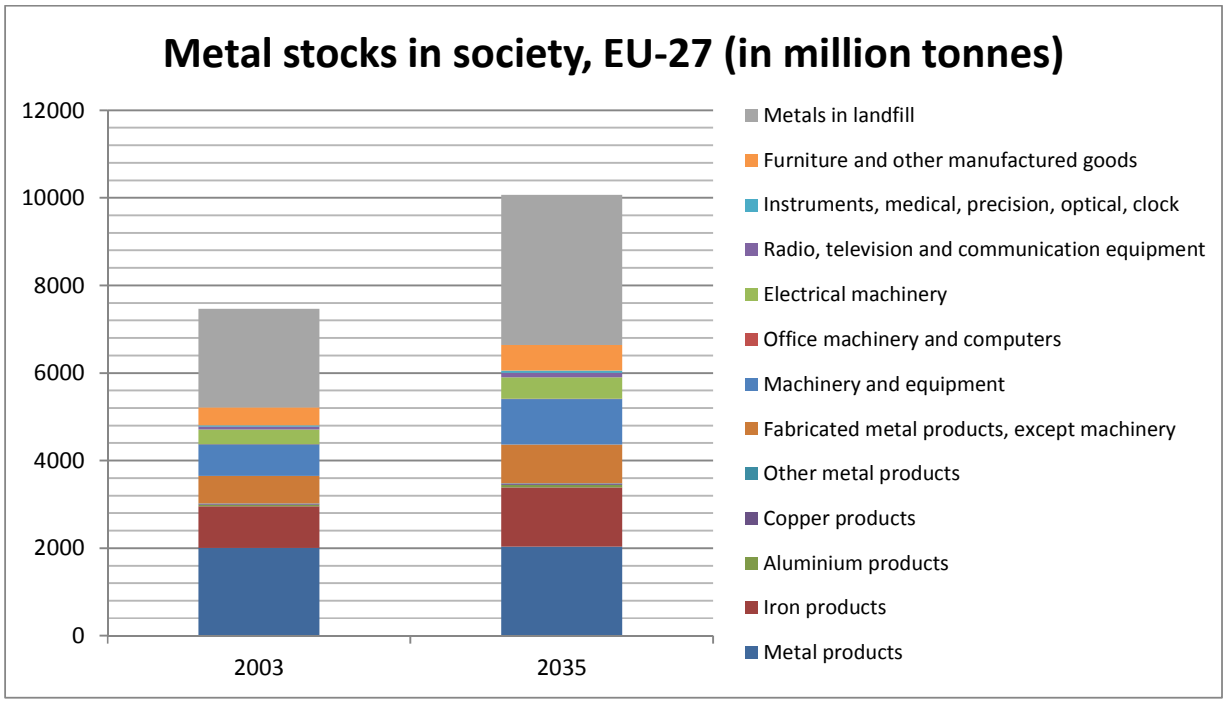


Figure 16: Metal stocks in the EU-27 (Schmidt 2010)[27].

6.1.2 Main drivers of metal use

Since the metals RMC is dominated by iron, copper and gold, this section focusses on the drivers for the use of these metals. This will also capture important drivers for most other metals, since they are used at least in part in the same applications.

Metals are used in all sectors of the economy. The use of metals has a very large number of drivers and these affect each other in a complex web of causal relationships. The Sensitivity Model allows us to present a simplified version of this web, where we select only 20-40 variables out of the almost infinite number of variables in the real economy (see Figure 17 below and Box 1 in Section 2.3.3). We can also select to present only the strongest causal relationships between these variables: the arrows in the Effect System in Figure 17. Note that besides these strong relationships, there are many more, weaker relationships between the variables in the Sensitivity Model.

[27] Estimates measured in actual weight of product, does not take into consideration the actual metal content in products. Weights are not comparable to the raw material equivalents in Figure 15.

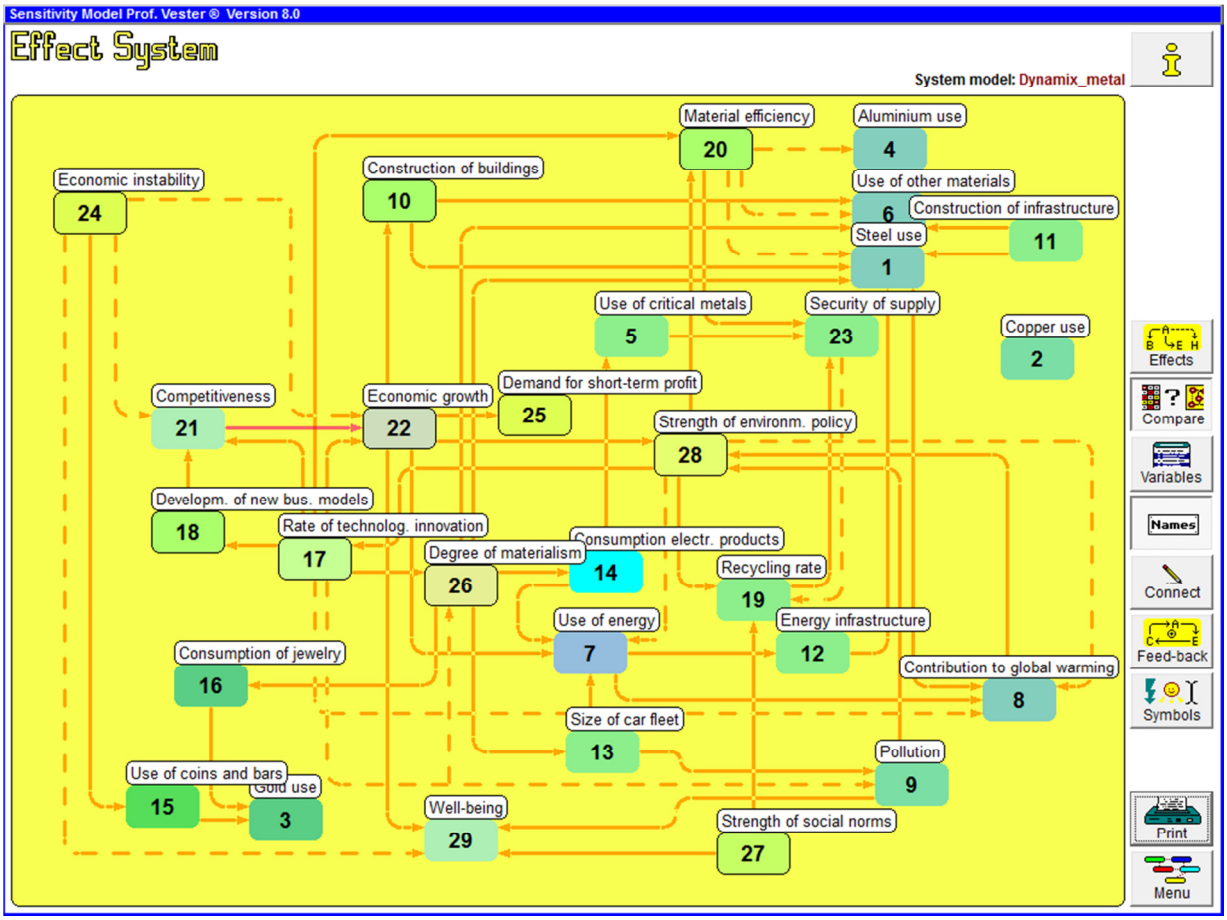


Figure 17: The Effect System from the Sensitivity Model illustrates a few of the most important causal relationships in the system affected by the metals policy mix. Solid arrows illustrate a positive causality, where an increase in one variable causes an increase in the other. Dotted arrows illustrate negative causality, where an increase in one variable causes a reduction in the other.

All causal relationships in the Sensitivity Model are accounted for in the map of the systemic role of all variables in Figure 18. This map shows to what extent a variable affects other variables in the system and to what extent it is affected by other variables. For example, Figure 18 indicates that the economic instability (Variable 24) and the demand for short-term profit (Variable 25) are active variables that have a great impact on other variables but are not much affected by the other variables. In the other corner, the contribution to global warming (Variable 8) and the use of “other materials” (Variable 6) reactive variables, which means they are strongly affected by other variables but do not have a great impact on other variables. The economic growth (Variable 22) is the most critical variable, which means it is both strongly affected by other variables (e.g., competitiveness, rate of innovation, and economic instability; see Figure 17) and has a strong impact on other variables (e.g., use of energy, construction of buildings, and demand for short-term profit). In the opposite corner, the use of coins and bars (Variable 15) and jewellery (Variable 16) are buffering or isolated: they are affected by few other variables and have an impact on few other variables in the system.

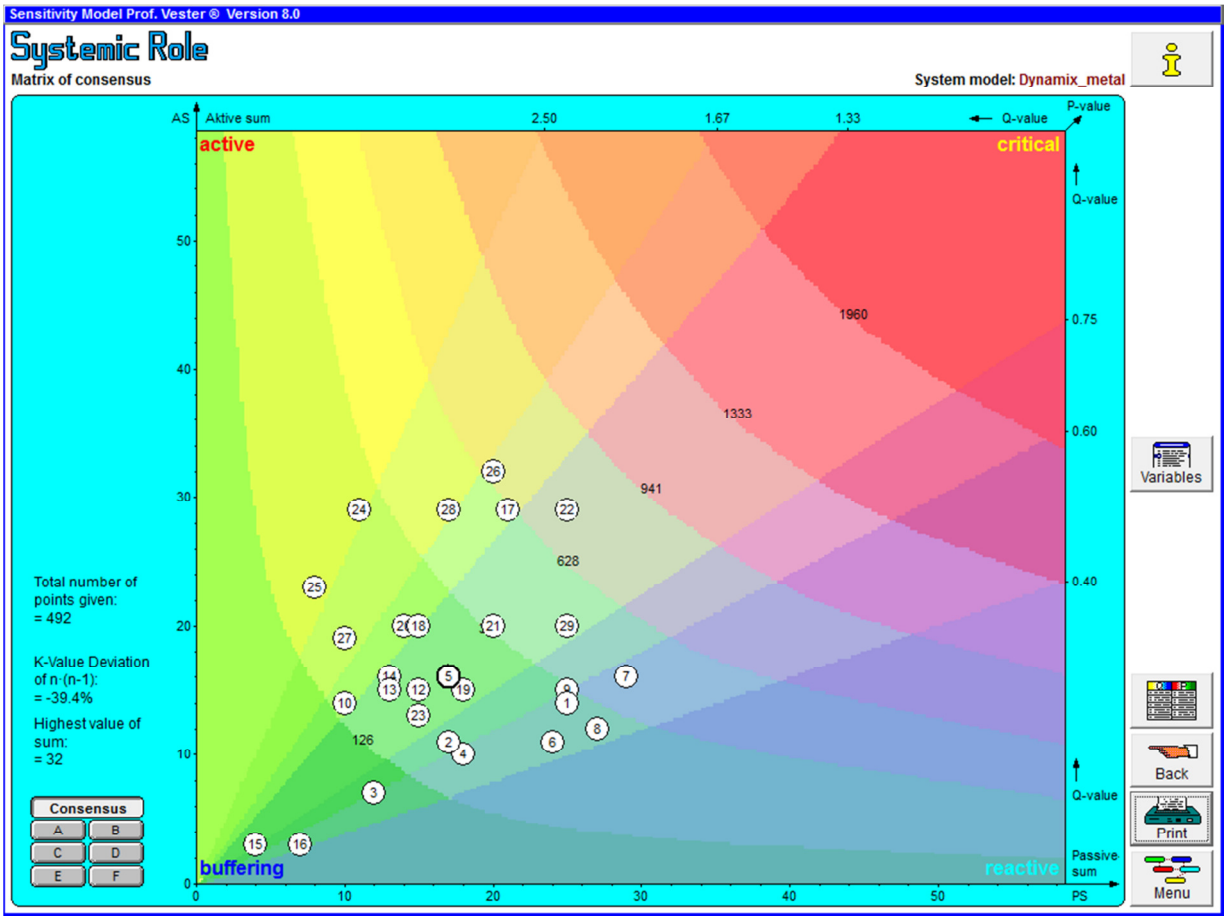


Figure 18: map of the systemic role of the variables in Figure 17. Note that this map takes all causal relationships into account, while Figure 17 only includes the strongest relationships.

Looking deeper into the causal relationships, iron is mainly used for the production of steel. Steel is to a large extent used for the construction and maintenance of buildings and infrastructure (56% globally, 35% in the EU), but also in machines, vehicles and many other products (Allwood and Cullen 2012; Eurofer 2014). This means that expansion and replacement of infrastructure, housing and commercial buildings are important drivers for steel use (Variable 1 in Figure 17). The growth of transport equipment, machinery and appliances is also a significant driver. All of these are closely linked to economic growth (Variable 22). However, according to Allwood et al. (2013), there is evidence that per capita requirements for steel stocks saturate around 10 tonnes per person. Figure 19 shows that beyond a certain level of economic development (measured by GDP per capita) iron ore consumption is not related to economic growth. For further discussion on the future use of steel, see Annex A.

