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D1.3
Comparing trends and policies of key countries:
Report about drivers for resource decoupling and the role of national policies

WP 1 – Why have resources been used inefficiently?

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Key word list

Resource Efficiency, Member States, Framework conditions, Institutions, Policies, Targets, Drivers, Barriers

List of abbreviations

ATF	Authorized treatment facility
BERD	Business enterprise Expenditure on Research and Development
bn	Billion
CAP	Common Agricultural Policy
CO_2	Carbon dioxide
DEFRA	Department for Environment, Food and Rural Affairs (United Kingdom)
demea	German Material Efficiency Agency
ETC/SCP	European Topic Centre for Sustainable Consumption and Production
EU ETS	The European Union Emissions Trading System
DMC	Domestic Material Consumption
DMI	Direct Material Input
ECN	European Compost Network
EEA	European Environment Agency
EHS	Environmentally harmful subsidies
EIO	Eco Innovation Observatory
ELV	End of Life Vehicles
EMAS	Eco-Management and Audit Scheme
EPR	Extended Producer Responsibility
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
ICT	Information and Communication Technology
IEA	International Energy Agency
kg	kilogram
KrWG	Closed Substance Cycle and Waste Management Act (Germany)
LATS	Landfill Allowances Trading Scheme
m^3	Cubic meter
MFA	Material Flow Analysis
MS	Member State
MSW	Municipal Solid Waste
n/a	Not available
NISP	National Industrial Symbiosis Programme
NGO	Non Governmental Organisation
NMS	New Member States
OECD	Organisation for Economic Co-operation and Development
PAYT	Pay-as-you-throw-system

PPS	Purchasing Power Standard
ProgRess	Resource efficiency programme (Germany)
R&D	Research and Development
RE	Resource efficiency
REE	Rare earths elements
REAP	Resource Efficiency Action Plan (Austria)
RES	Renewable Energy System
RMC	Raw Material Consumption
RME	Raw Materials Equivalents
RMI	Raw Material Input
SME	Small and medium enterprises
SNM	Strategic niche management
t	ton/tonnes
t/yr	tonnes per year
TMR	Total Material Requirement
UN	United Nations
UNEP	United Nations Environment Programme
USD	US-Dollars ($)
VA	Voluntary agreement
VAT	Value-added tax
WEEE	The Waste Electrical and Electronic Equipment Directive
WFD	Waste Framework Directive
WMP	Waste Management Plan
WPP	Waste prevention programme
WTO	World Trade Organization

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1. Introduction

This Deliverable reports on the activities and results of Task 1.3 of the POLFREE project.

As described in the Description of Work (DoW), the aim of this task is to (i) identify (key) underlying policy and institutional (contributing) factors and barriers as regards resource use based on an in-depth analysis of 3-5 key countries representing different performances; (ii) add findings from policy analysis at MS level regarding tax and subsidy systems, including in particular environmentally harmful subsidies (EHS), (iii) supplement the picture by screening relevant resource and waste policies in order to identify inconsistencies and gaps and draw conclusions for priorities, in particular for WP2, and (iv) assess policy interaction effects.

Chapter 2 will select 4/10 countries based upon a review of literature on decoupling material use from GDP with regard to their decoupling performance (absolute decoupling, relative decoupling, no decoupling) and briefly investigate the developments of the past years (2001-2011) and the drivers identified in the corresponding literature. Chapter 3.2 will carry out a screening of the existing resource policies in the selected MS and analyse whether there are national resource policies or policy mixes or strategies, quantitative reduction/decoupling targets or roadmaps, innovation strategies addressing resource efficiency objectives, with respect to tax and subsidy aspects in resource-intensive sectors. In Chapter 3.3, the policy analysis of the selected countries will compare waste policies and infrastructures. Each will assess the present configurations and constellations concerning their impact on resource use. Against the results of Chapter 2, the last chapter aims to summarise policy inconsistencies, gaps and barriers and draw conclusions on policy interaction and further requirements.

In the national policy context, the web of constraints has been investigated by analysing framework conditions as well as institutional factors and policy incentives working as drivers and barriers for the development of resource use and resource decoupling (4 focus countries for resource and raw material policies and 10 focus countries for waste policies).

The different waste and resource management approaches in the countries as well as the diversity in policy choices highlights a lack of orientation and uncertainty in the general transformation to a resource-efficient and circular waste and resource management. The web of constraints is strongly shaped by different interactively linked regimes, not at least with regard to infrastructural and innovation pathways. Large challenges lie in a more coherent treatment and more specifically directed guidance at European level and the coordination of stakeholder and industrial interests at national level.

Europe could take the lead (as is done with EU Roadmap) but needs to be more specific about the directions. Research should be carried out as a consistent regime analysis with view to different materials (biomass, energy carriers, critical minerals, industrial minerals, construction minerals, and waste, each of them with regard to their national and international dimension).

2. Key concepts and state-of-play: Resource use, resource productivity, decoupling

This chapter will briefly present the key concepts and terms relevant for measuring, monitoring and policy debate in the resources and resource efficiency policy fields. The aim is to provide an overview of the current state-of-play, the indicators used and the explanatory variables that have been distilled from various studies to explain the differences between countries.

2.1. Resource use

Resource efficiency has become a buzzword in Europe. As a concept it is basically about using less resources to achieve the same or better outcome (outputs / inputs). In terms of policy development resource efficiency provides an umbrella framework for combining initiatives towards e.g. energy and material efficiency (OECD 2012). A resource-efficient economy, which is understood as an economic system that is competitive, inclusive and operates within the planetary boundaries, has become a vision of the EU (EC 2011a, p. 3). In the European Roadmap to a Resource Efficient Europe, Domestic Material Consumption (DMC) is the provisional lead indicator, which captures the material resources aspects and does not deal with other resources (EC 2011b, p. 66).

The following figure shows the Domestic Material Consumption (DMC)[1] by the four material categories (fossil energy materials/ carriers, non-metallic minerals, metal ores and biomass) for the EU28 in the decade 2001 to 2011. The overall resource use in Europe remains high peaking in 2007. Due to the financial crisis in 2009 there has been a slump in the use of resources but consumption has started increasing again in subsequent years.

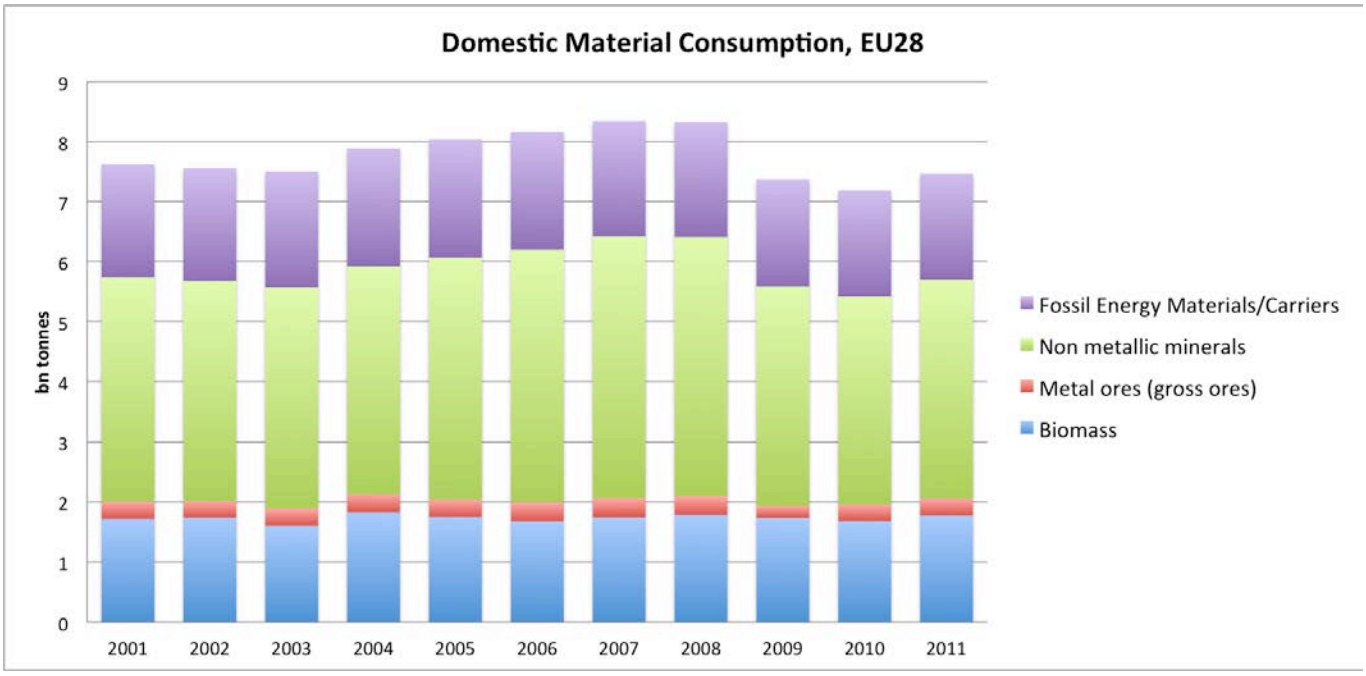

Figure 1: Domestic Material Consumption, by material categories - EU28; Source: Own compilation.

The following figure shows the material consumption on average and annual per capita basis in the EU and the European Member States (MS) in the past decade. While the EU average is approx. 18 t per capita and year, the numbers vary considerably among the countries: Malta is the modest consumer with

1 DMC = Direct Material Input - exports

4 t per capita, Ireland consumes 10 times as much with 41 t per capita. According to the EEA State and outlook on materials and waste, “only Germany, Hungary, Italy and the United Kingdom seemed to experience a long-term absolute decline in use of resources” (EEA 2012a, p. 12).