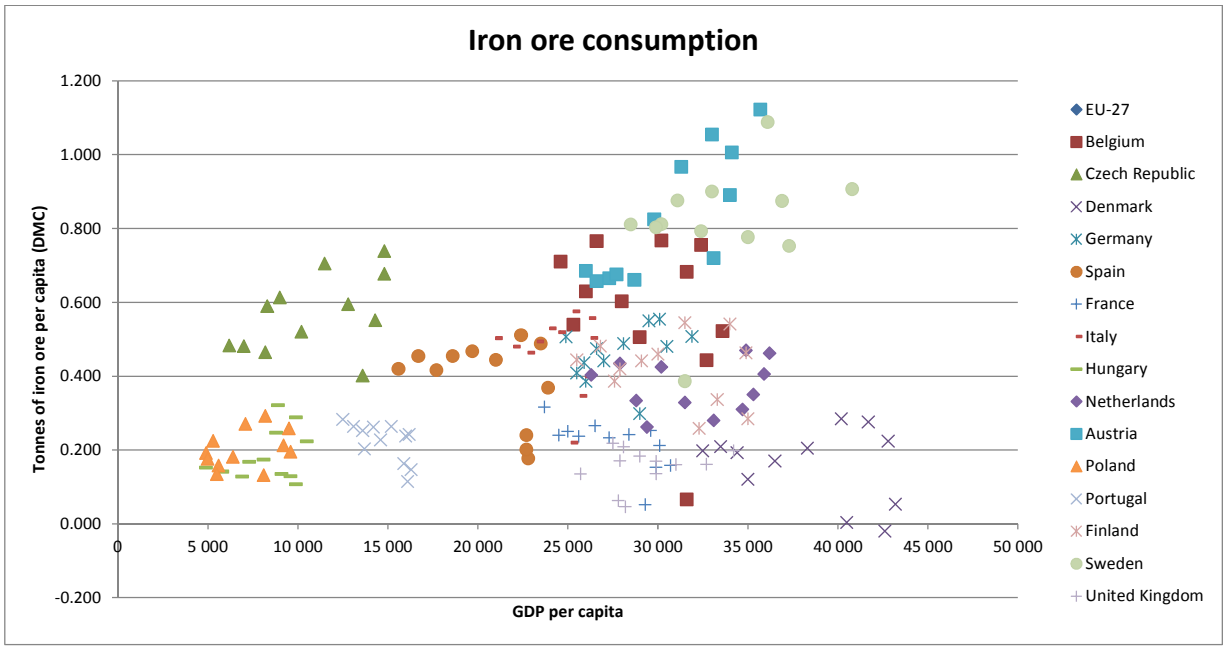


Figure 19: Annual consumption of iron ore consumption per capita seems to stabilise after a certain level of GDP per capita is reached (based on data from Eurostat).

If kept pure, steel can in theory be indefinitely recycled. It is estimated that some 80% of post-consumer steel is recycled (DTI et al. 2013)[28]. The recycling rates are the highest for heavy structures, motor vehicles and machinery (85-95%) and lower for smaller appliances and packaging, etc. (around 50%). At present about 38% of high-alloyed steel and 41% of low-alloyed steel used in the economy is from recycled iron and steel. That means 62% of high-alloyed steel and 59% of low-alloyed steel is based on primary raw material (UNEP 2011a). The future potential for recycling rates is bounded by cumulated alloys in the metal. Many alloy metals can be removed from the steel in the recycling process but a few remain, for example, copper. An estimated 4 kg of copper contaminates the flow for each tonne of steel recycled from old machinery (Kakudate et al. 2000). This is not a problem as long as most of the steel is produced from ore (Allwood and Cullen 2012), but when global steel use no longer increases significantly, copper contamination is likely to limit the potential recycling rate of steel (Ekvall et al. 2014).

Our application of the Sensitivity Model did not result in any strong causal relationships to the use of copper (Variable 2 in Figure 17). However, Figure 18 shows it to be almost as much affected by other variables as the use of aluminium (Variable 4). The explanation is that copper use is affected by several other variables in the Sensitivity Model, but that each driver for the use of copper is somewhat weaker, compared to the drivers for aluminium use.

The major current applications of copper are in electrical wires (about 60%), construction (e.g., roofing and plumbing) (about 25%) and industrial machinery (about 10%) (European Copper Institute 2014). Wires are used to transport electric energy over long distances and

[28] The International Resource Panel provide global figures that range from 52% to 90% (UNEP International Resource Panel. 2011. Recycling Rates of Metals – A Status Report).

within most electric products. Hence, the expansion of electricity systems (including, for example, the requirement for connecting new renewables capacity to grids) and production of electrical products are important drivers for copper use. Similar to steel, the demand for new buildings, infrastructure, transport equipment, machinery and appliances (very much linked with economic growth) also drives the demand for copper. Copper consumption per capita seems to be linked to GDP per capita - at least until about 12-14 kg per capita[29]. For further discussion on the future use of copper, see Annex A.

Because of its high value, most of the copper in used products is recovered for recycling. Copper recycling is not limited by alloys because all contamination is removed when recycling copper. However, the copper that ends up in steel scrap is lost and unavailable for recycling. Estimates of the total recycling of copper in global post-consumer scrap range from 43% to 53% (UNEP 2011a). At present about 27% of copper demand is satisfied by secondary raw materials.

The pattern of gold use is quite different from iron and copper. Most of it is used because of its symbolic value to produce jewellery (about 50%) and for investments such as coins and bars (about 40%) (World Gold Council 2014). Only smaller quantities of gold (10%) are used for its technical properties in electronic products, chemical industry, embroidery, etc. Coins and bars are used as safe investments during economic disruption. Such gold use is driven by the need for economic safety rather than by economic growth. The use of gold in jewellery, on the other hand, might be driven to a large extent by the desire to signal status, or by the urge to show love and affection. This is relatively independent from economic growth, although it might be affected by changes in the income inequalities and the distribution of wealth within a country. The gold in coins, bars and jewellery is easy to recycle. Gold on printed circuit boards from electronic products can also be recycled, but requires special sorting and dismantling. The recycling rate of gold in global post-consumer scrap has been estimated to be 96%, if remelting of jewellery and coins is accounted for. If gold in coins, bars and jewellery are excluded, the recycling rate might be as low as 15-20% (UNEP 2011a).

Besides an expected increase in global demand (particularly from the emerging economies due to rises in income and GDP) for buildings, infrastructure, vehicles, machinery and appliances, the demand for both bulk and rare metals is also expected to rise for the emerging technologies (including renewable energy technologies) (European Commission 2010b).

Current EU policy influences the collection and recycling of metals through difference waste legislation such as the End of Life Vehicles (ELV) Directive and the Waste Electrical and Electronic Equipment (WEEE) Directive. This has helped to underpin the recovery infrastructure and scrap market in most EU Member States, including for metals with significant externalities but limited commercial recycling potential. Strict environmental regulation and high energy costs, however, result in much metal scrap being exported to countries outside the EU to be reprocessed (DTI et al. 2013).

[29] Based on domestic material consumption (DMC) data from Eurostat for EU from 2000 to 2011.

6.1.3 Main barriers to reducing consumption of virgin metal ores and to increasing material efficiency of metals

According to Allwood and Cullen (2012), it is technically possible to reduce global metal production by 30% without loss of final service, simply through better design. McKinsey (2011) estimates that steel demand in 2030 could be reduced by 13% even when taking into consideration the increased global demand for steel for products, transport, buildings and infrastructure. Although a significant decrease, these figures are far from the DYNAMIX target to reduce the consumption of virgin metals in the EU by 80 % (Umpfenbach 2013).

A barrier to decoupling consumption of virgin metals from economic growth is the predominant business model of current industrial systems. Companies base their revenue on the sale of products. The revenues and profit of the companies typically increase if they sell a greater number of products. This drives an increase in the use of metals and other materials. The responsibility and opportunity to recover and reuse the product or recover and recycle the material are transferred to the end of the service life of the product.

There are many reasons why companies are not shifting to more service / functional /circular economy-based business models (Ellen MacArthur Foundation, 2012). These include financial barriers (e.g., investment costs, payback period, lack of capital, the fact that old products are written off), market failures (e.g., lacking information on the total cost of ownership[30], split incentives[31]) as well as organisational reasons (e.g., developing new offerings, not seeing downstream activities as part of the business, redefining companies core business[32], high risk[33], access to end-users[34], lack of reverse logistics infrastructure[35], etc.) (Oakdene Hollins 2011). It is also challenging to generate demand for service-based equipment use, since individual and corporate consumers have assumptions which are potentially hard to shift about the need for ownership in order to ensure control and availability.

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[30] For example, when companies or consumers buy products, they do not have complete information of the life time and actual performance of the product, nor of, e.g., the costs of maintenance and repair.

[31] Split incentives are when improvement efforts done by one value chain actor only benefits others and not themselves, e.g. design for disassembly does not benefit manufacturers, if they are not involved in end-of-life collection and waste management

[32] For example, a manufacturing company is good at manufacturing products through mass production. A mining company is good at mining. Both types of firms would have to acquire new competencies to deal with the collection of used products as this is typically done by other types of companies.

[33] When selling services instead of products, the ownership of the product remains with the service provider. The performance of the product is partly determined by the user, e.g. driving a car on a gravel road will increase the risk of stones hitting the car and damaging it, but it is the service provider that bears the costs if damages happen. Another example is a company that remanufactures products never knows exactly when used products will be returned. There is a higher risk of variability of supply.

[34] A metal processing company does not always have direct access to end-users of final products. Consumers may only be in contact with manufacturers of final products or sometimes only retail companies. At the product's end-of-life, waste management firms collect used products, but the recycling and remanufacturing companies rarely have direct access to the end-users.

[35] Reverse logistics is when a company set up its own take back system. It is an investment for a single company to establish a system that allows products to be sent directly back to the original producers.

Part of the metals produced is lost as production waste in the metals and the manufacturing industry. A barrier to reducing losses during production is the relatively low costs of materials compared to the (often perceived) high effort needed to reduce losses, in particular labour costs (Allwood and Cullen 2012). This is in part because external costs of environmental and social impacts are not included in the price of the metals. The external costs could in principle be internalised through environmental taxes and/or fees. However, as most of the metals consumed in the EU are mined outside the EU and sold on global commodity markets, it is not sufficient to internalise environmental and social costs that occur as a result of European mining.

There are indications that developed economies could feasibly satisfy most of their demand for metals through recycling and other closed-loop strategies based on existing stocks in the economy[36] (Allwood et al. 2013). Developing economies (including some EU Member States) may not be able to achieve a closed-loop economy until their metal stocks have grown to a sufficient size. This is related to investment in capital goods, new infrastructure and buildings.

High income levels and the relatively low cost of materials (including metals) has led to consumption patterns where products are discarded before the end of their (functional) technical life. In some cases, for example where energy efficiency improvements have reduced both environmental impacts and economic costs in use, it may represent the most sustainable choice currently available. In most cases, though, it results in a higher resource use than necessary. One reason for these consumption patterns is that it may be less costly to buy a new product than to repair the old one. Or it can also be due to consumerism, where people strive to be visibly materially better off than others. A culture of high and continuously growing levels of consumption, generally associated with well-being and success, has become the norm in western European countries (EEA 2012). Conspicuous consumption, where there is heavy societal pressure to maintain high consumption patterns and where competitive spending and displays of wealth are encouraged by society, is becoming common-place around the world (WBCSD 2008).

Metals are mostly used in durable goods. Private ownership of products and buildings sometimes results in infrequent use (e.g., power tools at home) and hoarding / storage of unused products. There are also barriers related to prolonging the life of products. For example, no market demand for second hand goods; lack of replacement / repair / refurbishment / upgrade possibilities; changing user needs; new products are more attractive (often driven by marketing). Technical barriers also exist such as the degradation of products (including corrosion / dirt / wear); increased risks of failure / decreased reliability; lacking skills in design for durability / refurbishment / upgrade; and, new more efficient technologies that encourage replacement.

There is still significant scope for reuse and recycling, but it is expensive (and more time and labour intensive). A lack of supply for spare parts can also hinder reuse and remanufacturing business models. Moreover, reuse is discouraged by technical barriers in the form of safety

[36] The EU exports a lot of its scrap metal, used products and cars. The amount of material corresponds to its imports. For steel, it is not so much the costs of collecting the waste materials, but the remelting facilities in the EU are old and expensive. Other countries have more modern facilities or pay less for the (often subsidized) energy.

(and hygiene) standards; guarantees of quality; and, old products not designed for future reuse (e.g., forwards and backwards compatibility).

The barriers to using less metals by design are, according to Allwood and Cullen (2012):

- Economic – it is often cheaper to use a larger amount of metals than needed, instead of paying the costs of using less[37] through, for example, better design. Manufacturing minimum weight designs may cost more.
- Technical - requirements / over-specification of design loads (e.g., higher loads during installation than in service). Asymmetrical risks of using less metal (manufacturers, for example, often choose to use extra materials to ensure a robust and reliable component/product than to carry the risk of component/product failure[38]). Optimised components may be less robust than those with excess capacity.
- Behavioural - customers may perceive lighter weight products as lower quality. With cars, customers expect more functionality or space. Consumers may be resistant to buying services rather than products because of lack of confidence in availability on demand. They may also be unaware of the negative impacts of the metals in the goods they buy because rare metals that are produced at a high environmental cost are hidden inside electric and electronic products.

6.2 Targets and lines of intervention in the policy area

6.2.1 Targets for 2050

Baseline without the policy mix

Gustavsson et al. (2013) developed a series of background scenarios that describe how society and the economy might develop without the intervention of any new policy (cf. Section 2.5). The surprise-free Reference scenario includes a relative decoupling between the economy and resource use in general. This decoupling is due to technological innovations partly driven by the economy, where a global economic growth leads to increasing prices of natural resources. The technological progression and innovation is described by the variable Total Factor Productivity that, in the Reference scenario, increases by 1% annually while GDP increases by 1.4% annually in the EU. This means that total resource use increases slowly.

For metals, we assume that metal use will continue to increase with GDP, without the policy mix for metals and other materials, but that it will level off and stabilise with the net additions of metals to societal stocks completed by 2050 (Umpfenbach 2013).

[37] The costs of an architect or engineer to optimise a design is often much higher than the material savings that would be achieved. For mass production it might make sense, but for products produced in low quantities, e.g. buildings, the additional time of a designer is not justified.

[38] E.g. a thinner wall thickness of a metal container risks being damaged more easily.

Alternative end-point sought

The DYNAMIX policy target for metals is that the extraction of virgin metals for EU consumption, measured as RMC, is reduced by 80%: from above 700 Mtonnes in 2010 (see Figure 15) to 150 Mtonnes in 2050. An overall reduction as large as 80% requires a significant reduction in the use of the most common metal ores such as iron, copper and gold ores.

We also want the 2050 target for metals to be met without a significant increase in the use of other resources or other environmental impacts.

Although the reduction of the use of other metals is also an important goal, this policy mix will focus on the consumption of the main bulk metals such as ferrous metals, copper, aluminium[39] and gold. The use of the other metals are already linked with the use of the main metals (they are used in the same applications) and some of the most important drivers for demand are the same. We acknowledge, however, that the measures for addressing resource efficiency of bulk metals and functional metals[40] are not exactly the same. The policy assessment will include a specific focus on whether the proposed measures for bulk metals also contribute to improving the critical situation for rare metals. It will also address the risk of unintended consequences through increased use of alternative materials.

Lines of intervention

The decrease in the use of virgin metals can be achieved through a combination of reduced total use of metals in general and increased levels of recycling, which can be broken down into the following broad lines of intervention (with very rough estimates of their impacts):

Reduced use of metals:

- Technical redesign of existing metal products to use in average 30% less material (cf. Allwood and Cullen 2012).
- Substitution of 20% of the metal with alternative materials when this is environmentally justified, or through a shift from metal products to services that deliver the same functions.
- A 40% decrease in demand for metals products and services using metals products through a combination of changes in consumption patterns, greater longevity and increased reparability of products and/or their parts, etc.

Increased recycling:

- A 20% increase in the recycling rate of post-consumer metal scrap.

[39] Aluminium is considered as a focus material to ensure that the consumption of steel and copper is not substituted with aluminium. Aluminium is also one of the major metals used in the economy and vital for many technologies in the future.

[40] Bulk metals are metals such as steel, aluminium and copper that are used in large quantities mainly for their structural properties. Special or functional/technological metals are used in small quantities in alloys; magnets and electronics to enhance the properties of other materials.

6.2.2 Conditions conducive to the lines of intervention

1) Improved data on metal flows, economic and environmental impacts attributable to metal flows, and awareness of the potential for reduced metal flows:

- Increased resourcing for statistics agencies working on material flow accounts, and increased data collection on metal content in products.
- Agreement at OECD or UN level on statistical conventions on methodology.
- Economic research on the role of metal reduction in increasing balance of trade and productivity, and the consequent impact on economic performance.
- Established procedures for an accurate assessment of the global environmental impacts of metals.

2) Technical redesign for reduced use of material needs:

- Increase in the relative price of metals and other materials (for example through the internalisation of external environmental and social costs),[41] compared to the labour costs associated to the redesign (the redesign itself, and the use of the redesigned product).
- Removal of barriers to adoption of redesigned products, such as compatibility with other related practices (e.g., house building), inertia in consumer choices, and lack of familiarity in new designs.

3) Substitution of current metal products to alternative, less metal-intensive products and services (e.g., car sharing) needs:

- The relative price of low-metal products and services becomes low enough to overcome inertia in the behaviours of consumers (NB: the cost of the metal is often a small part of final product cost).
- Specific metal products (e.g., beams or water pipes in construction) are banned if they have readily-available and cost-effective alternatives (e.g., wooden beams and polymer pipes).
- Supplier profits from lower-metal products/service are sufficiently higher than existing products and overcome transition costs/inertia (e.g., in business models, or promoting heavy marketing promoting change) and induce innovation into lower-metal products.
- Creation of alternative forms of economic safety or trust to substitute the use of gold (or other high-value metals) for investment purposes or speculation.

4) Decrease in the final demand for products/services containing metals, which can be obtained through:

4i) Increased sharing of tools, vehicles and appliances, and more efficient use of transport infrastructure and buildings:

- Relative price of ownership of good is sufficiently high compared to the costs of sharing, both actual and perceived, and including the costs/benefits of in/convenience.

[41] The external costs should be internalized not only for metals but also for other materials to avoid shifting from metals to other materials when this is not environmentally justified.

- A mature market for equipment services is developed, with sufficient availability and awareness of goods that can be shared, and/or of business models for sharing, with increased individual and business confidence that fully satisfactory availability of equipment can be achieved.

4ii) Reduced demand for transport and for the use of material products, such as appliances, furniture, cooking equipment, vehicles, and machinery:

- Increased relative costs of material products compared to labour, sufficient to out-weigh and go beyond the ongoing relative decrease in relative costs due to faster material productivity growth.
- Alternative ways to satisfy individual drives for status, challenge, social-interaction, contribution, curiosity, which do not involve significant use of material products; and
- Change in paradigm/mindset in what constitutes success or successful contribution.

4iii) Increasing longevity of products and/or their parts:

- The purchasing procedures avoids rewarding individual (or organisational) preferences for short-term decision making, so that longevity in a products with a long service-life can at least compete on equal footing (this could include internalising external environmental and social costs).
- The market shifts so that introducing new products with short life doesn't pay. As an example of the problem to avoid, cellphone producers currently profit from releasing many new models and driving short-term demand. Potential drivers to change this would include a high-cost of full-product purchasing compared to leasing and upgrade, and also alternative ways (e.g., software) to demonstrate novelty or wealth.
- New business models are developed based around leasing and sharing of products and equipment.

5) Improved recycling rates, which will require:

- Sufficiently secure and attractive rates of investment return in investments in high-performance, integrated recycling technologies, taking into account the global virgin metal price.
- Security of high volume supplies for high-performance recycling, including improved and expanded end-of-life collection (e.g., buildings, small WEEE).
- Product design, end-of-life collection systems and dismantling technology that allows the separation of parts to allow increased recycling rates.[42]
- Innovative and technically adept players in the recycling market.
- Improved data on metals and other resource flows through the economy; and increased use of that data as a key variable to judge economic and sustainability performance of the EU and its Member States.

[42] A high level of recycling requires that products are recovered after use and that the materials in the products are designed for recycling, carefully separated, and that integrated recycling processes are used (UN IRP/Reuter 2013). Particularly important is that almost all copper is separated from steel scrap in 2050. Any copper, from cables in machines etc., that remain in the steel scrap is lost from copper recycling and also reduces the maximum recycling rate of the steel (Ekvall et al. 2014).

6.2.3 Conditions for the mid-point 2030

To reach the end-point outlined for the year 2050 in the previous subsection, policy and innovation will together have to have overcome 'systems lock-in' to the current patterns of (generally) increased use of metals. The drivers of that systems lock-in appear to be:

On the macro-level

- The growth of firms' profits through increased sales of material goods drives most of the economic behaviour (N.B. healthcare and software).
- A large number of people, and invested capital, is engaged in greater sales of material goods.
- Member States base their own financing (e.g., levels of taxation required to support provision of services) on economic growth.
- Politics is highly influenced - through lobbies,voter paradigms, and assumptions about employment - by influences calling for more material growth.

Micro-level

- There is a need for improved skills and capacity, and perhaps also motivation, to supply low-metal solutions among, for example, architects and builders; skills and practical understanding are also unlikely to develop significantly without wider deployment of those solutions.
- Consumers do not reward low-metal solutions (including the provision of metal products as services), but are highly influenced by other factors - including social norms and marketing.
- Success and empowerment are often defined in terms of ownership (rather than access to) goods; until greater experience of leasing/shared ownership models changes cultural assumptions, individuals and businesses are likely to assume that secure access to equipment whenever needed requires them to have physical ownership.
- Longer working hours place a higher value on convenience during leisure time (as well as during working hours) compared to cost-saving/environmental impacts.

The lock-in has to be addressed before the final steps towards the end-point can be taken. To break the lock-in and be on the way to achievement of 2050 goals, it would be helpful if the following conditions (which themselves might be created without removing too much political or behavioural resistance) are fulfilled at the year 2030:

- Statistics on metals and other resource flows through the economy have been improved and are used to assess the economic and sustainability performance of the EU and its Member States.
- It has been convincingly demonstrated, and is widely (though not unanimously) accepted that the well-being of society is not dependent on increasing production and consumption of material goods.
- Economic models for states exist (and are being used) which demonstrate sustainable economies do not need to rely on increasing material productivity for stability and success.

- At least in some significant mainstream areas, successful businesses are operating under regulatory conditions which reward ever less metals consumption.
- A cohort of mechanical and materials engineers are able to design products for longevity, recyclability and repair/upgrade without any significant increase in costs;
- Improved processes for recovery and separation of metals from used products have become widespread, and their costs reduced.
- There are a wide range of well-understood, successful and popular business models based on leasing or shared ownership, with broadly positive customer experience;
- Mainstream culture no longer views material wealth as the main criterion for success and status - as alternative ways to lead a connected, empowered, participatory life are widely available, and valued. Marketing promoting the alternative view is much less widespread.
- The relative cost of metals for use in products is sufficiently high to trigger innovation in reducing use of metals - and there is a belief that it will continue to rise, relative to other costs. The cost of purchasing and using metals in the EU is not necessarily linked to the prices in the rest of the world (where prices are likely to have remained lower.
- There is economic research, based on sufficiently reliable data, which shows the economic benefits of metals reduction as a significant, beneficial policy for economic progress.

6.3 Policy objectives for the 2030 mid-point

Various barriers need to be addressed to reach the conditions we wish for the year 2030 and the endpoint we aim for in 2050. There are many ways to address each barrier. This list is not exhaustive but gives some examples:

- Economic barriers can be addressed through, for example:
    - Higher recovery value of metals.
    - Increased cost of metals and/or reduced relative cost of labour.
- Business barriers:
    - Shifting to service-oriented business models.
    - Support businesses based on leasing and sharing of products.
    - Support repair, reuse and refurbishment businesses.
- Infrastructure:
    - Develop infrastructure (e.g., recycling parks) to encourage take-back systems.
    - Standardise certain products and components (e.g., transformers and chargers), packaging, building elements to use as modules for a wide range of applications.
- Conceptual/sociological barriers:
    - Change the view on material wealth as the main criteria for success and status.
    - Increase the desire for used goods and/or decrease the attractiveness of new consumption products (see, e.g., Norman 2004; Chapman 2005).
    - Invite consumers to make a more responsible use of metal-intensive commodities.

- Lack of information:
    - Clearly specify the material content on all products (cf. current declarations on food products).
    - Keep track of location and ownership of specific products (e.g., boats and cars) to be able to recover them for future use.
    - Develop instructions on how to best repair and/or dismantle products and include them in the purchase.
    - Report on failure / call back rates.
- Lack of knowledge and skills:
    - Educated on new business models and life cycle thinking design such as design for reparability reuse, remanufacturing, recycling, etc.
    - Increase the ability to repair products through education and training.
    - Continue and strengthen the funding for research and development (R&D) in areas where increased knowledge and/or improved technology is vital for the aim of the policy.

The financial crisis and increasing globalisation and delocalisation of production to countries with low production costs and reduced environmental regulation requires the stakeholders in EU-27 to look for new solutions. This can offer opportunities for changing the drivers and barriers and allow for increased resource efficiency. These might allow the policy-makers and the society to move the focus from the quantitative perspective (the more – consumption and production - the better) to the qualitative perspective (the better, the better ….). That is, producing less at a higher price to reflect the environmental costs, but high-quality products that can be well appreciated by final consumers (if they can afford them, thereby implying equity issues).

6.4 The metals policy mix

This section presents a set of policy instruments that could be implemented if the political will and sufficient stakeholder and public acceptance are there. It should be noted that there is as yet no plans to implement this policy mix. We do not yet know if the policy mix or the instruments in it are effective or feasible, because the mix has not yet been assessed. We do think, however, that the mix is promising enough to make the assessment interesting.

Since the number of drivers and barriers at play is large, the number of potential policy instruments is very large. To allow for ex-ante assessment of the policy mix, we have striven to keep the number of instruments down. As a result, the policy mix is not likely to address all drivers and barriers mentioned above.

We have selected five instruments that we think can be among the most important and/or where an assessment is particularly important or interesting. The five key instruments is a mix of economic instruments, public investments, and a regulatory instrument:

- Internalisation of external environmental costs.
- Tax on materials used in the EU.
- Promotion of sharing systems.
- Spending on research and development.
- Product standards.

Information on each of these main instruments is presented in a common structure below.

We have also outlined a mix of supporting and complementary instruments related to planning, information, economic instruments and public investments. These aim primarily to make the five main instruments more feasible to implement:

- An EU strategy for dematerialisation.
- Information campaigns.
- Establishment of fora for communication.
- Removal of environmentally harmful subsidies.
- Establishment of advanced recycling centres.

Although our policy mix includes most types of instruments, it does not include any clear-cut case of cooperation-based (voluntary) instruments. The internalisation of external costs, the materials tax, and the removal of harmful subsidies are all part of a green fiscal reform. The tax revenues and the reduced spending on harmful subsidies will be used by the governments for funding of other parts of the policy mix and for reducing labour taxes.

Large parts of the policy mix do not have a clear focus on metals; instead they have an overarching touch. The reason for this is that we want to avoid simply shifting the burdens. If the policy mix makes the production and use of metals more expensive but does not affect the cost of polymers, wood, or concrete, there is a risk that material use shifts from metals to other materials in a way that increases total resource use and environmental impacts.

6.4.1 Green fiscal reform: internalisation of external environmental costs

Brief summary of the measure

The internalisation of external environmental costs is part of a green fiscal reform in this policy mix. It entails a gradual increase in taxes and fees on emissions and natural resources until 100% of the estimated environmental costs are internalised.

The increased environmental taxes & fees (IET&F) discussed here are not metal-specific but include all natural resources that are extracted in Europe: raw materials, energy and water. It also includes emissions that occur in all economic sectors in Europe. This will help form a coherent package, increase material efficiency and, at the same time, avoid simply shifting of environmental burdens from the metals industry and metals products to other sectors or commodities:

- Raw materials: these includes metal ores, but also the raw materials used to produce materials that clearly compete with metals (concrete, wood, etc.). Other raw materials (sand, gravel, etc.) are included in the instrument mainly to form a coherent whole but also to safeguard against burden shifting beyond what we expect today.
- Energy resources: a significant share of the energy resources are used to produce commodities for metals production (coal used to produce coke for crude-iron production, fuel used to produce electricity for primary aluminium production, etc.; IEA 2015). Oil and natural gas is used for producing polymers that compete with metals in certain applications. Energy resources used for other purposes are also relevant to include, because shifting from metals to other materials might affect the demand for energy resources in the manufacturing, use and waste management of the products. Including all energy resources in the instrument safeguards against simply shifting from metals products to products and services with a higher energy demand in these parts of the product life cycles.

- Water: water use could be affected when shifting from steel products to wood or other materials based on biomass. A shift from metals products to other solutions might also affect the water used in the manufacturing and use phase of the products. These effects might not be significant, and the external costs associated with the use of water are probably the least clearly connected to metals. However, the external costs of water use are still included in the instrument, partly to form a coherent whole and to safeguard against unknown risks of burden shifting.
- Emissions: metals production and metals processing are important point sources for emissions of, for example, CO_2 and heavy metals. The production of competing materials, such as concrete and polymers, is also associated with significant emissions. Shifting from metals to other materials will affect the emissions from manufacturing, use and/or waste management of the products. Including all emissions in the instrument safeguards against simply shifting from metals products to products and services with a higher environmental impact in the life cycle as a whole.