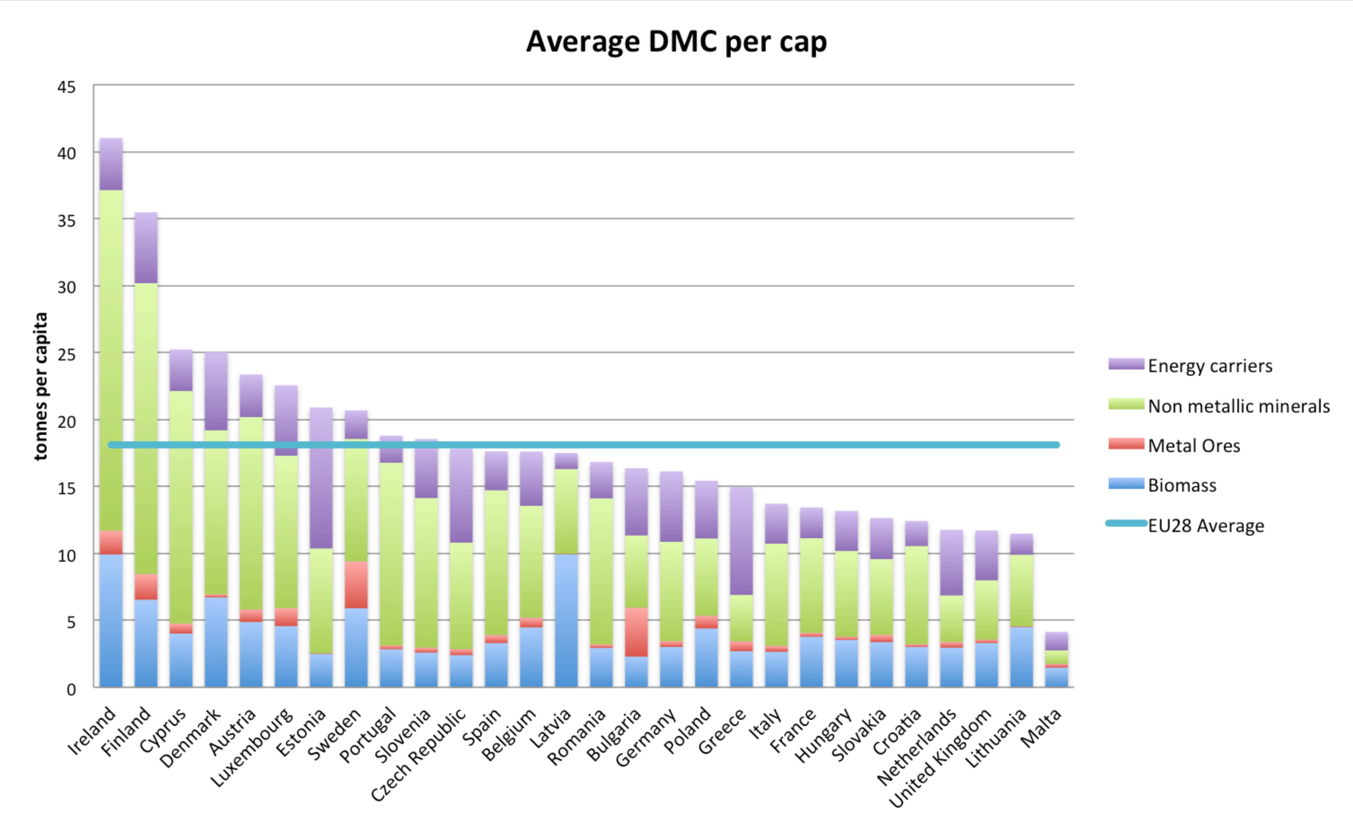

Figure 2: Average Domestic Material Consumption per capita and by material categories - EU28 (12 years, 2000-2011); Source: Own compilation, after BIO Intelligence, Update of analysis of DMC accounts, 2012, on the basis Eurostat data

Within the material categories, the following picture comes up:

- Member States with a considerable above EU average per capita consumption of **energy carriers**/ fossil fuels are Estonia (10.5 t), Greece (8.0 t), Czech Republic (7.0 t), Denmark (5.8 t), and Finland (5.3 t) [EU average is 4.0 t]
- Member States with a considerable above EU average per capita consumption **non metallic minerals** are Ireland (25.4 t), Finland (21.7 t), Cyprus (17.4 t), Austria (14.4 t), and Portugal (13.6 t) [EU average is 9.3 t]
- Member States with a considerable above EU average per capita consumption of **metal ores** are Bulgaria (3.7 t), Sweden (3.5 t), Finland (1.9 t), Ireland (1.8 t), and Luxembourg (1.3 t) [EU average is 0.8 t]
- Member States with a considerable above EU average per capita consumption of **biomass** are Latvia (9.9 t), Ireland (9.9 t), Denmark (6.7 t), Finland (6.5 t), and Sweden (5.9 t) [EU average is 4.1 t]

2.2. Resource productivity - resource efficiency

As "Headline Indicator" the EU Roadmap to a Resource Efficient Europe has determined resource productivity, which is complemented by a core set of indicators. This so-called "Dashboard" is a table summarising the essential resource aspects for the EU and the Member States (EC 2011a; BIO Intelligence et al. 2012, p. 68) showing the resource inputs of materials, water and land, supplemented by the output-based indicator of climate-relevant emissions.

Resource productivity has a monetary component and refers to the economic gains achieved through efficiency. It is calculated as value added / resource use. Material productivity as an indicator is calculated as economic output (GDP) / Domestic Material Input (DMI) or Domestic Material Consumption (DMC).

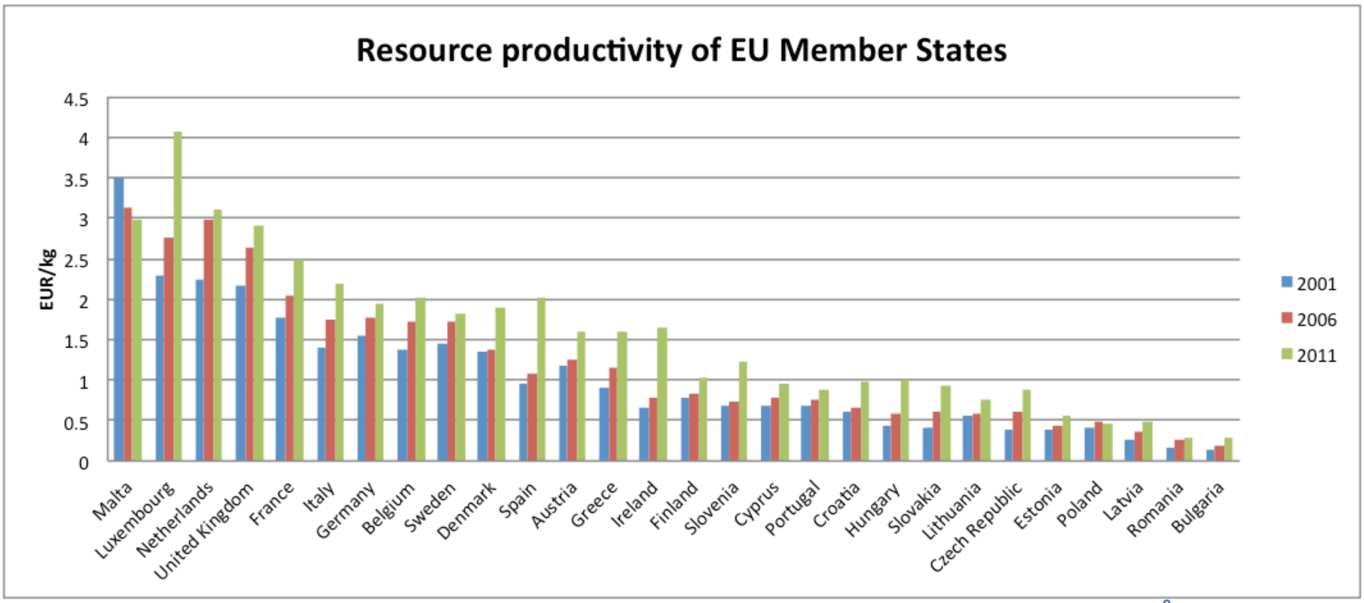

Figure 3: Resource productivity of EU Member States - EU28; Source: Own compilation, data Eurostat[2]

In this perspective the New Member States, inter alia, Bulgaria, Romania, Latvia, Poland, Estonia, are lagging behind, although all of them recorded productivity gains in the last 5-10 years. Resource productivity leaders are Luxembourg, the Netherlands, United Kingdom, Malta, and France. It is important to consider the economic structures of the countries: For example, Malta has a strong tourism sector and Luxembourg and the UK have large finance sectors. Their relatively high GDP per unit of resource is strongly influenced by these factors. The relationship between income and productivity is problematised by Steinberger et al. (2012; see Chapter 2.5.).

Resource intensity indicators are the inverse of productivity indicators. They are often used to discuss energy and emissions and are calculated as resource use / value added. Referring to the EU Roadmap, a higher resource (or material) productivity ratio would indicate better performance and growth consuming relatively fewer resources.

According to Moll et al. (2012), the resource productivity of the EU measured as GDP per cap/DMC per cap, which will be called material productivity in this study (see Kemp and Dijk 2013, p. 3, Deliverable 1.1), has more or less constantly increased in the period 2000 until 2009 to a total of 17%. At the same time, it shows considerable variations between the different Member States of 0.55 PPS (Purchasing Power Standards) EUR per kg in Romania up to 3.28 PPS EUR per kg in the Netherlands in 2009 (Moll et al. 2012). Grouping countries along an average per capita income of below or above 20,000 EUR (in PPS), there seems to be a division between the older EU15 and the younger EU13 countries according to their economic development.

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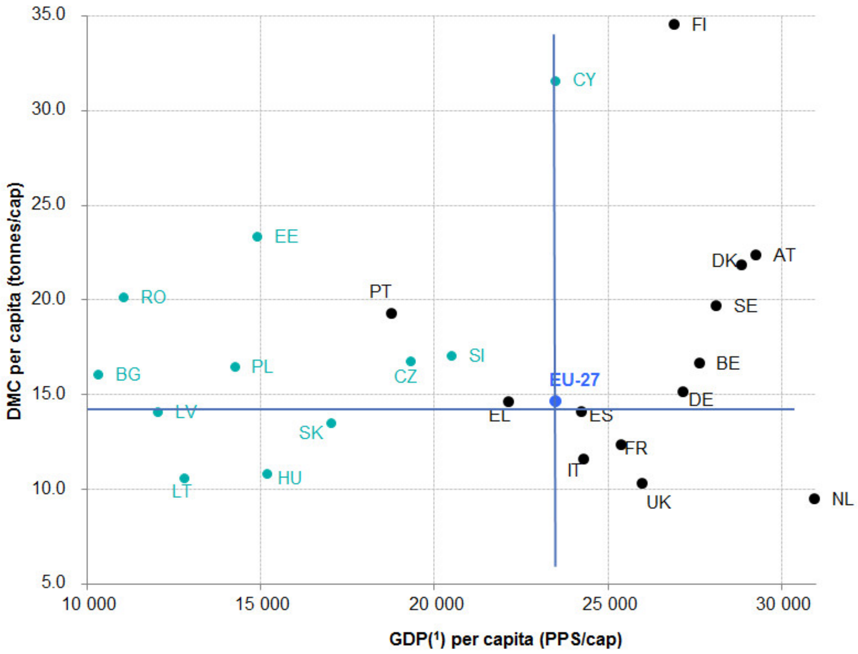
2 Ekins & Spangenberg (2013) suggest to relate resource productivity (RP) to the economic structure of countries.