In terms of economic flows and mechanisms, the words tax and fee are here synonymous. Policy-makers will choose to use the word that fits best in their political context. Both taxes and fees will be specified per kg of pollutant or ton of material. It will be paid to the national government. The revenues will be used to fund other policy instruments in the policy mix and to reduce taxes on labour.

The implementation of IET&F will be spearheaded by a coalition of the willing Member States (MS). It will be expanded until, eventually, all of EU has implemented the instrument.

Brief description of the design and scope

a. <u>When would it be introduced?</u>

Environmental taxes and fees already exist. This instrument means that they are gradually increased until 2050 (see below). They are also gradually expanded to further pollutants, resources, activities, sectors and countries until, in 2050, they cover the full scope of emissions and extracted resources in Europe. It is important that tax reforms are introduced gradually and have a long term perspective to allow time for those affected to adjust (UNEP 2014b). Indexation of taxes is also important to maintain the real value of taxes over time and ensure government tax revenue as well as maintain the impact of the tax on relative prices and thereby on agents' behaviour (European Commission 2012a).

b. <u>What is its aim?</u>

In the context of the metals policy mix, the IET&F aim to increase material efficiency, reduce the demand for products and services that require metals and other materials, and also to increase recycling. Such effects can be expected because the production of materials is energy intensive compared to most other activities: it requires much energy and cause large emissions per MEUR of added value. The IET&F will affect the cost of materials production more than the cost of most other activities. This will increase the price of materials and quite possibly reduce the use of materials where such reductions are possible.

In a broader context, the instrument also aims at increasing energy and water efficiency and at reducing pollution. Such effects can be expected because IET&F will make the use of energy and water and the emissions of pollutants more expensive.

Finally, the instrument aims at creating jobs. By making material and energy more expensive and reducing labour taxes, the instrument can shift the use of production factors in the economy from energy, water and materials to labour.

c. Which economic sectors and point(s) in the lifecycle would it be targeted at?

All sectors and all points in the product life cycle where resources are used and pollutants emitted.

d. What requirements does it place on relevant players?

In order to levy taxes, there must be a clear way of measuring or documenting the amount of resources used or emissions produced. Resource extraction and emissions of a large number of pollutants from factory chimneys and wastewater pipes can be measured with existing technology. Diffuse emissions from, e.g., landfills, agriculture and forestry would have to be estimated based on calculations. Methods for such calculations have to be harmonised and widely agreed upon.

The external cost of each pollutant and resource has to be decided upon. This depends strongly on perspectives and methods used in the monetisation of health and environmental impacts. Deciding on the external costs will require a political consensus or negotiations procedure in EU-27. Scientific findings on the impacts of pollutants and resource extraction need to be used as basis or input to this procedure.

e. Links/synergies/interlinkages with other instruments within the same policy-mix

There is an overlap with the other instruments in the green fiscal reform. In particular, if the materials tax is implemented, an IET&F can be regarded as a double punishment of materials use, because the IET&F will also affect the cost of using materials. This can reduce the acceptability of the instrument.

The IET&F is likely to be more easily accepted if it is part of a coherent and more comprehensive policy package. If it is supported by information and combined with the removal of harmful subsidies and with environmental investments and subsidies in, e.g., sharing systems and in research and development, the coherency of the policy instrument might be more apparent and the acceptability of the IET&F might increase. These instruments are all part of the metals policy mix. The IET&F might also benefit from support through a joint EU strategy for sustainability, which has not been described as an element in this policy mix.

f. For taxes and subsidies: what is the level of the tax/subsidy?

As indicated above, the magnitude of external environmental costs cannot be objectively decided. The methods for estimating environmental costs vary widely depending on the source (e.g., Steen 1999a, Steen 1999b, Bickel & Friedrich 2005, Lindberg 2014).

Several attempts to estimate total external costs have been made, using different methods. The EXIOPOL (2014) project estimated the global external costs to Euro 2.35 trillion in the year 2000, corresponding to less than 7% of the global GDP that year. In contrast, Trucost (2013, p.8) estimates the global external costs in 2009 to be US$7.3 trillion or 13% of global economic output that year. Referring to earlier sector-wise figures from Trucost, KPMG (2012) states that the global environmental impact in 2010 amounted to:

- for mining: US$86 billion or 64% of sector earnings (p.113),
- for metals production: US$69 billion or 71% of sector earnings (p.113),
- for car manufacturing: US$33.7 billion or 22% of sector earnings (p.73),
- for beverage production: US$35.4 billion or 42% of sector earnings (p.81),

- for chemicals production: US$43 billion or 43% of sector earnings (p.88),
- for food production: US$200 billion or a full 224% of sector earnings (p.100),
- for airlines: US$11.6 billion or 52% of sector earnings (p. 65),
- for marine shipping: US$15.7 billion or 59% of sector earnings (p.106), and
- for telecommunications, including internet: US$12 billion or just 2.5% of sector earnings (p.123).

The level of the IET&F in the assessment models will be a very rough estimate of the 100% internalisation of external costs. This has several reasons:

- The magnitude of external environmental costs cannot be objectively decided (as stated above).
- Actual IET&F cannot be expected to accurately reflect the actual impacts on human health and environment. These impacts will often depend on the time and place when emissions occur. A policy instrument cannot take such detailed circumstances into account. Instead, actual IET&F are likely to be the same for a kg of a specific pollutant, regardless of where and when it is emitted, at least within the same country.
- The assessment models do not include accurate estimates of the emissions of the large range of pollutants that affects human health and the environment. Instead, we need to use rough default values for the total external costs of different sectors or activities.

Researchers at different universities and institutes have made widely diverging estimates of the environmental and external costs associated with different emissions and with the extraction of different resources. There is no objective method for concluding that one estimate is more accurate than another. For the purpose of the ex-ante assessment, it is useful to choose estimates of the environmental costs that are much higher than the current environmental taxes; otherwise there will be little external costs to internalise and the policy instrument will have little impact on the material flows etc. Even so, we can choose estimates from several different sources. For the initial policy mix we can, for example, assume that the level of taxes and fees are the potential IET&F identified by Hogg et al. (2014). The increase in green tax revenues will be 35 € billion in the year 2016, 88 € billion in 2020, and 101 € billion in 2025, in the twelve MS that we assumed to be involved in the first phase of the IET&F (see Hogg et al. 2014). Compared to total GDP of these countries, the IET&F corresponds to 0.63% in 2016 and 1.57% in 2025. This increases the cost of using any materials, since the production of materials is based on natural resources and also an important source of emissions. Using the revenues to reduce labour taxes will (probably slightly) reduce labour costs.

From 2030, IET&F will be implemented in all MS and increase gradually until full internalisation is obtained in 2050. The level of the taxes at this point depends on the estimates of the environmental costs, as discussed above. Based on the figures from EXIOPOL, Trucost and KPMG above, we could simply assume that the external costs correspond to 35% of the value added for material goods and transports. For the purpose of our assessment, we would then neglect the rather small external costs from services other than transports. The simplistic 35% estimate is a bit lower than the global Trucost estimates for the relevant sectors, but the Trucost estimates are also a bit higher than the estimate from EXIOPOL.

If the models used in the ex-ante assessment allow for more refined modelling of the environmental costs, we could use the estimates of Alberici et al. (2014) for external costs of energy. They estimate the current external costs in EU-28 to be 122 € billion for electricity production (Table A3-6) and 77 € billion for heating excluding domestic heat pumps and solar thermal (Table A3-7). If sufficient data are available, we could alternatively use the estimates for specific emissions and resources that are used in the calculations of Trucost (2013) or Hogg et al. (2014), or estimates currently being developed by Steen.

g. For tax: who is to pay it and how are the revenues to be used?

- A tax on natural resources (raw materials, energy, and water) will be paid by companies extracting the resources or using the land.
- The IET&F on emissions from the stacks and wastewater pipes of large production plants will be paid by the owners of each production plant. These owners will also pay the IET&F on estimated diffuse emissions from stockpiles.
- The IET&F on diffuse emissions from landfills, agriculture, and forestry, will be paid by the companies responsible for these activities.
- Energy-related IET&F on emissions from production facilities that are too small to have instruments for measuring actual emissions from stacks will be part of the fuel tax and included in the fuel price.
- Energy-related IET&F on emissions from vehicles and residential buildings will also be part of the fuel tax and included in the fuel price.
- Part of the revenues are used for funding other instruments in the dynamic policy mix: the sharing systems, increased spending on research and development, information campaigns, advanced recycling centres, etc. (see below).
- The rest of the revenues will be used for reducing taxes and charges on labour that are paid by the employers. How much this will affect labour taxes, depends on the total IET&F revenues, on the total labour taxes, and on how much is spent on the other instruments.

h. What physical flows (if any) are directly targeted by the policy instrument?

All physical flows to the extent that they are associated with emissions and resource use.

Governance

a. At what level scale should the instrument be deployed (EU, MS, etc.)?

Members States (MS) at least until 2030. After 2030: EU in the Safe Globe Scenario but still MS in all other scenarios.

b. What stakeholders should be involved in the negotiations and agreement?

Mainly MS governments, industrial associations, NGOs and researchers.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Owners of large production plants will be obliged to measure emissions from the stacks and drainpipes.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

Coordination is important in order not to distort the common market more than necessary, which is likely to be a condition for political acceptability.

e. What is the perceived feasibility and acceptance among key actors?

IET&F can be feasible at a moderate level because they only mean an incremental change compared to the environmental taxes and fees that are already implemented. Resistance is likely to occur from the process and manufacturing industry, particularly those that compete on a global market for commodity products. This resistance can perhaps be reduced by the fact that the tax revenues are used for reducing taxes and charges on labour that are paid by the employers.

Expected environmental impacts and effectiveness

IET&F is likely to reduce various health and environmental impacts through the reduction of emissions of greenhouse gases, SO_X, nitrogen, particulates, toxic substances, etc.; however, part of this effect is likely to be offset by polluting industry and use of virgin material moving outside EU or at least outside the MS that implement the IET&F. For example, the extraction of metal ores and other natural resources and the production of metals and other materials will be more expensive, but only in the MS that implement the IET&F. Such activities might then decrease in these countries but instead increase elsewhere in the world. The extent of such leakage is as yet unknown.

Key expected economic impacts

In MS that implement IET&F, parts of polluting industries (process industry, etc.) will be less competitive and is likely to lose market shares. More innovative parts may be able to respond over time through efficiency gains and product change. On the other hand, the competitiveness will increase in labour-intensive sectors (for example, most of the service sector). As a consequence, the structure of the economy in the MS, and eventually in the EU as a whole, is likely to change towards an increased share of services.

Key expected social impacts

In the long run, the IET&F is likely to increase the number of jobs since the reduction in labour taxes makes labour less expensive. This effect is likely to be small until 2030 but somewhat greater after that. However, distributional effects of tax reforms are also very important to consider, for example, how different industries are affected and between social-economic groups.

A change in the structure of the economy is likely to cause temporal unemployment. We expect the scale of job losses not to be significant compared to usual rates of job turnover in the economy as a whole. However, at the local level unemployment and associated social impacts can be significant.

People might have to move to find new jobs. Since process industry to a large extent is located in rural areas and service sector to a larger extent is concentrated to cities, this might increase the urbanisation with associated social challenges.

A new job in, e.g., the service sector is likely to require different skills, compared to an old job in, e.g., the process industry. This means people might have to expand their education to find new jobs. It might be relevant to combine this instrument with the complementary skill enhancement measure in the overarching policy mix.

6.4.2 Green fiscal reform: materials tax

Brief summary of the measure

This is a value-based tax on all materials that are used in the EU: steel, concrete, paper, polymers, glass, textiles, etc. The materials tax is to be levied on all types of materials in order to avoid burden shifting from metals to other materials. It is levied even on renewable materials because also renewable material resources need to be used efficiently.

The materials tax is levied regardless of whether the material is produced from virgin, natural resources or from recycled raw material. The tax is applied also on recycled material for two reasons:

- Recycled metals, paper and plastics are globally traded goods. Implementing a tax on virgin materials only will make recycled materials relatively cheaper to use in the EU (compared to virgin material). This is likely to shift the use of recycled materials to the EU from the rest of the world. However, it is not likely to significantly increase total recycling. This is because the supply of recycled material is rather insensitive to changes in demand.
- If the tax is applied also on imported material, as we suggest, it is much more difficult to implement on virgin materials only. This is because virgin and recycled materials are often mixed and sometimes impossible to distinguish from each other.

The tax will be levied on the material regardless of where it is produced. It is levied on imported as well as domestic materials in order not to distort the competitiveness of domestic material production in the EU. Exported materials are exempt from the tax in order not to distort the competitiveness of domestic material production outside the EU.

Eckermann et al. (2012) distinguish between three types of materials tax: taxation of extraction, taxation of the first industrial use of the materials, and taxation of the consumption. The materials tax presented here is not an extraction tax, nor a taxation of the consumtion. It resembles a tax of the first industrial use of the materials (steel, concrete, paper, etc.). However, the tax also applies on simple imported products such as wires, pipes, etc. (for details, see below). The tax exemption is not only for exported materials but also for similarly simple products.

The material tax takes the form of an ad-valorem tax, which is levied on the traded quantities of raw materials and finished materials to and within the EU. As usual in the case of taxes, the total tax burden falls on both buyers and sellers. Similar to the value-added tax (VAT) the level of the materials tax is a proportion of the value added in the value chain. However, while VAT is added all through the value chain, the materials tax only applies to value added in the materials production (i.e., up to and including steel mills, cement mixer, paper mill, etc.) and not to value added in the manufacturing industry or the wholesale and retail sector.

Brief description of the design and scope

a. <u>When would it be introduced?</u>

As mentioned in section 6.4.1, it is important that tax reforms are introduced gradually and have a long term perspective to allow time for those affected to adjust (UNEP 2014b). Policy makers need to allow for a long time to pass from when the tax is introduced to when it reaches levels that are high enough to significantly change material flows. We suggest here

that the material tax is introduced in 2020, increases slowly until 2030 and then more rapidly until 2050.

b. What is its aim?

The materials tax aims to reduce material use in the EU through reduced production losses, more material-lean products and increased material efficiency in general.

c. Which economic sectors and point(s) in the lifecycle would it be targeted at?

The primary target of the materials tax is the manufacturing industry in EU-27. This is part of the production phase of products that are manufactured in the EU. The tax will increase the material cost of the manufacturing industry, which, hopefully, results in an increase in the material efficiency of their processes and a reduction in the quantity of redundant material in the manufactured products.

d. What requirements does it place on relevant players?

The EU negotiators within WTO have to find an agreement that allows the EU to levy taxes on imported goods. Such an agreement can be justified by arguments related to environmental and health protection. It can also be defended by the argument that the import duty will not distort the competition but rather level the ground since the tax is also levied on domestically produced materials.

In order to levy import duties, the material value must be estimated for products where this material value is a large share of the total import price. This will require an agreement on default values for each kg of different materials. A procedure to estimate the material value of products containing a mix of materials has to be developed. Note, however, that imported complex products such as cars and electronics are not likely to be affected by the materials tax. The share of the material value is likely to be below the threshold level (see below).

The companies in the extraction (e.g., mines) and materials production industry (e.g., metals smelters) will have to declare payments and revenues of materials tax, similar to the current VAT declarations. Companies in the manufacturing industry will have to declare exports of products that are exempt from the materials tax (see below).

e. Links/synergies/ interlinkages with other instruments within the same policy-mix

The combination of materials tax and increased environmental taxes and fees can be regarded as a double punishment of materials use, because the IET&F will also affect the cost of producing and using materials. This can reduce the acceptability of the instrument.

The materials tax is likely to be more easily accepted if it is part of a coherent and more comprehensive policy package. It can be supported by an EU strategy for dematerialisation, by information, and by the establishment of fora for communication. It can be combined with the removal of harmful subsidies and with environmental investments and subsidies in, for example, sharing systems and in research and development for material efficiency. These instruments are all part of the metals policy mix.

f. For taxes and subsidies: what is the level of the tax/subsidy?

The material tax will be very low when introduced at 2020. It increases linearly to 30% of the materials value in 2030. From 2030 it increases linearly until, at 2050, it reaches 200% of the value of the materials.

g. For tax: who is to pay it and how are the revenues to be used?

Similar to VAT each producer in the extraction and materials production industry pays in proportion to the value added by that producer. However, while the full VAT in the end is paid

by the final consumer, the full materials tax is paid already by the manufacturing and construction industry that uses the material.
The materials tax is also paid by importers of materials and by importers of simple products (wire, pipes, body parts for cars, etc.) where the value of the material is a sufficiently large share of the product value. The threshold is 50% of the product value in 2020, decreasing linearly to 20% in 2030 and to 10% in 2050. This will make it possible for EU manufacturers to compete on the European market:

- EU manufacturers of the simple products (wire, pipes, etc.) will compete at an equal footing with manufacturers outside the EU.
- EU manufacturers of more complex products (cars, cell phones, etc.) will not compete at an equal footing, but for them the cost of material, and thereby the tax, is a smaller share of the total production cost.
- As the tax increase over time to 30% and eventually to 200% of the material value, the threshold is gradually lowered to allow manufacturers of slightly more complex products (simple car parts, etc.) to compete at an equal footing with manufacturers outside the EU.

Exported material and products where the materials value is above the threshold are exempt from the materials tax, because they are not used in the EU. This will make it possible not only for material producers but also for European manufacturers to compete outside the EU.
The revenues from the materials tax will be used for reducing taxes on labour.

h. What physical flows (if any) are directly targeted by the policy instrument?

All materials used in EU-27 and the products that are used in EU-27 where the materials value is above the threshold above.

Governance

a. At what level scale should the instrument be deployed (EU, MS, etc.)?

The tax is from the start implemented in each individual Member State (MS). After 2030, it becomes an EU tax in the Safe Globe Scenario but remains a national tax in all other scenarios.

b. What stakeholders should be involved in the negotiations and agreement?

Within the EU, at least MS governments and industrial associations and unions related to the extraction, materials production and manufacturing industry. Taxes on imported materials and tax exemptions for exported materials probably need to be negotiated within the World Trade Organisation (WTO).

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Not applicable.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

Coordination is important in order not to distort the common market more than necessary.

e. What is the perceived feasibility and acceptance among key actors?

This instrument is likely to be controversial. Resistance from the materials production industry is likely to be particularly severe until it has been made sure that the tax will also be levied on imported materials and that exempt will be made for exported materials.

Expected environmental impacts and effectiveness

The materials tax aims at reducing the production of materials. If it is effective, natural resources will be saved for future generations, the climate impact is likely to be reduced and emissions of toxic substances are also likely to be reduced, reducing impacts on both human health and ecosystems. This is because production of materials typically is energy intensive compared to most other activities: it requires much energy and cause large energy-related emissions per MEUR of added value. In addition, materials production includes the most important point sources of several toxic substances.

Key expected economic impacts

With the design above, the overall economic growth is not likely to be significantly affected. It might even be beneficial for the economy. Meyer (2011) found that a tax on the use of metals in investment goods industries (if combined with an international agreement on recycling for metals; and with information and consulting program concerning material inputs in sectors with high concentration of small and medium sized firms) is likely to increase GDP.

The European manufacturing industry will at least initially be less competitive because of higher material costs. Over time, however, this is likely to be at least partly off-set through the use of more material-efficient techniques. As the tax will eventually be levied also on imported manufacturing products where the value of the material is above 10% of total product value (see above), the more efficient European industry might even gain an advantage on the European market.

The structure of the economy might be affected, with a greater emphasis on services and high-value goods and less production and consumption of cheap goods where the cost of materials is a significant share of the total product price. Housing and constructions are likely to be more expensive, because materials cost is a relatively large share of the total cost in this sector.

Key expected social impacts

A change in the structure of the economy is likely to cause temporal unemployment. Also people might have to move to find new jobs. Such transitions are associated with social challenges.

In the long run, the materials tax is likely to increase the total number of jobs since it makes labour less expensive.

6.4.3 Promotion of sharing systems

Brief summary of the measure

Sharing systems for cars, bicycles, tools, and equipment are established by local authorities or through economic support to private initiatives. The sharing systems for bicycles, cars and tools will mainly be set up in urban areas, including cities, towns and larger villages. Sharing systems for agricultural equipment will be established in rural areas.

A combination of the following options will be implemented, depending on local and national conditions, etc.:

1) Local authorities set up a scheme for sharing of cars, bicycles, tools, and equipment.
2) Local authorities support the setting up of private sharing systems through funding of part of the investment cost.
3) National authorities support the private sharing systems
   a) through deductions in income tax to consumers for the renting costs, or
   b) through a differentiation in VAT between goods and services.

This is part of a package to make leasing and sharing of products more convenient, compared to owning the same products.

Brief description of the design and scope

a. When would it be introduced?

We suggest this policy measure is introduced in 2020, as it is relatively easy to implement.

b. What is its aim?

The aim is to reduce the use of metals and other materials through a reduction in the number of products used.

c. Which economic sectors and point(s) in the lifecycle would it be targeted at?

The measure targets primarily households but also commercial leasing companies as well as non-profit organisations. It focusses on the use phase of the product life-cycles. However, the measure will indirectly affect also the production phase, where manufacturing firms may see demand for their products decrease.

d. What requirements does it place on relevant players?

Consumers have to pay an annual membership fee to be allowed to borrow the products in the sharing scheme. They also have to return borrowed products intact within a given time. In countries that introduce a tax deduction for renting costs (Option 3a above), consumers have to document and declare how much they spend on renting to get the tax deduction.

e. Links/synergies/ interlinkages with other instruments within the same policy-mix

Options 2 and 3 above can easily be combined. However, public sharing systems (Option 1) can counteract public support for similar private initiatives (Options 2 & 3). Coordination among national and local authorities is required to avoid a case where the national authorities support private sharing systems and local authorities set up competing public sharing systems.

The establishment of sharing systems is likely to be more effective if it is part of a coherent and more comprehensive policy package. It needs to be supported by information. It can also be combined with, for example, a green fiscal reform. These instruments are part of the metals policy mix.

f. For taxes and subsidies: what is the level of the tax/subsidy?

The type and level of subsidy will depend on the option chosen above. For Option 1, the set-up of the sharing system will be fully funded by the municipality. The running of the public sharing system (reinvestments, maintenance, administration, communication, etc.) will be funded in the following way:

- from 2020 to 2030: to 50% through membership fees and to 50% through public funding.

- from 2030 to 2050 in the scenarios Economic bonanza and Divided we trudge: still 50/50 through membership fees and public funding.
- from 2030 to 2050 in the Reference scenario and the scenarios Safe globe and Back to nature: 100% through membership fees.

For Option 2, 25% of investment and reinvestment costs will be covered by public funds in the period 2020 to 2030 to get the system started and growing.

For Option 3a, tax deductions will be 50% of renting costs between 2020 and 2030. From 2030 and on, tax deductions will be reduced to 25%.

For Options 3b, the lowest available VAT will be applied on renting services. This level of VAT will vary between Member States.

g. For tax: who is to pay it and how are the revenues to be used?

Membership will be individual and the fees are paid by the individual consumer. Money for the public funding and tax deductions will be collected as part of the local and national income tax on households. The level of the tax increase will depend on the cost of the sharing systems. The distribution of the tax increase will be the same as the already existing local tax.

h. What physical flows (if any) are directly targeted by the policy instrument?

Cars, bicycles, tools, and equipment.

Governance

a. At what level scale should the instrument be deployed (EU, MS, etc.)?

Municipality (Options 1 & 2) and national (Option 3) level.

b. What stakeholders should be involved in the negotiations and agreement?

Municipal and national authorities and also potentially competing private initiatives, such as car rentals and private car-sharing systems. In addition, manufacturing firms should be involved to encourage them to adapt to these new business models.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Consumers that do not fulfil their obligations will be charged an extra fee. After repeated failures they can be excluded from the sharing system. Consumers that do not document and declare renting costs will not be allowed the tax deduction in Option 3a.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

Coordination at EU level is not important. Coordination between municipalities and national authorities is important (see above).

e. What is the perceived feasibility and acceptance among key actors?

If this measure becomes very expensive, it can encounter resistance from tax payers. Public sharing systems are likely to encounter resistance mainly from competing private initiatives.

Public sharing systems are likely to be particularly popular among consumers in the scenarios Safe globe and Back to nature. On the other hand, more competing private initiatives are also likely in these scenarios.

Expected environmental impacts and effectiveness

As a first estimate, the sharing systems are likely to have a limited impact on the total use of materials. This is because a relatively small share of the materials is used for producing cars, bicycles, tools, and equipment. The materials affected, however, are mainly metals and polymers, which are associated with relatively high environmental impact in the production phase.

Key expected economic impacts

The overall economic growth is not likely to be significantly affected. The overall structure of the economy is also not likely to be affected before 2030 and in most scenarios after that. However, in the scenarios Safe globe and Back to nature the sharing systems can become widely used and result in a shift in the economy from manufacturing industry to the service sector, particularly to the sharing systems themselves.

Key expected social impacts

Public sharing systems can potentially contribute to a stronger sense of community among citizens and increase the legitimacy of the municipality and its authorities. A widespread use of sharing systems can potentially contribute to enforcing the social norm that owning the products you use is not important.

On the other hand, sharing systems might lead to increased social stratification, where specific social groups stick together and share their higher/lower value belongings.

6.4.4 Increased spending on research and development

Brief summary of the measure

This instrument implies continued and strengthened public funding of research and development (R&D) in EU-27 for recycling and material efficiency. The R&D for recycling will include:

- Design for recycling;
- Efficient and consumer-adapted systems for collection, and identification of the role for the public sector in ensuring their provision;
- Technology for dismantling and separation of components and material; and
- Technology for recycling.

The R&D for material efficiency will include, for example:

- improved processes and products;
- new business models; and
- non-material alternatives for safe investments.

The objective of the last item in the list is to find ways to substitute metals, particularly gold, with other ways of delivering the service safe investments.

Brief description of the design and scope

a. When would it be introduced?

We suggest this policy measure is introduced in 2020, as it is relatively easy to implement.

b. What is its aim?

The aim is to increase recycling and material efficiency through improved technology, systems and knowledge. This serves to reduce the use of virgin material. It also serves to enhance the competitiveness of the European industry.

c. Which economic sectors and point(s) in the lifecycle would it be targeted at?

The measure targets primarily research at universities and institutes and R&D in the manufacturing industry. The results of the research are expected to directly affect the manufacturing industry, the wholesale and retail sectors, and the waste management. All of the economy is expected to be indirectly affected.

d. What requirements does it place on relevant players?

Not applicable.

e. Links/synergies/ interlinkages with other instruments within the same policy-mix

The materials tax might be more easily accepted if it is combined with an increased R&D on material efficiency. Increased R&D on recycling can make it easier to have ambitious long-term targets in the extended producer responsibility (EPR; part of the overarching mix). It can also help expanding the EPR to textiles and other new products and flows where the recycling technology is not yet well established.

Spending on R&D for material efficiency might be more accurate if supported by an EU strategy for dematerialisation. The R&D spending on recycling might be more effective if supported by the establishment of fora for communication. These instruments are also part of the metals policy mix.

f. For taxes and subsidies: what is the level of the tax/subsidy?

For the purpose of this project, we assume that the public spending on R&D for recycling and material efficiency is doubled at 2020 and that its share of total public R&D spending is kept constant after that.

g. For tax: who is to pay it and how are the revenues to be used?

Money for the public funding will be collected as part of the local and national income tax on households. The level of the tax increase will depend on the level of R&D spending. The distribution of the tax increase will be the same as the already existing local tax.

h. What physical flows (if any) are directly targeted by the policy instrument?

Products that are manufactured in EU-27; the materials that are used for the manufacturing; and the waste from products that are used in EU-27.

Governance

a. At what level scale should the instrument be deployed (EU, MS, etc.)?

At all levels. The greatest impact will probably be at the EU level through Horizon 2020 and future EU research frameworks and in Member States through national research funding. However, regional and municipal funding of R&D would also be affected.

b. What stakeholders should be involved in the negotiations and agreement?

The European Commission (DG Environment, at least); national, regional and municipal authorities; researchers; associations for the manufacturing industry and waste management.