([1]) GDP/DMC (GDP in PPS, purchasing power standard; suited for comparing across countries in one year)
Source: Eurostat (online data codes: nama_gdp_c , demo_gind, env_ac_mfa)

Figure 4: Resource productivity, cross-country comparison 2009; Source: Moll 2012, p. 2

These indicators, however, do not include "ecological rucksacks" or "hidden flows".[3] This means that they only detect those components of the resource input and consumption, which are directly fed into the economic process, excluding unused extraction and extraction-related erosion and excavation.

The most comprehensive indicator of an economy-wide resource productivity is GDP / Total Material Requirement (TMR). TMR measures how much primary global resources (in weight) are required to supply national production and consumption activities; it includes "rucksacks", or in other words the resources that are extracted, but not used directly, e.g. overburden in mining, harvest residues in agriculture and forestry, and the by-catch in fishing. Due to data constraints, the TMR is not, yet, widespread. It has been calculated for 20 world countries and the EU and more comprehensive data is expected in 2014. Material (or resource) productivity is therefore often used as a proxy indicator. In order to give an impression of the magnitude of the relations between Direct Material Inputs (DMI) and hidden flows, the following figures present a selection of countries, due to data constraints at different points of time.

3 DMI consists of domestic extraction (used) plus imports - DMC consists of DMI minus exports.

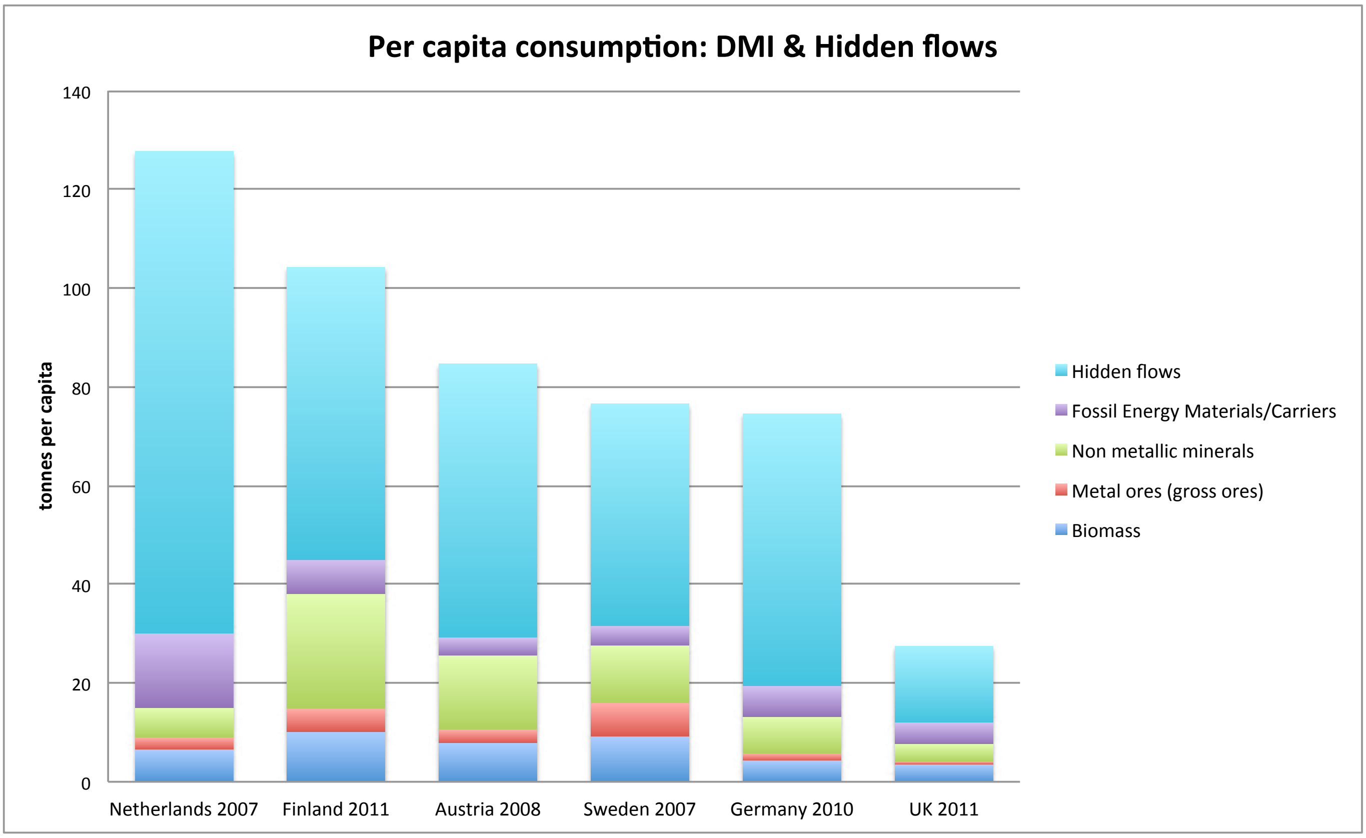


Figure 5: Domestic Material Input plus hidden flows, by material categories for selected countries at different points of time; Source: Own compilation (data by Helmut Schütz/WI)

At European level, the indicator RMC (Raw Material Consumption), which includes Raw Material equivalents embodied in trade, is increasingly taken into consideration, thus moving towards a more comprehensive picture without being fully complete though.

2.3. Decoupling

This study will also use the term decoupling to refer to the delinking of economic growth and primary resource use. Decoupling can be relative (e.g. the rate of primary resource use increase is lower than the rate of economic growth) or absolute (e.g. primary resource use declines while the economy grows).

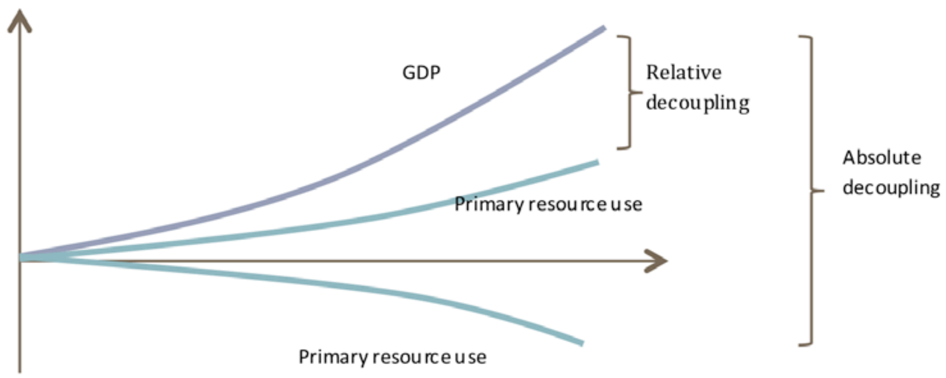


Figure 6: Relative and absolute decoupling; Source: O'Brien et al. 2013

Decoupling of resource use from economic growth is also a central element of the RE Roadmap (resource decoupling) as well as decoupling economic growth from environmental pressures (impact decoupling). The term "double decoupling" is used when resource use as well as environmental pressures is delinked from economic growth.

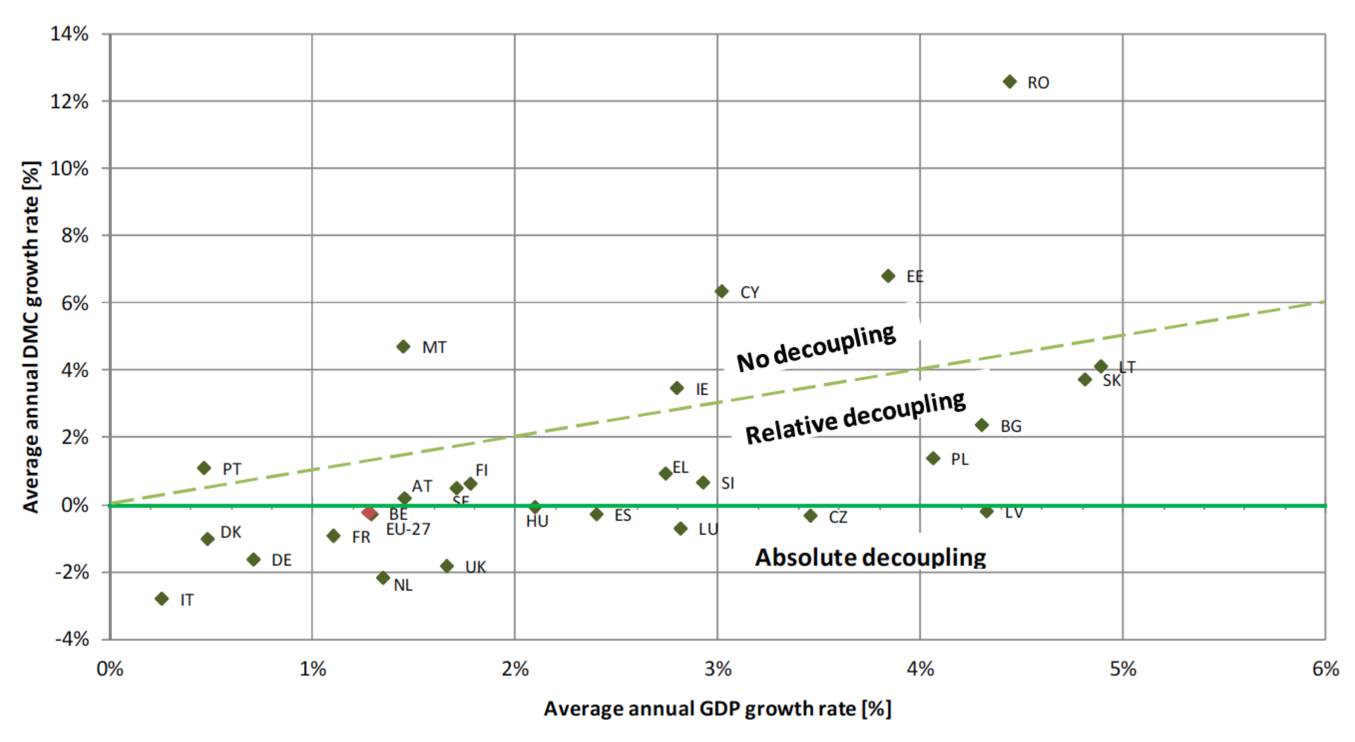


Figure 7: Average annual growth in DMC and GDP by country (average 2000-2009); Source: BIO Intelligence 2012b (update DMC accounts), p. 29

According to a recent BIO Intelligence study, many of the old Member States have achieved absolute decoupling when the average annual growth rates of DMC are plotted against the average annual growth rates of GDP over the period 2000 to 2009 (see figure above). This is Belgium, the Czech Republic, Denmark, France, Germany, Italy, Latvia, Lithuania, the Netherlands, UK, and Spain, with Hungary on the border between relative and absolute decoupling which, however, could indicate a growing outsourcing of primary material extraction. Austria, Finland, Sweden and Poland belong to the relative decoupling fraction; Estonia and Romania show no decoupling at all. It is also assumed that the economic crisis may have had a large influence on the positive development (BIO Intelligence 2012b, p. 29). In the best case, decoupling is achieved by substantial improvements in the resource efficiency of key sectors without shifting extraction and problems abroad or by changes in the structure of the economy, for example, by reducing the share of resource intensive industries towards a more service-oriented economy.