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Not applicable.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

Some coordination at EU level would be valuable to increase the likelihood that the R&D funds are used efficiently.

e. What is the perceived feasibility and acceptance among key actors?

Increased spending on R&D are likely to be widely accepted, particularly if it aims to improve not only the environment but also the competitiveness of European industry.

Expected environmental impacts and effectiveness

The effectiveness of research is difficult to predict. Little impact is expected before the year 2030. On the other hand, if the R&D is effective and results in increased recycling and material efficiency in the EU-27, knowledge transfer to other parts of the world will, in the long term, contribute to recycling and material efficiency also in other parts of the world. This will reduce the energy-intensive production of virgin materials and the associated environmental impacts.

Key expected economic impacts

If the R&D activities are successful, this will temporarily increase the competitiveness of European industry through reduced raw-material costs, until the knowledge transfer makes the technology and systems available also in other parts of the world. If the R&D activities are continuously successful, delivering a continuous flow if efficient innovations, it will allow European industry to stay one step ahead of its competitors.

Key expected social impacts

The social impacts are difficult for the author team to predict.

6.4.5 Product standards

Brief summary of the measure

This instrument entails the development of standards for specific metals products and metals components that regulate the design to, for example:

- Improve the modularity to increase reparability and reuse of components, taking into account impacts on energy efficiency.
- Reduce the unnecessary use of material.
- Substitute metals for other materials when appropriate, for example shifting from copper water-piping to polymer piping.

The EU should attempt to initiate the development of international standards within the framework of the International Organization for Standardization (ISO). If and when this fails, European standards should still be developed within the framework of the European Committee for Standardization (CEN). The standards could be based on, for example, the best practices from value-chain co-operation in the preceding 10 years.

Brief description of the design and scope

a. When would it be introduced?

Time might be needed to gain acceptance among policy-makers and in the industry for the idea of product standards with an explicit environmental purpose. Several years will also be needed to develop the first standards. We suggest that a set of product standards can be completed by the year 2030.

b. What is its aim?

The aim is to reduce the use of virgin metals through product redesign, increased longevity, and increased reuse.

c. Which economic sectors and point(s) in the lifecycle would it be targeted at?

The product standards will primarily affect the manufacturing industry. It may also affect importers of manufactured goods to EU-27.

d. What requirements does it place on relevant players?

The requirements will be stipulated in each product standard. They might include material choices and/or other aspects of product design.

e. Links/synergies/interlinkages with other instruments within the same policy-mix

The idea of product standards with an explicit environmental purpose might be more easily accepted if such standards are part of a dynamic policy package that begins with the establishment of EU strategies for dematerialisation. This package could also include a green fiscal reform that includes, for example, a materials tax and the removal of environmentally harmful subsidies. Increased R&D on recycling and material efficiency and the establishment of discussion fora might allow for more ambitious product standards, which would make this instrument more effective. All of these supporting instruments are part of the metals policy mix.

f. For taxes and subsidies: what is the level of the tax/subsidy?

Not applicable.

g. For tax: who is to pay it and how are the revenues to be used?

Not applicable.

h. What physical flows (if any) are directly targeted by the policy instrument?

Selected metals products. The standards should initially cover a few select products or components only, where there is little economic or functional cost of reducing material use, shifting material or increasing the ability to reuse and recycle the product. Water piping might be a good example of such a product.

The instrument should be gradually extended to more and more products and include also products where the functionality etc. is affected. In the long-term a product standard might, for example, set a limit to the quantity of material in a passenger car.

Governance

a. At what level scale should the instrument be deployed (EU, MS, etc.)?

Globally, if possible. Otherwise EU.

b. What stakeholders should be involved in the negotiations and agreement?

Associations for the manufacturing industry, national authorities, researchers and the European Commission (DG Environment, at least).

c. For obligations: what stakeholders are responsible? What consequences do they face if they fail to comply?

Producers are responsible for adhering to the standards that have been developed and accepted. If not, their products will not be allowed at the EU market.

d. Is it important and technically necessary to coordinate the instrument at EU-level?

Coordination at EU level is essential. It is important to make a common effort to establish international standards within the framework of ISO. If this does not succeed, cooperation within CEN is necessary to establish a European standard.

e. What is the perceived feasibility and acceptance among key actors?

Product standards are likely to meet resistance from the associations of manufacturing industries and from manufacturers of products that do not meet the standards.

Expected environmental impacts and effectiveness

The environmental benefits will differ widely between standards, depending on the volume of products affected and on the requirements of the standard. A very rough estimate is that the product standards will affect 1-10%, by weight, of new metals products in the year 2030 and 5-20% of new metals products in the year 2050. These figures are global, if the standards are global. They are European if the standards are European.

Product standards are likely to be effective when they specify the type or quantity of material in the product, in the sense that the environmental benefit from reduced material use can be estimated in advance. The environmental benefits are more difficult to predict for standards that aim at modularity to increase reparability and reuse of components.

Key expected economic impacts

The overall economic growth is not likely to be significantly affected. The overall structure of the economy is also not likely to be affected. However, individual companies and manufacturing plants will be excluded from the European market if they cannot meet the requirements of the product standards. They will be dependent on the demand of markets outside EU, which is likely to affect their revenues and production volume.

Key expected social impacts

Increased unemployment can cause social problems in areas where affected manufacturing plants are important to the local economy.

6.4.6 Supporting and complementary instruments

EU strategy for dematerialisation

This instrument aims to change the mind-set of national policy-makers and to pave the way for the material tax (see below) and other ambitious policy instruments. The strategy is an official EU document and is primarily an industrial and economic strategy. The process for agreement of the strategy is essential for its political credibility - involving engagement of major industrial groups and Member State economics and finance ministries.

It makes explicit links to the impact of greater resource productivity on macroeconomic change, employment and well-being, in the context of expected low, future EU GDP growth. The development of the strategy should begin immediately, and inform economic performance assessment under the European Semester. The document should be ready and agreed upon by the Member States around the year 2020. It includes the plans for achievement of certain dematerialisation objectives in the context of strategic structural change, in particular pointing to the price trends and other market changes which policy will look to deliver to bring about dematerialisation. Its goal is to create credible market expectations of change, to give economic actors ample time to prepare for them and change their investment, innovation and depreciation strategies. The document will therefore agree the nature of the instruments to be used to achieve change in market conditions.

Information campaigns

This instrument aims to change the mind-set of the public, authorities, and companies. One goal is to increase public acceptance of the other policy instruments. Another goal is to influence the consumption pattern and related behaviour. This can be beneficial for all strategies for reducing the use of all virgin metals through product redesign, increased longevity, and increased recycling. The information campaigns can have broad or narrow topics and targets, for example:

- Counteracting commercials by pointing at alternative routes to well-being that do not involve increased consumption.
- Encourage people to buy jewellery produced from materials with lower environmental impacts than gold.

Fora for communication

This instrument aims to facilitate communication throughout the value chain of priority products, to enable innovation, where current co-ordination structures do not yet exist (as they already do in the vehicle industry). The EU will co-fund the establishment of fora for nations and regions where appropriate, depending on the industrial structure of the value chain. It will co-ordinate an EU level mechanism for value-chain co-operation and co-ordination. Such co-ordination can fulfil several purposes, for example:

- Giving producers and recyclers the opportunity to discuss what quality of the recycled materials can be obtained and what quality of the material is required for different applications. This can serve to establish or strengthen the markets for recycled material and increase recycling level.

- Creating critical mass between purchasers and suppliers in value chains, that allow sufficient purchasers and suppliers to innovate - in the knowledge that their innovation will have a market (suppliers) or will be able to benefit from innovative components (purchasers).

Removal of harmful subsidies

A complementary part of the green fiscal reform is the removal of two environmentally harmful subsidies (EHS): limited liability for accidents related to metals extraction, and subsidies associated with the purchase of company cars. These subsidies are selected here because they are both related to metals. They affect they mining of metals ores and the size and number of cars.

The money saved through the removal of these EHS will be use for reducing the tax on labour, just like the environmental taxes and fees (Section 6.4.1) and the materials tax (Section 6.4.2). The monetary flows are likely to be small. The economic and environmental impacts of the EHS removal are also likely to be small. However the instrument can still be important to form a coherent and comprehensive green fiscal reform.

Advanced recycling centres and reuse mechanisms

This instrument aims to increase reuse and recycling and also to decrease the demand for products through increased longevity. Its objective is to increase collection of waste for recycling and also to facilitate second-hand trade, repairs and redesign of used goods.

This instrument implies that local or national governments support community initiatives aimed at enhanced reuse, and invest in advanced recycling/reuse centres that include:

- Facilities for collection of recyclable fractions.
- Second-hand shops of building components, clothes, furniture, etc.
- Repair shops for furniture, bicycles, tools, etc.
- Shops for redesign of waste products into art or new useful products.

Visitors to the recycling centre are welcomed by personnel who help them to search the waste for items that can be reused, repaired or redesigned rather than discarded (cf. Ljunggren Söderman et al. 2011). In addition, businesses are encouraged to work with the recycling/ reuse centres to identify products capable of reuse, reconditioning, and re-entering the market.

6.5 Adaptation of the policy path to different scenarios

As stated above (Section 2.5) the policy mixes should be adaptive. Until 2030 the EU and the world will have changed for other reasons than the initial policy mix. Policy-makers should be prepared for new barriers that might occur and also to take advantage of opportunities that might arise.

Gustavsson et al. (2013) developed five background scenarios for the purpose of testing the robustness of the policy mixes. We use these background scenarios also to describe how the second phase of the policy mix can adapt to external developments.

The outline of the policy mix above is relevant for the Reference scenario. In the scenario Safe Globe EU develops towards a federal state. This makes it possible for EU to levy the

environmental taxes and fees and the materials tax, instead of requiring the members states to do so.

In the scenario Divided We Trudge, however, EU becomes weak and divided. It will not be able to require Member States to implement the green taxes. Instead, will be implemented by a coalition of the willing Member States.

6.6 Revisions after ex-ante assessment

The policy mix on metals and other materials presented in Sections 6.4-6.5 was essentially included in the first edition of this report, which was published in February 2015. The policy mix has evolved since then, thanks to feedback and food-for-thought from many directions. The metals author team continued to reflect on the policy mix, in part inspired by the other DYNAMIX policy mixes. We also received feedback from stakeholders, from the DYNAMIX Advisory Board, and from an external scientific reviewer at the European Commission. Last but not least, results from the quantitative and qualitative ex-ante assessment of the different instruments of the policy mix affirmed some parts of it but also called for a few changes. The feedback, the revisions and the final version of the policy mix are all summarised in this section.

6.6.1 Reflections and feedback on the policy mix

The overarching policy mix (Chapter 4) includes elements that we found useful also in this chapter: the extended producer responsibility and programmes for skill enhancement. We added adapted versions of these instruments to the policy mix on metals and other materials to form a more coherent policy package.

The author team presented revised versions of the policy mix at the 4th DYNAMIX Policy Platform, at the World Resources Forum (Ekvall et al. 2015), and in a scientific paper (Ekvall et al. 2016a). While preparing these presentations, the role of primary and supporting instruments became more clear to us. Primary instruments aim at shifting the material flows in the society, while supportive instruments aim at making the primary instruments more effective, efficient and feasible. Some of the instruments that are presented as key instruments in Section 6.4 are really supportive instruments more than primary instruments. Learning this affected the structure in which the final policy mix is presented in this section.

We also found it necessary to better define the scope of the policy mix: what materials are covered by the materials tax, etc. The original scope (metals) was expanded to other materials in order to avoid burden-shifting from metals to other materials. Hence the relevant scope of this policy mix is metals and materials that significantly compete with metals. This affects, for example, the name of the policy mix.

Stakeholders at the 4th DYNAMIX Policy Platform argued that high environmental taxes cannot be implemented in the EU only, because it will seriously affect the competitiveness of EU industry and shift environmentally harmful activities outside the EU, rather than stop them. The materials tax above includes border tax adjustments to reduce impacts on the competitiveness and also to reduce shifting of environmental burdens from the EU to the rest of the world. To further improve the policy mix, we propose that border tax adjustments are introduced also for the environmental taxes and fees, where this is possible.

Stakeholders at the DYNAMIX Policy Platforms and final conference also questioned the target of 80% reduction in virgin metals use, stating that a) metal resources are more

abundant than we know, because we have not searched much of the Earth's crust for metals, and b) metal resources are not depleted when they are extracted because metals can easily be recycled. This affected our arguments for reducing the use of virgin metals.

The DYNAMIX Advisory Board suggested that this report should include a narrative to present and explain each of the policy mixes. Such a narrative for the policy mix on metals and competing materials is presented in Subsection 6.6.2.

The external reviewer stated that the choice of policy instruments should be better advocated. The narrative below is an attempt to do this. The external reviewer also found a lack of justification for the proposed timing of implementation of the different policy instruments. We have added brief justifications. To make it easier for the reader, we have added these in Section 6.4 rather than here.

The quantitative assessment of the policy mix indicates that it can be effective as well as efficient. The results from the economic models (Bukowski and Sniegocki 2016, Antosiewicz et al. 2016) indicate that economic instruments need to be broad and very strong to have a significant impact on the total use of materials resources. High taxes on material use and environmental burdens are likely to have a negative impact on the economy if the tax revenues are recycled back to the households as lump sums, as often assumed in economic models; however, when these taxes are part of a green fiscal reform, they are used for reducing labour taxes. The models indicate that such a fiscal reform stimulates economic growth. They also indicate that a radical green fiscal reform can significantly reduce climate impacts and increase the efficiency in the use of material resources, at least if the materials tax and environmental taxes affect the technology used in the industry. All this affirm the decision to include a radical green fiscal reform in this policy mix.

One of the quantitative environmental models illustrates that successful spending on R&D on improved dismantling processes for vehicles and machines can have significant impact on the recycling of, for example, copper (Ekvall et al. 2014, Ekvall et al. 2016b). This affirms the decision to include R&D spending in the policy mix.

The qualitative part of the ex-ante assessment included a legal assessment (Luca and Roberts 2015). It concluded that all instruments in this mix seem to be compatible with WTO treaties. This includes the border-tax adjustments, since these aim at no more than leveling the ground for competition between EU and non-EU producers. The categories of instruments in the policy mix have, at least in part, predecessors in EU legislation. However, the introduction of EU-wide taxes requires a unanimous vote in the Council, which makes them difficult to implement. Luca and Roberts (2015) recommend that the protection of human health and the environment should be explicitly mentioned to justify the policy instruments. These conclusions are taken into consideration in the narrative below.

Luca and Roberts (2015) remark that compliance with standards is voluntary. Technical requirements should be more effective because they are mandatory. For this reason, we exchanged product standards for technical requirements in the policy mix.

The qualitative assessment also included an investigation of the public acceptability of the policy instruments and policy mix (Vanner et al. 2016). They found that the internalisation of external costs, the materials tax, and product standards are likely to be contentious or even highly contentious and, hence, politically difficult to implement. They recommend that measures be taken to ensure that the environmental and material taxes do not threaten the

competitiveness of the EU industry. This is the purpose of the border-tax adjustments, and we expanded them to account not only for the material tax but also for environmental taxes.

To increase the acceptability of the taxes, Vanner et al. (2016) also recommend that the green fiscal refom be presented in a way that makes the benefits of the reform apparent for the public. To make the reduced labour tax more clearly visible in the policy mix, we presented it as an explicit policy instrument in the revised policy mix, and not as an integrated part of the description of the materials and environmental taxes.

Regarding the product standards, Vanner et al. (2016) recommend that individual Member States that are sceptic to certain product standards be allowed temporal exemptions from these standards. This is now included in the description of the technical requirements that displaced product standards in the policy mix.

6.6.2 The revised policy mix for metals and competing materials

Aim and objectives

Human consumption of renewable and non-renewable material resources is skyrocketing. Rising global population and affluence levels, ever more widespread adoption of westernised lifestyles and production and consumption patterns risk contribute to future increases in resource consumption. The resource use and associated environmental impacts contribute to transgressing existing planetary boundaries. Human activities are expected to require two planet Earths around 2030 (Moore et al. 2012).

Umpfenbach (2013) indicates, based on Bringezu (2009) and UNEP's International Resource Panel (Fischer-Kowalski et al. 2011) that the use of virgin metals in the EU need to be reduced by 80%, calculated as RMC, to reach a sustainable level. The level of this target can be disputed; however, the extraction and production of metals are responsible for a significant share of the energy demand, GHG emissions and toxic impacts of human society. Reducing the dependency on virgin metals can also counteract risks related to future supply of certain metals, because the mineral reserves and/or mines are located at very few places in the world (relevant for, e.g., several rare earth metals; European Commission 2014e). Increasing the efficiency in the use of metal resources is, in addition, important for generating as much economic value and/or well-being and serving as many functions as possible with a given resource base. For these reasons, our policy mix aims at significantly reducing the use of virgin metals in the EU.

A policy mix that simply shifts the use of virgin metals or associated environmental impacts from the EU to other parts of the world does not address global environmental justice or sustainability. To reach a sustainable future, the global recycling rate is, for example, more relevant than the recycling that takes place within the EU. Hence, the policy needs to also account for impacts beyond the EU boundaries.

Metals compete with other materials in important applications: with concrete and wood in constructions, with paper and glass in packaging, with polymers in packaging and in components in machinery, and with textiles in furniture. However, shifting to the use of other materials sometimes is detrimental for the environment, the economy or other societal goals. A reduced use of reinforcement (steel) bars in concrete buildings is, for example, likely to result in an increase in the use of concrete large enough to increase total GHG emissions. To

avoid burden-shifting to other material resources, the scope of the policy needs to be expanded to include not just metals but also the competing materials.

In conclusion, our policy mix aims to steer the EU towards the 80% target in reduced use of virgin metals, without significantly hampering the economy, without increasing the use of virgin metals in other parts of the world, and without significantly increasing the use of other material resources and environmental impacts. This aim serves the purpose to reduce the impacts on human health and environment. It also contributes to making the economy more robust with respect to risks related to future supply of metals.

For this aim, the policy mix on metals and competing materials has the following objectives:

- Increase the efficiency in the use of metals and all competing materials
- Increase the global recycling rate of these materials
- Substitute metals by other materials, where this is beneficial for the environment and well-being

The policy mix includes a few strong primary instruments, aiming to achieve these objectives: a materials tax, extended producer responsibility, technical requirements, and general environmental taxes (see Primary instruments below and Figure 20). It also includes a larger set of supportive instruments that are less controversial and that aim to reduce the negative side-effects of the primary instruments. The supportive instruments include, but are not limited to:

- Border tax adjustments, to reduce the impact on the competitiveness of EU industry
- Retraining programmes, to facilitate a change in the structure of the labour market
- Spending on research and development (R&D), to facilitate changes in technology
- Information campaigns and infrastructure to facilitate changes in behaviour

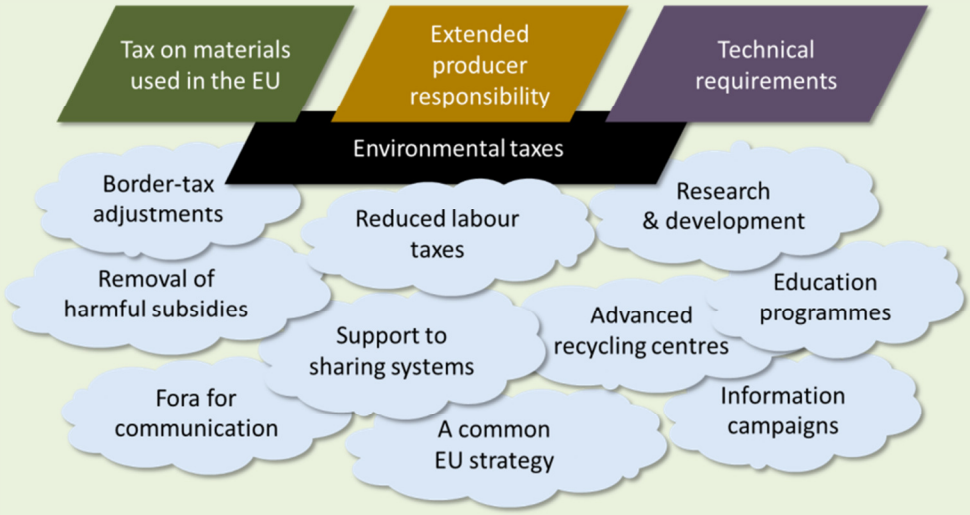

Figure 20: Illustration of the policy mix on metals and competing materials. The four primary instruments are embedded in a larger set of supportive instruments.

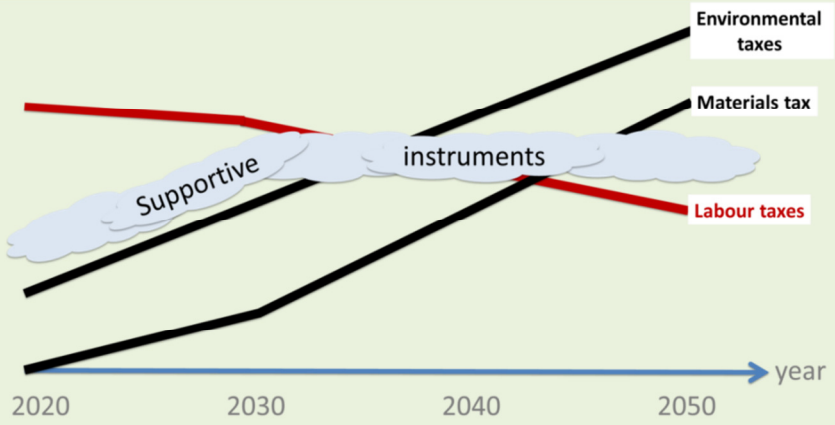

Figure 21: Qualitative illustration of the dynamics of the green fiscal reform.

An important part of the combined policy mix is a radical green fiscal reform where taxes on rmaterials use, pollution etc. are introduced and gradually raised while labour taxes are reduced (see Figure 21). The policy mix overall is dynamic in order to first create a shift in paradigms, available technology, and other important conditions, and then a significant increase in material efficiency and recycling. The first steps includes R&D spending and the creation of a common EU strategy. The tougher instruments, notably the material and environmental taxes, are gradually introduced with willing Members States leading the development. To what extent they can be harmonised within the EU will depend on whether the EU becomes a stronger or a weaker union.

Primary instruments

The primary instruments in the policy mix are chosen to achieve the objectives of material efficiency, recycling and justified substitution. They are designed to be effective but not more controversial than necessary.

a. A substantial materials tax (to increase material efficiency)

A tax on metals and all competing materials that are used in the EU is introduced in 2020 and then gradually increases to 30% of the net price of the finished material in 2030 and 200% of the net price in 2050. This tax aims specifically at increasing material efficiency, primarily in the manufacturing and construction industry. It is gradually increased over 30 years to allow for the industry to adapt to the tax. The materials tax is to be levied on all types of materials in order to avoid burden shifting from metals to other materials. It is levied even on renewable and recycled materials because also these need to be used efficiently.

The material tax can take either of two different forms. It could be a value-based tax, which is levied on the traded quantities of finished materials to and within the EU. Alternatively, it could be a weight-based tax levied on the extraction of raw materials from nature and the traded quantities of recovered recyclables to and within the EU. A value-based tax is simpler to decide on and revise because the tax rate is negotiated and decided for all materials at the same time. A value-based tax also automatically reflects the scarcity of different materials to the extent that the scarcity affects the net price of the material. The drawback is that it is not just a tax on the (virgin and recyclable) material resources but also a tax on the labor and capital costs of the materials industry.

The weight-based tax has the advantage that it is a tax on virgin and recyclable raw materials only. In addition, it reduces the volatility of the material costs in the manufacturing and construction industry. This makes it easier for the industry to invest in and plan for material efficient processes and procedures. However, the level of a weight-based tax needs to be separately decided for each raw material and each flow of recyclables. When applied on recyclables it might also create barriers to the collection of recyclable material in the EU.

More information on the materials tax can be found in Subsection 6.4.2 and Section 6.5.

b. Extended producer responsibility (to increase global recycling)

The extended producer responsibility (EPR) is the instrument in the mix that specifically aims at increasing materials recycling. A supply of recyclable material is a prerequisite for recycling of all materials. For metals and paper, where a global market for recycled materials is well established and where recycled and virgin materials compete in many applications, an increase in the supply of recyclable material is the most effective way to increase global recycling. This is because the global supply of recyclable material is limited.

The EPR means that producers in a broad sense are given the responsibility for securing a specified level of collection and recycling of their own products and packaging. A system of EPR is already implemented in the legislation of several Member States. Our policy mix includes an expansion of EPR to additional product groups (and to materials rather than product groups) in all Member States.

The EPR scheme is funded through fees from the producers. For packaging and some products, a material-specific fee is charged per kg of mass. For other products, a specific fee will be charged per item. This basic set-up will be common all through EU. However, individual Member States are allowed to organise the EPR scheme in a way that fit the national conditions. They can also vary the charge per item or kg depending on the design of the product to stimulate design for recycling and material efficiency.

c. Technical requirements (substitution and material efficiency)

This instrument entails the development of technical requirements for specific metals products and components that are sold and used in the EU. These documents regulate the design of these products and components to:

- Improve the modularity to increase reparability and reuse of components, taking into account impacts on energy efficiency.
- Reduce the unnecessary use of material.
- Substitute metals for other materials when appropriate, for example shifting from copper water-piping to polymer piping.

Compliance to the technical requirements is mandatory; however, we propose that Members States be allowed to negotiate temporary exemptions from specific technical requirements that they find difficult to accept. In other respect, this instrument is similar to the product standards described in Subsection 6.4.5.

d. Increased environmental taxes (all objectives and reduced environmental impact)

The idea of environmental taxes is based on the Polluter Pays Principle. In this policy mix, already existing environmental taxes are gradually increased and expanded with an aim to fully internalise all external environmental costs by the year 2050. The environmental taxes are not metal-specific but also levied on other natural resources that are extracted in Europe (raw materials, energy, and water) and on emissions that occur in all economic sectors in

Europe. This will increase material efficiency and recycling, and, at the same time, avoid simply shifting environmental burdens from the metals industry and metals products to other sectors or commodities.

Implementing the environmental taxes alongside the materials tax result in a double taxation of, for example, the emissions and resource use from the production of material. Such overtaxation can perhaps be justified as a measure to overcome the barriers to investments in material-efficient technology and systems.

More information on the environmental taxes can be found in Subsection 6.4.1 and Section 6.5.

Supportive instruments

There are many barriers to implementing the primary instruments above. If implemented without additional measures, they can significantly reduce the industrial competitiveness, hamper economic growth, increase unemployment in the EU, and shift polluting activities and resource use to other parts of the world. This would make them ineffective in increasing sustainability, unacceptable for the public, and politically unfeasible. Supportive instruments are designed to reduce the barriers of implementing the primary instruments, for example by reducing the negative side-effects. In addition, the supportive instruments can give direct contributions to the objectives of the policy mix.

a. Border-tax adjustments (to reduce impacts on competitiveness)

As described in Subsection 6.4.2, the materials tax is levied also on imported materials and simple manufactured products. Exported materials and corresponding products are exempt from the tax. With such border-tax adjustments, the materials tax does not distort the competitiveness of domestic materials production within nor outside the EU.

To reduce the impacts of environmental taxes on the competitiveness, border-tax adjustments can in principle be implemented also for the environmental taxes. This would ideally result in a full internalisation of external costs of production oustide the EU, when the products are imported to the EU. It would also mean an exemption from environmental taxes for products that are exported from the EU. In practice, border-tax adjustments with respect to external costs are difficult to implement, because it requires that the external costs are agreed upon. To reduce distortions to the competitiveness caused by environmental taxes, we propose that EU strives in this direction.

b. Labour tax reductions (to stimulate employment)

Part of the revenues from the materials tax and the environmental taxes will be used for funding the rest of the policy mix. As a very crude estimate, this might require half of the materials tax and half of the increase in environmental taxes until the year 2030 and then remain at the same level. The rest of the revenues will be used for reducing labour taxes (cf. Subsections 6.4.1 and 6.4.2). This means labour taxes can decline slowly until 2030 and more rapidly after that.

c. Removal of harmful subsidies (for a coherent fiscal reform)

A green fiscal reform is likely to be more easily communicated, understood and accepted if it includes the removal of environmentally harmful subsidies. This policy mix includes the removal of two subsidies related to metals: the limited liability for accidents related to metals

extraction and subsidies associated with the purchase of company cars. More information on this instrument can be found in Subsection 6.4.6.

d. R&D spending (to facilitate technological improvements)

The primary instruments make material use and pollution more expensive. This serves to increase the competitiveness of resource-efficient and clean products, production processes and systems. When the materials tax and the environmental taxes result in the use of more efficient technology, these instruments can stimulate economic growth (Bukowski and Sniegocki 2016).