A sectoral analysis of the decoupling issue depicts an absolute decoupling for some sectors, e.g. mining of minerals, energy and water supply, mining of fossil fuels, by showing an absolute decrease of the material input going along with a growth of the economic value (see figure below). Note that this analysis uses the indicator Raw Material Input (RMI).[4] Here again, "this could indicate that these sectors had decoupled their economic growth from resource use (…) but this could also be a result of greater imports of materials over the past decade" (BIO Intelligence 2013, p. 33). The other half of EU-27 sectors has noticed economic growth being accompanied by increased material resource use. "With the exception of the transport sector, the growth in material use was lower than the economic growth" thus possibly indicating a relative decoupling (Bio Intelligence 2013, p. 33)."

[4] RMI (Raw Material Input) = DMI + raw material equivalents of imports

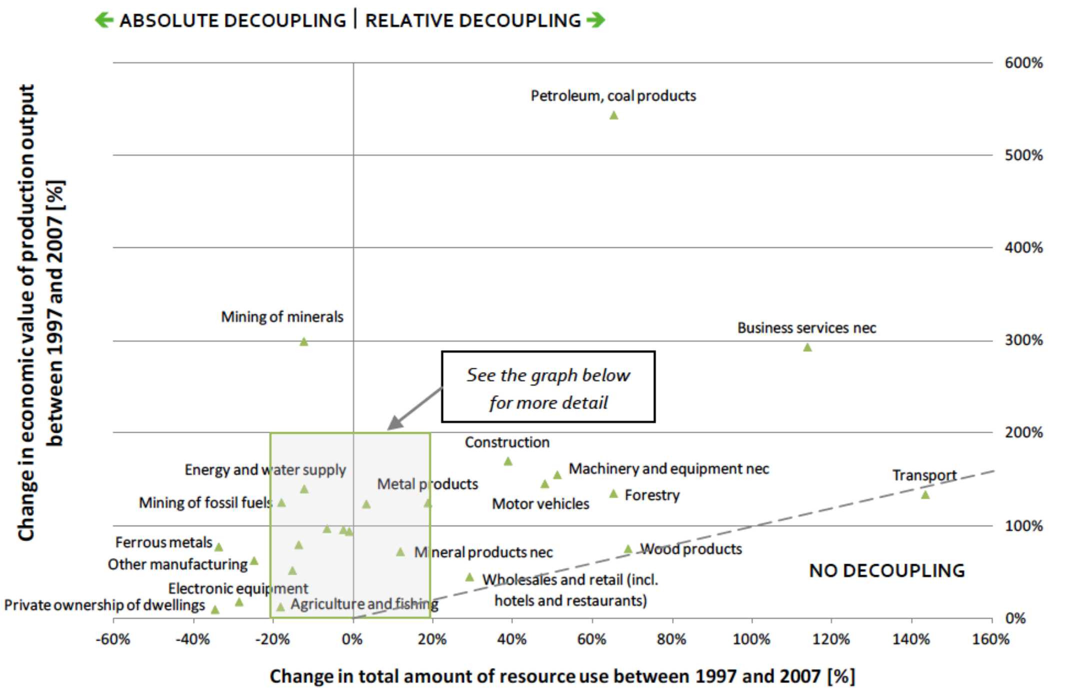


Figure 8: Developments of changes of material use compared with changes of economic value in sectors, 1997-2007; Source: BIO Intelligence 2013a, p. 33

2.4. Eco-innovation

Eco-innovation is a highly topical concept complementing and fuelling the discussion about resource efficiency and potential progress. While benchmarking of national innovation systems is quite established to-date (e.g. EU, Research and Innovation Performance, 2013), the monitoring and benchmarking of progress in national eco-innovation systems is a rather new research field. According to the project Eco-Innovation Observatory (2009-2012) "Eco-innovation is any innovation (i.e. any new or significantly improved product (good or service), process, organisational change or marketing solution) that reduces the use of natural resources (including materials, energy, water, and land) and decreases the release of harmful substances across the whole life-cycle" (EIO 2013, p. 2).

Preferably, the concept and the measurement should relate to all "innovation in or oriented towards resource use, energy efficiency, greenhouse gas reduction, waste minimization, reuse and recycling, new materials (for example, nanotechnology-based) and eco-design" (Arundel & Kemp 2009, p. 3), which is, however, far from being the case. The Eco-Innovation Observatory (EIO) was established for gathering strategic knowledge and integrated information on eco-innovation for companies and innovation service providers as well as a solid decision basis for policymaking (EIO 2010). The eco-innovation leaders of 2012 (according to the Eco-innovation Observatory Index within the context of the identical project) were Finland, Denmark, Sweden, followed by so-called good eco-innovation achievers Germany, Spain, Belgium, Slovenia, Ireland, and Austria. Only average eco-innovation performers were the Netherlands, Luxembourg, UK, France, Italy, Czech Republic, and countries catching up in eco-innovation were Portugal, Bulgaria, Romania, Estonia, Cyprus, Hungary, Malta, Latvia, Greece, Slovakia, Poland, and Lithuania.[5]

[5] The Eco-Innovation Observatory Project has established a new ranking in 2014. The Scoreboard was not grouped along leaders, good achievers, averages performers and catching up countries so far; therefore this illustration is used.

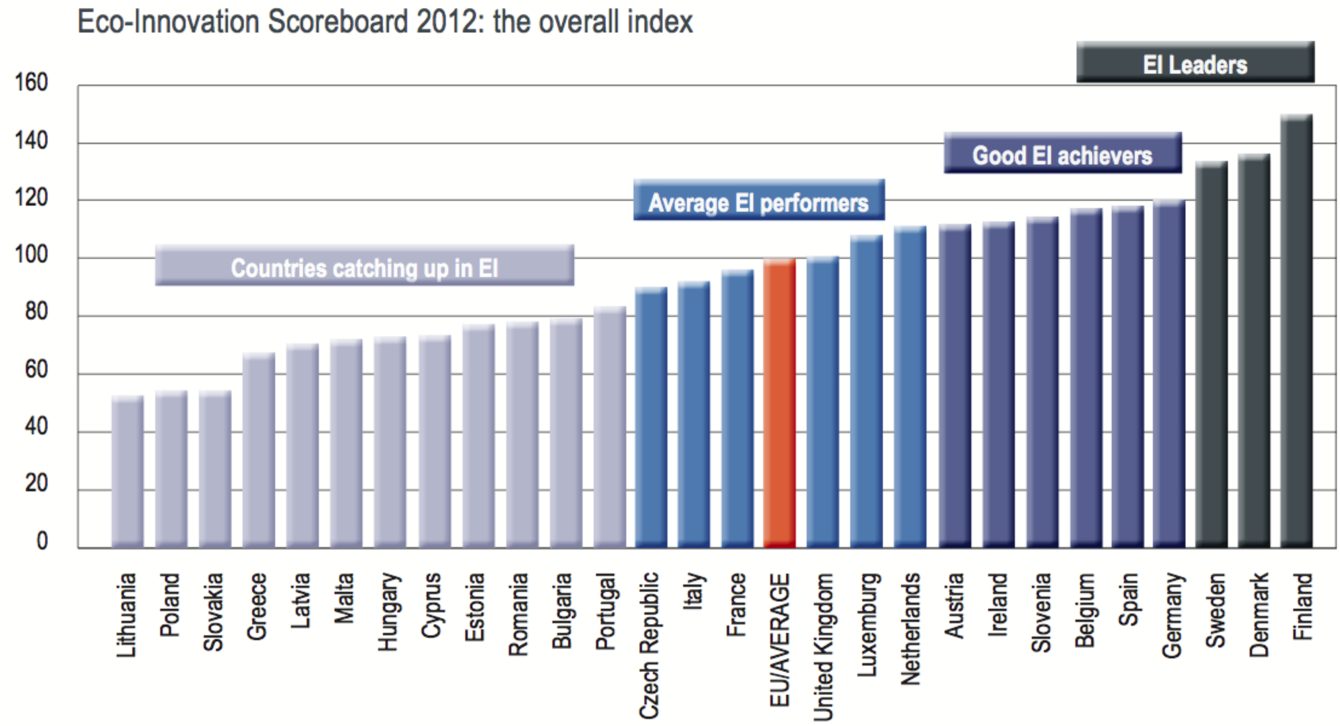
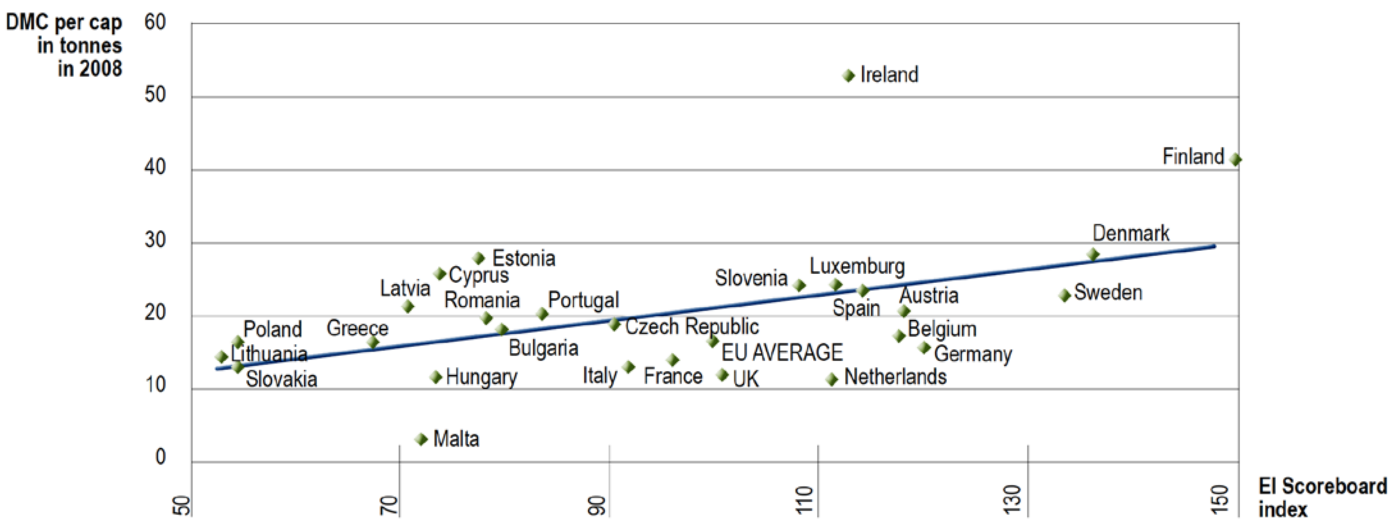


Figure 9: Eco-Innovation Scoreboard 2012: the overall index; Source: EIO 2013, p. 19

While Figure 9 seems to suggest a positive correlation between economically developed and less economically developed Member States at first glance, the Eco-innovation Annual Report finds a remarkable lack of correlation between eco-innovation and low resource use (see Figure 10).



Note: 2008 is depicted as it is the most recent year data is available before the financial crisis; the financial crisis led to sometimes significant, but temporary, reductions in material consumption in Member States.

Figure 10: Eco-innovation and material use (DMC) in Member States (2008); Source: EIO 2013, p. 23

2.5. A closer look on the resource productivity indicator and results

In the following, three problems are briefly plucked from research. They take a critical look at the indicator resource and/or material productivity and its connection with systematic distortions that have to be kept in mind.

The income-productivity nexus

Investigating an international perspective, Steinberger et al. note that although "the global international variability in DMC per cap is much larger than the inter-EU variability" (Steinberger et al. 2010, p. 1151), indicating a relation with economic development (measured by GDP), "material consumption per cap varies significantly between industrialized countries with similar levels of income" calling for examining further factors influencing these differences (Steinberger et al. 2010, p. 1149).[6]

They stress that biomass is the material that is consumed in the most equitable manner and is the dominant form of material consumption of rather poor countries. In contrast, fossil fuels and ores and industrial minerals are mainly "consumed by a small global elite" (p. 1152). This pattern of material consumption is not random, but clustered along either poor countries using predominantly biomass, and rich countries using much larger shares of fossil fuels and ores/industrial minerals and construction minerals (p. 1152). At the same time the authors find material productivity significantly correlated with income except fossil fuels and ore/industrial minerals thus implying that the indicator "as a measure of physical efficiency of an economy, systematically favours high income countries over low income ones" (p. 1156) and therefore suggest to limit the material productivity indicators for comparison to "fairly narrow income cohorts" (p. 1157). Economic figures show that many of the New Member States do not yet belong to those cohorts suggesting a cautious use of material productivity comparisons.

In contrast to these findings, Bringezu et al. found that "Countries reached high income at very different levels of TMR ranging between 32 and 100 t/cap" pointing out "that a high resource requirement is no prerequisite of economic wealth and prosperity is possible at relative low resource requirements" (Bringezu et al. 2004, p. 121). This discussion is far from being completed and refers to the measuring issue, which not only applies to the question how to adequately describe complex material flows but also and especially to the measurement of welfare by GDP (Schepelmann et al. 2010).

The inelasticity problem

In a similar manner, Steinberger & Krausmann (2011) examine the correlations of different resource groups with income-elasticity.[7] Income-elasticity is a parameter to measure the responsiveness of demand for a good or service to changes in income. They find fossil consumption growing proportionally with income, while biomass consumption is very poorly correlated with income, i.e. that fossil fuels have high and biomass a low income-elasticity. The other resource groups, industrial and construction minerals lie between the two. They conclude that "the inclusion of the inelastic biomass in the energy/material input to economies makes those who are consuming less fossil fuels seem inefficient in comparison with the richer counterparts" (Steinberger & Krausmann, 2011, p. 1175) calling for an "elasticity based understanding of composite resource consumption". The authors suggest that income elasticity of consumption (resources / population = national resource use per capita) is a more meaningful and robust quantity than resource productivity" "as an indicator used in analysis of trends and as a basis for scenarios, with the goal of explaining past and futures resource use" (p. 1175). Inter alia, this is due to the fact "if economic growth and development result in ever growing incomes,

6 The paper quantifies the variability and distributional inequality in international material consumption, measures the influence of population, GDP, land area and climate on material consumption and trade, and examines the coupling amongst material flows of the material groups biomass, construction minerals, fossil energy carriers, ores/industrial minerals (Steinberger et al. 2010).

7 Studying productivity of resources (energy, material flows, carbon emissions) in the year 2000 by systematically relating the results to income elasticities of the resources

dematerialization (…) requires null or negative income elasticity: the economic growth must be accompanied by decreases in resource use" (p. 1775).

The high purchasing power and global trade nexus

Another interesting argument in the debate whether resource productivity is the appropriate indicator for international comparisons is put forward by Giljum et al. (2011). Although there is a very high or even critical dependence of the European states on resources located and extracted outside Europe, which therefore have to be imported,[8] it is the last stages of the value chains that create the highest value added. While this is a truism, it nevertheless leads to a higher purchasing power for all primary and secondary raw materials and intermediate goods and services and must be considered a driving factor for global trade and the associated environmental impacts from trade activities and infrastructures (p. 35). It "allows countries and world regions with high purchasing power to increase resource consumption beyond their own national resource capacities", i.e. increasing their ecological trade deficits (p. 35). Because "resource efficiency is highest for the continents with the highest levels of resource extraction *and* consumption; (…) one might assume that Europe and North America are the most sustainable continents in terms of resource use; the contrary is the case" and this is why "total levels of extraction and consumption are crucial additional indicators" (Giljum et al., p. 42). Due to high rebound effects (Jackson 2009) bound to the more efficient use of resources absolute reductions per capita have to be part of the analysis (EIO 2013, Bringezu 2014, Dittrich et al. 2012).

In addition, the cause-effect relationship of high purchasing power of the net resource importing countries is not completed, as this could be a result of many drivers, including a gradually improving material efficiency, one could argue.

2.6. Variables explaining variations between countries

There is a series of studies investigating the question of which factors actually contribute to different country performances with respect to resource use? A literature review identified four studies laying a focus on different types of contribution factors. Bristol University (Science Communication Unit 2012) observes big differences as evident between EU Member States varying by a factor of more than 30 in resource productivity. The authors identify three key drivers of resource use: population, economic growth and resource productivity (Science Communication Unit 2012, p. 6). Krausmann et al. (2011) see the size of per capita material use and its composition as depending on a range of bio-geographical and economic factors, such as economic development and the sectoral structure of the economy but also the climate, the population density and the resource endowment as having "significant influence on patterns of resource use across countries". Further influences come from international trade, they state.

The Eco-Innovation Observatory (EIO 2013) tested and evaluated five structural indicators (material intensity related to land area, population density, the share of renewable energy in electricity mix, the share of coal in primary energy mix, and the share of manufacturing in Gross Valued Added (GVA) for their relationship to both material consumption and material productivity, and came to the following results: "Countries with a small land area and high population density tend to have a relatively low level of material consumption per capita, whereas countries with a low population density and large land area, like Sweden and Finland, have typically higher per cap levels of material consumption. One reason could be that material consumption is heavily influenced by construction minerals, which are used for roads (and infrastructures, A/N). The material requirements for roads in countries with a low population density is generally higher on a per cap basis than those for countries with a high pop density, like Belgium or the Netherlands" (EIO 2013, p. 25). Further influences come from the country-specific energy mixes, e.g. France hardly uses coal but nuclear power. Finland and Sweden show a wide gap between per cap consumption, particularly due to a high dependence on fossil fuels (Finland) and nuclear and

[8] Ca. 1/3 of the material and energy resources are imported, e.g. the EU-27 countries possess only 3% of the global iron ore reserves, 1% of global oil reserves, and 1% of global uranium reserves (USGS 2006) (Giljum et al. 2011, p. 27).

hydropower (Sweden). Usually, Eastern European countries with a low population density and high share of coal in their energy mix show an above average per cap material consumption. Surprisingly, "no correlation could be found for the question whether countries with a high share of manufacturing industries have a higher level of per capita consumption, or conversely, whether countries with a high share of service industries have a lower level of per cap consumption" (EIO 2013, p. 26).

The European environment - state and outlook (SOER 2012) points to the fact that the "EU has become the largest net importer of resources in the world, effectively shifting environmental burdens elsewhere" (EEA 2012a, p. 10) while the study identifies economic growth as one of the key drivers for material resource use, despite a structural change to more services, because it is associated with "increasing affluence, and growing levels of household consumption". Another decisive factor is consumption of energy (EEA 2012a, p. 10), but "on the whole, however, the main driving force seems to have been the relative pricing of labour, material and energy and the prevailing tax regimes, which make labour more expensive. Despite the high potential for improving materials and energy productivity, most macro-economic restructuring and fiscal reform programmes in recent years have tended to focus on reducing labour costs" (EEA 2012a, p. 16). Finally, Talmon-Gros (2014) who analysed material productivity development dynamics between 1980 and 2008 in order to explore empirical regularities in material productivity development over time finds that "there exists no 'mechanism' which will result in similar, high levels of MP globally. Therefore, if MP performance is to be improved globally, appropriate policies are necessary" (Talmon-Gros 2014).