However, for the industry and consumers to choose resource-efficient and clean options, these must be available at a cost that is not prohibitive. Successful public spending on R&D for material efficiency and recycling contributes to making the technology and systems more resource-efficient and cleaner. It also contributes to reducing the cost of these options. This can increase the positive impact of the materials tax on resource efficiency as well as the economy. Successful R&D can also can contribute to increasing resource efficiency without the need for materials and environmental taxes. At any rate, the positive impact of the policy mix is likely to be greater when R&D is added.

More information on the R&D can be found in Subsection 6.4.4.

e. Education programmes (to facilitate an shift in employment structure shift)

The policy mix is likely to shifts the structure of the economy, for example from production of materials and goods to services and new business models. This can cause a mismatch between the workforce and the required skills. The proposed instrument includes the development and implementation of programmes for retraining of workers in sectors where unemployment is likely to occur in order to provide them with the skills required in sectors that are likely to grow.

The educational programmes also encompasses a strategy for including resource-efficiency aspects into relevant academic and vocational curricula, as described in Subsection 4.4.5.

f. information campaigns (to stimulate and facilitate behavioural change)

Changes in consumption patterns and source separation are needed to achieve a shift to more efficient products and services, and to increased recycling. Information can be effective, when combined with other instruments, at different stages of a shift in behaviour. It can be used to explain why a change is needed, how to go about it, and to what extent a change has been successful.

A few further thoughts on information campaigns can be found in Subsection 6.4.6.

g. Sharing systems (to facilitate behavioural change)

A shift to sharing of products means that fewer products need to be produced, which contributes to increased material efficiency. This instrument includes the establishment of public sharing systems for cars, bicycles, tools and equipment, or economic support to private sharing systems. For more information, see Subsection 6.4.3.

h. Advanced recycling centres (to facilitate behavioural change)

To stimulate recycling and reuse, local or national governments invest in centres for recycling and reuse (see Subsection 6.4.6).

i. Fora for communication (to stimulate networking)

The EU will co-fund the establishment of fora for communication between actors throughout the value-chain of important products and recycled materials. This can contribute to establishing markets for new recycled materials such as textiles. It can also contribute to products becoming more resource-efficient from a life cycle perspective. For more information, see Subsection 6.4.6.

j. A common EU strategy (to harmonise legislation in Member States)

An EU policy mix on metals and competing materials require that the Member States agree on what should be included in this policy mix. The development of an EU action plan or strategy can be a way to initiate such harmonisation of views and legislation. This could be part of a revision of the Circular Economy Package, but it could also be a separate document – a strategy for dematerialisation – as discussed in Subsection 6.4.6.

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Annex A:

Some quantitative notes on metal use in Europe

Steel

The use of steel per capita in the EU does not show any clear trends in recent years. Therefore, it is difficult to predict how the use of steel will evolve in the EU in the next few decades. This section presents the business as usual (BAU) scenario. It shows indicative dynamics of steel use in the EU in the case when a) no additional decoupling policies are introduced, and b) the trends observed in the EU and the US do not change until 2050.

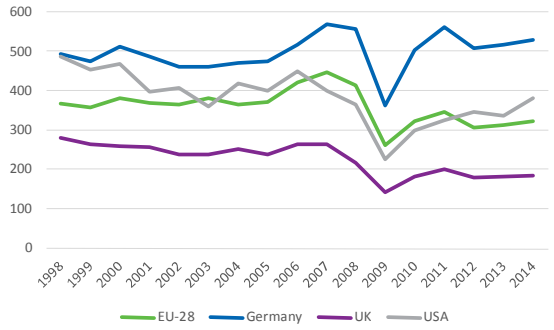

Figure 22: Apparent steel use (crude steel equivalent), kg per capita. Source: World Steel Association (2009, 2015).

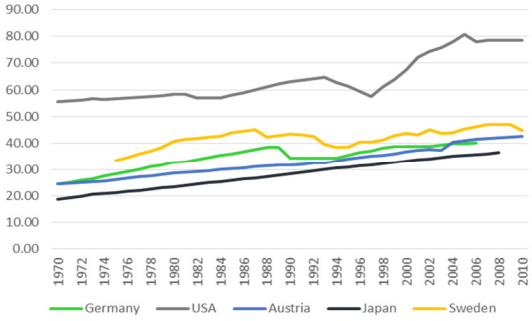

Figure 23: Changes of residential floor space per capita in OECD countries. Source: Own calculation on the basis of data from the national statistical offices, WISE Institute.

Steel is predominantly used in the construction sector, but also for transport equipment (vehicles, trains and ships), machinery and containers.

When considering future steel use in construction sector, three trends must be taken into account. Firstly, in most developed countries residential floor space *per capita* is increasing at least since 1970s. Rising income leads to higher demand for living space. Reversing this trend requires a significant behaviour change. Secondly, demographic projections for the EU28 (EUROPOP2010[43]) indicate that the European population is likely to slightly increase (+3%) by 2050. This is an effect of immigration outweighing natural population decline. In the BAU scenario, more conservative scenario is employed, with zero net migration leading to population decline. Thirdly, the use of steel in construction sector depends on the future technology trends. Recent developments focus on making buildings more energy and water efficient, rather than limiting the use of construction materials. Therefore, it is assumed for the BAU scenario that the use of steel per square meter of new buildings will remain constant, while the amount of infrastructure and other buildings will develop proportionally to the residential floor space.

[43] See European Commission (2011b) for a detailed description of the projection

Another key consumer of steel is transport equipment industry. BAU scenario assumptions concentrate on vehicles, which are responsible for the majority of steel use in that sector. The weight of new cars is declining. While their average age is roughly constant (and is even increasing for LDV and HDV), their mileage is increasing. Therefore, it is assumed that increasing demand for transport in BAU scenario will result in higher mileage and fuel use, but not in increased vehicle sales (see, e.g., Campestrini and Mock (2011) for an overview of vehicle market trends). Moreover, the use of steel per passenger car is constant – vehicle manufacturers are using other materials to increase the size of a car (mostly aluminium) and adding safety features. Assuming a continued decline in European population, it should be expected that the transport sector demand for steel will also slightly decrease.

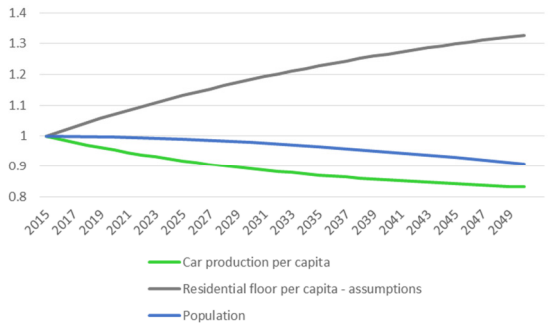

Figure 24: Steel use in construction and transportation equipment – BAU assumptions. Source: Own calculations, WISE Institute.

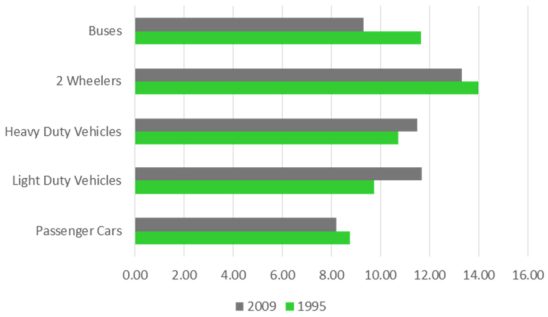

Figure 25: Average age of vehicle fleet in Europe. Source: EEA (2011b).

The steel use trends in machinery sector are very difficult to predict. While the trend towards miniaturization and slimming of products decreases the demand for steel, increasing mechanization of production leads to more steel used in the machines. Past trends in the US do not clearly indicate which of these effects will be more important in a long-term perspective. Although the consumption of steel in machinery sector has increased since 1980s, that change was rather modest and the growth trend has reversed during the last decade. After the households and industry reach a saturation point, they tend to replace their old machines and appliances with new ones rather than buy more of them. Therefore, the related steel consumption tends to flatten out.

The highest decline of steel use is assumed in packaging and containers. Despite the rapid growth of the population and GDP in the US during the last 30 years, the consumption of steel for packaging declined by 40%. It is assumed that a similar trend will be present in Europe and in the next couple of decades packaging steel will be replaced by more sustainable alternatives.

Demographic trends and a constant steel intensity of buildings and transport equipment assumed in BAU scenario imply a slight increase of steel use in both sectors. Since the data are not conclusive about the technology trends in machinery and equipment, it is assumed that the steel use will remain constant in that sector. Therefore, construction will become the main consumer of steel in the next decades according to the BAU scenario.

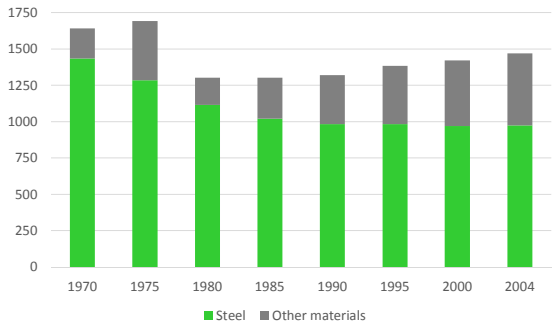

Figure 26: Weight of an average US car (kg) and its steel content. Source: U.S. Geological Survey (2006).

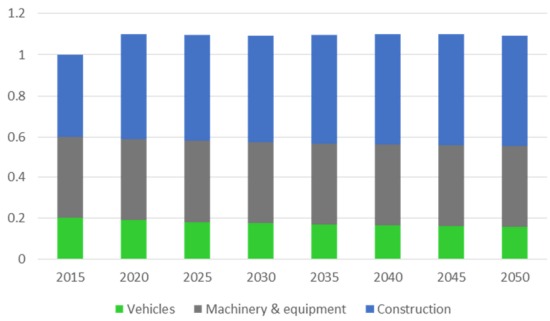

Figure 27: Steel use in Europe – BAU scenario (2015=1). Source: Own calculations, WISE Institute.

One important caveat is that steel in both machinery and transport sectors is to some extent replaced by other metals like aluminium. The possibility of substitution by other metals and materials must be kept in mind when designing policies to reduce steel use.

Copper

Copper is mostly used to produce wires and plumbing for the construction sector, but is also used in electronic products, machinery and transport equipment. Therefore, the use of copper is closely related on one hand to the technology processes and on the other hand to the development of infrastructure and buildings. Due to its effectiveness as a conductor of electricity, copper is relatively easy to recycle. However, this property also drives demand for this metal and it can be substituted with other metals, but currently it is uneconomical (alternatives are more expensive).

To estimate the future demand for copper in BAU scenario, several assumptions were adopted about the development of the main sectors in which it is used, including the "copper intensity" of each sector. Copper is mainly used in construction sector, transportation vehicles and machinery and equipment. Therefore, we can use estimates of future volume of construction and the number of cars produced in Europe.

The consumption of copper in the construction sector (mainly wires and tubes) is difficult to predict. The amount of copper needed to deliver electric energy does not change over time, while tubes used in plumbing are relatively easily substitutable by other materials such as plastic or PCV. However, the expected increase in the use of heating and cooling appliances in BAU scenario also results in a higher demand for copper.[44] Therefore, in BAU scenario we assume an increase of copper use per square meter by 20%.

There is little data on consumption of copper per passenger car. However, combining data on copper use in production of transport equipment in the US and on the number of cars

[44] According to the Copper Development Association, average air conditioner contains more than 20 kg of copper (http://www.copper.org/education/c-facts/home/).

produced indicates that the amount of copper needed per one car is close to saturation. Similar conclusions can be derived from the analysis of technological reasons for using copper in cars – it is needed to produce cables and wires. Vehicle equipment becomes more energy efficient and might increasingly rely on wireless communication. However, there is twice as much copper in hybrid and electric cars in comparison to a conventional vehicle (Weed and Morand 2010). Assuming that mitigation policies will put an increasing pressure on limiting greenhouse gases in transport, it is likely that hybrid and electric vehicles will become more widespread in the long-term perspective. Therefore, BAU scenario assumes that copper use per an average car will almost double by 2050.

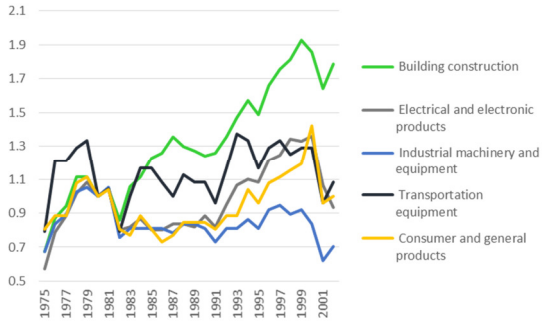

Figure 28: Evolution of the use of copper in different sectors in the US (1980=1). Source: U.S. Geological Survey (2005).

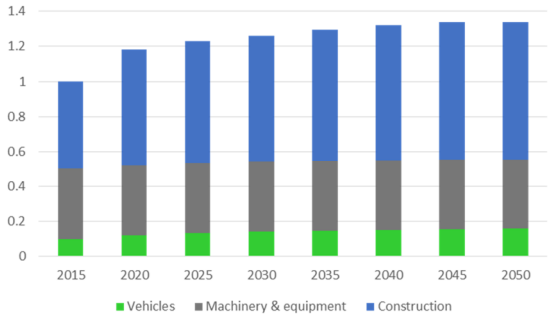

Figure 29: Copper use in Europe – BAU scenario (2015=1). Source: Own calculations, WISE Institute.

Because of the assumptions about copper intensity in future buildings, the increase of the copper use in that sector is more visible than the rise in steel consumption. The amount of copper required to produce transport equipment likewise is expected to be larger than presently. Broad adoption of hybrid and electric vehicles will drive the increase of the demand for that metal. However, since vehicles are responsible for only approximately 10% of total copper use, this will have a limited impact on the overall copper use in the EU.