Table 1: Recent studies examining explanatory variables for material/resource use and differences between countries

Study	Year(s)	Geographical coverage	Indicator(s)/ methods	Relationships/ correlations	Explanatory variables for country differences
Steinberger, Krausmann, Eisenmenger (2010)	2000	Global (175 countries)	DMC, extraction and trade flows, variability and inequality in international material consumption	MP significantly correlated with income, but not for fossils and minerals, i.e. indicator favours rich countries	Poor countries use predominantly biomass, rich countries have larger shares of fossil fuels and minerals
Steinberger and Krausmann (2011)	2000	Global; varying sample sizes	Domestic Energy Consumption (DEC), Total Primary Energy Supply (TPES), DMC, carbon emissions (from fossil fuels and cement production), GDP in PPS	Global systemic relationship between material, energy and carbon productivities, and economic activity	- Biomass is inelastic - Fossil fuels tend to scale proportionally with income
Steger and Bleischwitz (2011)	1980-2000; 1992-2000	EU-15 EU-25	MFA and regression analysis		Energy use and energy efficiency, construction investments (roads and dwellings), car possession, size of service sector
Giljum et al. (2011)	2000	Global - world regions	Global Resource Accounting Model (GRAM)	High purchasing power favours ecological trade deficits and rebound effects	Purchasing power, global trade, ecological trade deficits, rebound effects
SOER Materials (2012)	2000-2011	EU-27	DMC and further indicators	Striking correlation between material use and consumption of energy, decoupling due to substitution of domestic production	Economic growth, energy consumption, relative pricing of labour, material and energy and the prevailing tax

					regimes
Talmon-Gros (2014)	1980-2008	Global		No mechanism that leads to similar high levels of material productivities globally	
EIO (2013)	2000-2008	EU-27	DMC, eco-innovation inputs (e.g. R&D), eco-innovation outputs (e.g. patents); structural conditions	No direct relationship between eco-innovation performance and material productivity (leading eco-innovation performers have partly high material use figures)	Material intensity related to land area Population density Energy mix Economic structures
Wiedmann et al. (2013)	2008	Global (186 countries), time series analysis	Material footprint, RME of international trade, link to consumption based accounting (MRIO) multi-regional input-output modelling; multivariate regression analysis	Achievements in decoupling in advanced economies are smaller than reported or even non-existent. Europe: Use of nondomestic resources is on average 3fold larger than the physical quantity traded.	As economies mature, their MF/cap becomes considerably larger than their DMC/cap
Steinberger et al. (2013)			Decoupling, cluster and panel analysis	Developing and emerging countries have a higher long term economic dependency on materials and fossil fuels than mature economies, but the short term economic-material coupling is paradoxically higher for mature industrialized countries	

Source: Own compilation

It is clear that the messages from different quantitative and qualitative analyses are by no means unique. Results naturally depend on what is considered, which indicators are used, and what the focus is. However, in order to get a rather comprehensive picture, it is necessary to look at absolute figures, relative figures, per capita figures, time series, ratios and further variables. At best, taken together they may provide insights into a system that is highly complex and dependent from a multitude of influencing variables. Patterns that show stability over time or results that do not match good judgement (e.g. how come that the country with the highest resource use can be called an eco-innovation leader?) suggest that a closer examination is necessary. A growing Europe apparently requires more and more monitoring and benchmarking studies, but benchmarks should always be studied carefully and unnecessary duplication should be avoided. Rather, benchmarks on the basis of long-term orientation targets and indicators are urgently needed.

In this sense, Bringezu et al. point to the significance of policies and framework conditions: "In the course of economic development, TMR/cap can be reduced in absolute terms. However, the limited cases of documented absolute decline of TMR/cap resulted each from political influence, either as specific measure to reduce a major component of TMR or as change of policy framework resulted in enormous technical improvements, which lead to certain increases of resource efficiency through at least partial abandonment of highly resource extractive industries. Nevertheless, policy may also exert a retarding influence on a structural change towards increased resource efficiency. Therefore, future dematerialization of economies may not be expected from business as usual under current conditions, but will require synergistic changes in policy and industry" (Bringezu et al. 2004, p. 122).

2.7. Why policies matter

Only few countries have managed to decouple resource use from economic growth and reduced material use in macro-economic and absolute terms (Moll et al. 2012; UNEP 2011; Steger & Bleischwitz

2011); regulation effects are dissatisfying. A high demand for and an inefficient use of resources remain the prevailing consumption patterns in Europe (Dittrich et al. 2012; Giljum et al. 2011). Previous analyses have shown that the economic development and resource use connexion depends on a complex interplay between formal and informal institutions (North 1990), environmental policies (Bleischwitz, Welfens & Zhang 2009, 2010; de Bruyn et al. 2009; Ekins & Speck 2011; Jacobsson et al. 2009) and systems of innovation (EIO 2013; Kemp 2012; Vasseur & Kemp 2011; Nelson 1993). Targeted analyses of resource efficiency policies and eco-innovation systems, e.g. by the Eco-Innovation Observatory (EIO 2013) and the European Environment Agency (EEA 2011a; Bio Intelligence 2012a; 2012b) have revealed the importance of country-specific national governance patterns, structures and institutional developments.

Though the empirical evidence of such country-specific factors is striking, the intensity and the direction of how these national features shape the resource use of economies is less clear. What is clear, however, is that it is not just the specific environmental policies that are powerful here. Other policies that do not pursue environmental objectives at all or have a traditional purpose (Bleischwitz 2012, 2011; Baedecker et al. 2009) come into play.

One may distinguish between general factors that are relevant for most economic activities and those that are specific to resource use. With regard to general factors, the setting of such national policies is called the „framework condition“ of economies. A key feature here is the fiscal system of states, where the EU competences are relatively low. The taxation systems of the Member States set strong incentives towards a wastage of natural resources and a shortage of employment (Bleischwitz 2011, Weizsäcker et al. 2009). The overall share of public revenues generated by resource taxes in Europe is extremely low (5% of overall environmental taxes, Eurostat/EC 2012) and very different among the European MS states; incentives for consumers and businesses to save resources are generally still moderate and often limited to informational tools (EEA 2011a). Environmental tax reforms implemented in some EU countries predominantly focus on energy sources and are on the decline again, particularly in former EU-15 (Ekins and Speck 2011). The European countries strongly compete regarding jobs and site-related factors for enterprises while varying their economic framework conditions.

In addition to such framework conditions set at the level of states one should also look at (intentional and unintentional) side effects of other domestic policies, such as industrial or construction and housing policies, or at economic recovery programmes that are designed to serve other purposes. The latter include, for example, fiscal and structural reform programmes, demand and demand-stimulating policies, and general economic laws (e.g., growth and acceleration law in Germany), the specific configurations and relations between labour, corporate and environmental taxation and tax exemptions, subsidies, etc. (Eurostat/EC 2012; Bahn-Walkowiak et al. 2012; Pollitt 2011).

A related point can be made with regard to infrastructures. The majority of infrastructure investments are done at the level of Member States and lower jurisdictional levels. In line with Member States' proposals and paradigms, a considerable amount of the EU cohesion policy funding (almost 12%) is used to subsidise large infrastructure projects contributing to economic convergence and to an increased use of non-renewable resources and greenhouse gas emissions in the long term (Usubiaga et al. 2011). There are striking imbalances in favour of resource inefficient practices and this is likely to be true in other sectors too. Due to their traditional close link to economic development, infrastructure projects are critical factors for long-term commitments towards specific technological paths, not least because of the related highly specialised institutional and technical division of labour.

There is indeed also the wider debate on „National Innovation Systems“ (Nelson 1993) that has revealed the importance of states. From that we may conclude that the existing incentive structures within the individual national economic systems in general and their specific interplays with intermediary institutions and the resource processing industries in particular shall be seen as important explanatory variables regarding the diffusion of incremental and radical innovations as well as technological lock-ins and path dependencies (EIO 2013). From this we conclude that, for the time being and because technological and policy innovation and diffusion (Hoff 2012, Ashford & Hall 2011, Tews 2006, Berry & Berry 1999) are interactively linked, nation states and national policies are highly relevant for the interpretation of the variable magnitudes of absolute resource consumption, eco-innovation and resource efficiency performances (EEA 2012a; Steinberger & Krausmann 2011, Steinberger et al. 2010).

One can make this point event stronger when looking at raw materials policies. While resource efficiency policies tend to focus on the demand side, raw material policies rather focus on the supply side. They also act as necessary entry into the international dimension of resources. As long as international commodity markets are distorted by different framework conditions and purchasing power, as long as prices are highly volatile and conflict-minerals are likely involved in a number of international value chains, then any European resource efficiency policy restricted to its internal market fails to address Member States' markets realities. In that regard it is necessary to emphasise that foreign policy authority and power are predominantly located at the level of Member States. Foreign resource policies are crucial for the security dimension of raw materials, exploration activities and access to raw materials, (Bleischwitz et al. 2012; Bahn-Walkowiak & Steger 2013). Even within Member States, the supply of resources, beginning with geological services and the grant of permissions as well as supply structures are entirely organised at the level of Member States (Bleischwitz et al. 2012; Tiess 2009) and lower jurisdictions. There is little evidence that those factors will be coherently regulated by the EU in the short term whereas it might be a relevant question for POLFREE whether and to what extent this could be a policy option.

To conclude: in order to understand why resources have been used inefficiently in Europe in the past decades (Dittrich et al. 2012; Giljum et al. 2011), it is essential to compare political and institutional structures and actors at the national level, while including interactions of EU and MS policies with regard to resource use such as in the context of secondary materials or food. Such an analysis has to become part of a broader analytical framework in order to assess the interplay of those policies and institutions and inertia factors and incentive structures that are potentially counteracting systemic or technological leaps. This research perspective may also enrich approaches of transition management by asking for the role of states towards unleashing more systemic eco-innovation within the terminology of landscape, socio-technical regimes and niches (van den Bergh et al. 2011, Kemp 2010, Geels & Schot 2007).

Thinking ahead towards the development of an ex ante assessment tool, one should be aware that the theoretical basis for empirically explaining inefficient resource use and the role of nation states is not yet well developed. However, recent studies investigating, for example, market failures provide important insights regarding the incentive-barrier complexity (Meyer et al. 2011; Ecorys 2011a; Bleischwitz et al. 2009; Bleischwitz & Jacob et al. 2009). Typically, this is a multi-directional process with dynamic interactions between policies, institutions and actors at many levels, including nation states. Such a web of constraints comprises negative and positive externalities, spread of information and information deficits, adaptation and coordination processes and deficits and path finding processes as well as lack of orientation. In order to cope with the multitude of influencing factors in both the resource efficiency and inefficient resource use strands, a systematic but pragmatic way has to be chosen if one wants to arrive at comprehensible conclusions. This points to the relevance of key industries in the representative countries (NAMEA; EXIOPOL) because "only a limited number of sectors require a significant share of total resource requirements of the economy" (Bleischwitz et al. 2009, p. 254), thus suggesting a sectoral approach as an element for analysing countries' performance.[9]

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9 Due to publication restrictions it is not possible to refer to EEA results at this point of time. The report „Progress on resource efficiency and decoupling in the EU-27" by Watson et al. comprises new insights and data from environmentally extended input-output analysis for the period 2000-2007.

A next step is to derive and systematise evident influencing factors from recent literature and barrier analysis and bring them into an analytical framework in which the policy-institution interplay of influences, i.e. the role of public-private institutional structures for resource efficiency in the policy field, the role of underlying incentive structures in resource intensive sectors (e.g. meat, car mobility) and positive / negative interactions and incoherencies between both fields become apparent with the objective to bring about factors favourable for the phasing out of resource efficiency barriers.

3. Policy and institutional impacts on resource use

Chapter 2 looked at recent developments as well as key concepts and indicators in the context of resource use, resource productivity / efficiency, decoupling and eco-innovation for resource efficiency as a first step. On the basis of that and in order to identify potential factors of influencing changes in resource efficiency, the report will conduct an in-depth analysis of 4 selected countries and spotlight on further countries when necessary, thus representing different configurations and performances concerning resource policy.

3.1. Methodological approach

Introduction In WP2, a comprehensive strategy will be developed aiming at a radical increase of resource efficiency. Clearly, there is no single policy instrument that is able to overcome all relevant obstacles and fulfil all the necessary functions. Rather, policy instruments have to complement and reinforce each other within a policy mix. But: The project does not start at zero. There are already many policies and institutions in place that exert stronger or weaker, positive or negative influences on resource efficiency. Therefore, it is necessary to investigate the present interacting policy-institutional mix at work.

The methodology consists of the analysis of the institutional framework and the existing incentives for actors in their respective contexts (e.g., companies, markets, public administrations, policies). This relatively broad approach is important because "resources" is no established action or policy field yet and thus many side effects of existing incentives and institutions must be taken into account.

The methodology includes methods and tools on:

- Referring to economic approaches: socio-economic and technical regimes and market developments, in particular in the area of recycling and waste management, metal industry, automotive industry and the respective regulatory environment.
- Referring to policy approaches: evidence-based qualitative country-comparative policy research of policy processes (politics), institutional structures and frameworks (polity) and evaluation criteria and dimensions (policy) in the policy field material flows and resource management and its interactions with neighbouring policy fields.
- Sub methods are: Empirical social research, secondary analysis of quantitative and qualitative ex-post case studies and case comparisons (descriptive and closing) statistics

The study refers to the drivers and barriers research (with a particular focus on barriers) (Bleischwitz and Jacob et al. 2009, Bleischwitz et al. 2009, Baedecker et al. 2009), policy diffusion research (Tews 2006) and the research on capacities of nations concerning particular environmental issues (Jänicke 2002, 2005). Particularly, the study draws on the “Analytical framework” of WP1 and the definition of barriers.

Underlying research questions

- What kind of impact do specific institutional frameworks and incentives have on the macro-economic or sectoral resource consumption?

- Which kind of configurations of conditions and incentives can be identified as good or bad practice in the multi-level system?
- What specific aspects or policies are transferable, if possible, in order to promote a sustainable increase in resource efficiency?
- What obstacles have to be overcome, which incentives have to be implemented?
- Which target and conflicts of interest have to be taken into account and what forms of market, policy, and system failures are evident?

Research steps

The following steps are performed:

1. **Context analysis**, selection of the relevant institutions and framework conditions and reflections on their assumed impact, supplemented by current research and background discussions;
2. **Analysis** of countries, strengths and weaknesses of existing institutions, policies, institutional changes and impacts, goals and conflicts. The work relies as much as possible on sound quantitative or empirical research.
   Quantitative inputs for the purpose of assessment impact of relevant institutions (1) MFA data (DMC, TMR, etc.) data on market developments, benefit/ potential analyses, data from survey results, databases/Surveys (EU CIS, EIO, Innovation Union, etc.), secondary data from econometric methods (panel and time-series analysis, input-output analysis) are used.
3. **Final Assessment** and development of hypotheses.

Selection of countries

The country sample was selected on the basis of preliminary considerations and project internal discussion. It was proposed to include pioneers and laggards, countries with a high and a low per capita resource use, new and old Member States, countries from north, south, east and west, resulting in a sample of ten countries: Austria, Estonia, Finland, Germany, Hungary, Netherlands, Poland, Spain, Sweden, UK. Project internal discussion suggested to concentrate on those countries that could be easier linked to other work packages and complement results from these. The final selection decided to investigate a wider sample for the policy area “waste” and concentrate on a small sample of Austria, Germany, Hungary, and Netherlands for the policy area “resources” (and include further countries where instructive). It is assumed that in all those countries, influencing factors can show a specific and different profile of institutions and actors, incentives/disincentives, framework conditions. If not, this could indicate fundamental system failures.

Selected countries for focused investigation are:

- Austria
- Germany
- Hungary
- The Netherlands

Selected countries for further background investigation are:

- Estonia
- Finland
- Poland
- Spain
- Sweden
- UK

Initially, it was planned to examine resources and waste policies along the very same analytical criteria. Due to the fact that the waste sector is more strongly influenced by EU regulation than present resource policy to-date and that it is basically the older and far more established policy field, two slightly different approaches were developed and will be explained in the individual sections.

3.2. Resource Policy – Country review and comparison

Focus: AT, DE, HU, NL + spotlights on other countries

As a starting point illustrating the national diversity, the following table combines facts for the contexts resource use, resource productivity, decoupling and eco-innovation performance for the country selection. The first column indicates the average resource use (DMC/cap) in the years 2000 to 2011. In this selection, the Netherlands and UK are far below EU average (which is 18 t/cap) while Finland is extremely above EU average, Estonia and Austria are well above average. All ten countries show an increasing trend of resource productivity within the period of 2006 to 2011. Decoupling trends are diverse again (as described in the previous chapter) and the eco-innovation rank does apparently not correspond with material use. Different periods are used here due to insufficient data situation.

Table 2: Trends in resource use, resource productivity and decoupling compared to eco-innovation rank in 10 selected EU countries

Member State	Resource use t per cap DMC (2000-2011) EU average 18t	Resource productivity trend (2006-2011)	Decoupling (on DMC basis) (2000-2009)	Eco-Innovation Observatory Index (2013)
Austria	23.2	increasing	relative	9
Germany	16.2	increasing	absolute	3
Hungary	13.3	increasing	on the edge	23
Netherlands	11.6	increasing	absolute	13
Estonia	23.9	increasing	no	16
Finland	38.0	increasing	relative	2
Poland	15.7	increasing	relative	26
Spain	17.6	increasing	absolute	6
Sweden	20.8	increasing	relative	1
UK	11.8	increasing	absolute	5
POLFREE vision target	5.0 RMC/cap			

Source: Own compilation

Under the headline "Transforming the economy" the EU Roadmap (EU 2011a) describes four major guidelines and milestones:

- **Sustainable consumption and production** - By 2020, citizens and public authorities have the right incentives to choose the most resource efficient products and services and market and policy incentives that reward business investments in efficiency are in place.
- **Turning waste into a resource** - By 2020, waste is managed as a resource (see chapter 3.3).
- **Supporting research and innovation** - By 2020 scientific breakthroughs and sustained innovation efforts have dramatically improved how we understand, manage, reduce the use, reuse, recycle, substitute, safeguard and value resources.

- **Environmentally harmful subsidies and getting the prices right** - By 2020, EHS will be phased out and a major shift from taxation of labour towards environmental taxation will lead to substantial share of environmental taxes in public revenues.

The following sections will now deal with the question whether and in how far the selected countries have evolved activities to meet these requirements. This certainly cannot cover the entire spectrum and be complete. However, the analysis might give a few insights that can be linked to further considerations on barriers.

The investigation approach results in three pillars: the framework conditions (pillar 1), the institutional set-up (pillar 2) and the incentive system (pillar 3). In the course of the country review, the pillars are analysed with regard to different dimensions and indicators.

To this end, the approach is to compare the parallels and differences among the Member States at the national level, looking for corridors of influencing.

A - Framework conditions

Framework conditions are split into geological and economic framework conditions. Two selected geological framework conditions shape the starting conditions for any resource policy: the country-specific endowment with raw materials and the raw material dependence and production figures relating to it. Economic framework conditions such as the key sectors[10], the available infrastructures, the tax proportions and the economic performance (in GDP/cap) are further conditions that are not easily influenced by policy in the short to mid-term and may thus predetermine a specific RE performance within the scope of the analysis. At the same time, they provide preliminary information on potential problem areas that require long-term planning and may indicate specific demand for a tailored set of measures.

B - Institutional set-up

The institutional set-up shall provide insights on configurations of policies and competences that might be viewed as favourable or unfavourable for resource efficiency gains. In the resource policy area, it cannot be called legal framework because that has not been established. As regards waste, there is a regulatory framework. The institutional structure effective in terms of resource use and resource efficiency and waste shall be examined by three criteria for each field: the implemented policies and goals (programmes/action plans & targets, including information whether they are binding or non-binding) as well as the allocation of responsibilities.

C - Incentive system

The incentive system is explored along two criteria: targeted RE market incentives and economic policies with intentional or unintentional impacts on resource use and resource efficiency, while including EU important interfaces. The market incentives concentrate on environmental taxes, (implemented) resources taxes and waste charges, and funding (in terms of subsidies or grants) or tax breaks for resource efficiency investments. The side policies section looks at recovery programmes (and their green elements) and innovation policies (and their green elements), and resource-relevant subsidies in the context of resource intensive product groups/ sectors, in particular meat, cars and housing. The EU interface includes information on agricultural subsidies (due to CAP) and infrastructure subsidies (due to Cohesion Fund).

[10] The term key industries or sector refers to industries that are of particular importance for a country in relation to certain criteria. What criteria is used in an individual case depends on the context and discourse, e.g. if the industry is a major supplier to other industries, strong in innovation, serves a particular image of the country, contributes to aspects of care or military. Key industries are frequently the subject of an specific industrial policy or special treatment. The term will here refer to the share of value added to GDP.

The criteria used do not claim to be exhaustive and equally the analysis of this study cannot replace any evaluation of effectiveness of individual instruments. Rather, the purpose is to gain insights into a complex interacting structure of impacts of different programs / instruments / policies, etc. It should also be possible to draw conclusions on the kind of barriers that exist at systemic and structural national level.

3.2.1. Framework conditions

Geological framework conditions

Austria records a relatively high dependence on foreign imports. Austria's import dependency on fossil fuels accounts for 47% while import dependency on metals is at 40% (Eurostat 2012a). Austria is one of Europe's major producers of iron cement gypsum, magnetite (BGS 2014, p. 2). Austria stopped the production of domestic coal in 2006 (Euracoal).

Germany produces especially large quantities of lignite (2.5% of world production), which the country is well endowed with. In combination with its production of oil and natural gas, Germany's import dependency on fossil fuels lies at around 35%. Import dependency on minerals is even lower at around 27% (Eurostat 2012a). Inter alia, Germany is an important producer of cement, gypsum, pig iron, crude steel, kaolin, and salt (BGS 2014, p. 43).

Hungary's import dependency rate on fossil fuels and metals is at 43% and 31% respectively (Eurostat 2012a). Among European countries, Hungary is a major producer of bauxite, lignite, pig iron, and crude steel (BGS 2014, p. 54).

The Netherlands has a long history of extracting oil and natural gas (>1% of world output). However, Dutch North Sea oil has seen periods of declining production, which led to an overall import dependency on fossil fuels of 41% (Eurostat 2012a). Apart from natural gas, the Netherlands is an important producer of pig iron and crude steel (BGS 2014, p. 82). Import dependency on metals accounts for 35% (Eurostat 2012a).

As regards to some industrial minerals, considerable world production shares are located in Europe, usually dominated by one country while the majority is dependent on imports. This is the case for kaolin (16.9%), salt (6.9%) and potash (10%) where the indicated shares in world output are from Germany. The Netherlands has more than 2% of world salt production, Austria of magnetite, and Germany again of bentonite (BGS 2014, p. vii). As regards metals, none of the four selected countries plays a major role in metals production,[11] but the Netherlands is a major transhipment centre of all kind of materials that enter and leave Europe. Europe is practically self-sufficient with regard to construction minerals.[12] Here, Germany is currently the leading producer (19.4% of total European production), the Netherlands (3.1%), Austria (2.5%), Hungary (ca. 2%, estimated) (BGS 2014, p. 144f.). As minerals are so-called low cost materials, it can be more cost-effective to trade cross-border than to transport within national borders. That is why Austria, for example, is a net importer of sand and gravel (BGS 2014, p. vi) while Hungary is a major producer of perlite which is an industrial mineral often used for construction works.

Economic framework conditions

[11] Out of the wider sample, some European countries have a relevant share in world outputs: Finland (>1% of chromium and nickel), Poland (4.6% of silver, 1.4% of lead, 2.5% of copper), Sweden (>1% of silver, zinc, lead), Poland (>1% of coal), UK (>1% of natural gas and petroleum) (BGS 2014, p. viii).

[12] Due to different definitions and inconsistencies as well as lack of monitoring requirements in many countries, correct data on construction minerals such as primary aggregates are difficult to establish (BGS 2014, p. 144).

Economic conditions are assumed to be general factors that are relevant for most economic activities and those that are specific to resource use. In this analysis economic performance is measured as GDP per capita in purchasing power standards (PPS) as well as GDP at current market prices per capita in PPS. Furthermore, key economic sectors for each Member State are derived according to their contribution to value added of the economy. In the next step, resource intensive sectors are identified (according to RMI) thus making it possible to locate the main sources of resource use.

The **Austrian** economy is considered as one of the most prosperous and developed economies in the EU. The Austrian yearly GDP per capita in Purchasing Power Standards (PPS) records 33,300€ (Eurostat 2012b). Construction, machinery, vehicles and parts, food, metals, chemicals, lumber and wood processing, paper and paperboard, communications equipment, and tourism rank among its key economic sectors. According to the RMI, the construction sector, agriculture, and transport are the top three sectors (BIO IS 2013, p. 62). Overall, Austria's resource productivity is around 1.50€ per kg (Eurostat 2011). Infrastructures are ranked very high (8 of 148) with a score of 6.3 (of 1-7), according to the WEF Global Competitiveness Index.

With a relatively high GDP per capita in PPS at 31,300€, **Germany** is placed among the top economies of the EU (Eurostat 2012b). It is highly export-oriented with a strong focus on the manufacturing industry (automotive industry, mechanical industry, etc.). The top economic sectors are motor vehicles, machinery, chemicals, computer and electronic products, electrical equipment, pharmaceuticals, metals, transport equipment, and foodstuffs. Germany is the one of the leading producers of wind turbines and solar power technology in the world. According to RMI, the construction sector uses the most raw materials (mostly minerals), the energy and water supply sector is the second largest resource intensive sector (mostly fossil fuels); fossil fuel extraction and refineries consume are next, and the agriculture and food and drink industries consume the largest amounts of biomass, while the manufacturing industries consume most of the metal ores (BIO IS 2013, p. 43). Resource productivity lies at 1.90€ per kg (Eurostat 2011). Infrastructures are ranked very high (9 of 148) with a score of 6.2 (of 1-7), according to the WEF Global Competitiveness Index.

Hungary's GDP per capita in PPS of 16,700€ is well below the EU28 average (Eurostat 2012b). The country's resource productivity is at 1.00€ per kg (Eurostat 2011). Hungarian key economic sectors are mining, metallurgy, construction materials, processed foods, textiles, chemicals (especially pharmaceuticals), and motor vehicles. The construction sector uses the most raw materials (mostly minerals) while the agriculture sector consumes the next-highest quantity of materials (mostly biomass); further the manufacturing of coke and refined petroleum products is the third most resource intensive sector when the RMI is considered (BIO IS 2013, p. 52). Infrastructures are ranked as rather weak (51 of 148) with a score of 4.8 (of 1-7), according to the WEF Global Competitiveness Index.

The **Dutch** GDP per capita in PPS is with a score of 32,800€ only slightly lower compared to the one of Austria (Eurostat 2012b). However, resource productivity is in comparison to Austria more than twice as high at 3.12€ per kg DMC (Eurostat 2011). Key sectors are identified as agriculture-related industries, metal and engineering products, electronic machinery and equipment, chemicals, petroleum, construction, microelectronics, and fishing. According the RMI, the top resource intensive industries are the manufacturing of coke and refined petroleum products, the construction sector (mostly metal ores), the agricultural and the food and drink industry are next (BIO IS 2013, p. 201). Infrastructures are ranked very high (10 of 148) with a score of 6.2 (of 1-7), according to the WEF Global Competitiveness Index.

3.2.2. Institutional set-up: Policies, targets, responsibilities

The following analysis of policies, targets and responsibilities is based on country profiles provided by the European Environment Agency (EEA 2011a) and desktop research for updates.

In 2011, the European Commission published the **Roadmap to a Resource Efficient Europe** after a multi-year consultation process with stakeholders and experts. With the roadmap, the European Commission illustrates the rationale for resource efficiency in Europe (Ekins & Spangenberg 2013, p. 1) and envisages a transformation of the EU-wide economy by 2050 which shall be "competitive, inclusive and provides a high standard of living with much lower environmental impacts" (EC 2011a, p. 3). Both strategies have deployed a lot of dynamics among stakeholders, academia, businesses, NGOs, etc. but the response must be considered limited with respect to the European population and popular media.

According to the Roadmap the Member States are implicitly called upon to become active in developing strategies and measures in line with the path outlined within the 3 main sections of the roadmap for

- Transforming the Economy
- Natural Capital and Ecosystem Services
- Key Sectors

Each section contains different themes whereby milestones are set for each theme by 2020. Hence, milestones enable identification and qualitative monitoring of actions for the Commission and the respective Member States as well as tracking progress of the overall development (Ekins & Spangenberg 2013, p. 1).

Policies and targets

Resource objectives in national programmes, strategies and regulations

Resource efficiency and resource conservation are gaining in importance on the political agenda and are increasingly substantiated in single nation states. The majority of the European member states have implemented the EU-regulations with resource efficiency relevance, for example, addressing electronic equipment, batteries, end-of-life vehicles and packaging (see Chapter on waste), regulations which have been introduced long before the RE Roadmap. In the EEA-Survey (2011a), 31 European states named four strategic goals that refer to resources: Decoupling of economic growth from resource consumption (mentioned 5 times), the efficient use of resources (mentioned 22 times), the reduction of resource consumption (mentioned 6 times) and cutting back the input of mineral raw materials (mentioned 10 times). The countries that seek to limit the use of mineral resources are Belgium, Denmark, Germany, Estonia, Finland, Lithuania, Austria, Sweden, Slovenia, and UK. Three countries regard metals as priority resources (France, Finland, Austria), five do likewise with regard to construction minerals (Estonia, Finland, Austria, Portugal, Hungary).

Targets can play a decisive role in regard to the development of societies. Targets are essential within the scope of technological and social developments, on one side, and support the respective instrumentation, on the other side. Experiences from the energy and climate sector have shown that the influence targets have on strengthening innovation should not be underestimated. A distinction between goals or objectives and targets has to be made. Goals and objectives describe rather generic policy aims, such as the improvement of environmental quality or reduction of environmental burdens. Goals can neither be quantified without further specification, nor do they set binding timeframes. Targets, on the contrary, are specific, quantifiable, measureable, and usually have a binding deadline within which they must be met (EEA 2011a).

A distinction between two main types of targets can be made:

Efficiency targets aim at increasing a specific value or physical quantity, e.g. resource productivity = gross domestic product : resource use (in analogy to labour productivity) *or* resource intensity = resource use : gross domestic product (as the inverse of productivity). Thereby, resource efficiency is the overarching concept, which can be achieved by either increasing resource productivity or reducing resource intensity (O'Brien et al. 2013).

Absolute limits to consumption or targets of reduction aim at an absolute reduction of resource consumption or use for the whole economy or per capita.

Many countries introduced qualitative and operational objectives at different levels to reduce the use of fossil fuels and associated emissions. These targets favoured and accelerated innovations in the sphere of energy efficiency and the use of renewable energies. Yet, the majority of resource flows of the socio-industrial metabolism does not address the energetic, but the unenergetically used abiotic and biotic raw materials (and water), as well as the growing amount of land used for human settlement and transport infrastructure and the transformation of virgin territory into agricultural land. Therefore, a number of states, as well as the EU, have formulated (partly quantitative) objectives in addition to climate and energy goals aiming at increasing the resource efficiency/-productivity of their economies. To stimulate material and energy efficiency at all societal levels, some member states, such as Germany, have created special institutions and instruments.

Furthermore, a series of objectives exist that affect resource consumption indirectly. Examples comprise waste related goals (reduction of waste, increase recycling, minimum recycling quotas, minimum recovery rates) or general objectives for a green economy (increase of investments, restrictions of exports). Nearly all states formulate environmental goals, including far-reaching qualitative goals and a broad, even divergent definition of resources (Herrmann et al. 2012; Öko-Institut et al. 2012). Likewise, initially less specific ideas can contribute to a growing consensus over time. Nevertheless, it usually takes several policy cycles until a combination of long-term and short-term, vertically and horizontally integrated targets, comes into being that is equipped with precise and proper indicators, and accompanied by measures that distribute and implement competences (Raecke 2011). Additionally, short legislative periods hamper the development of long-term objectives and visions. This might be one reason for objectives lagging behind the development of indicators, which can be done outside political processes.

Although it can be noticed that promoting resource efficiency has become common practice, a variety of studies reveals that most countries rather focus on energy efficiency and waste targets than on resource efficiency. Examples are terms like a sustainable, efficient, or rational use of natural resources and resource conservation; more substantial is the minimisation of primary material input. Typically, operationalized targets refer to the domains of energy, waste, water- and land use and, thus, constituting the fulfilment of EU requirements or implementation of relevant EU directives (EEA 2011a; BIO IS et al. 2012c). Quantitative resource targets that exist in European states (with some exceptions such as Austria) do not cover the resources metals, industrial minerals and construction materials. The strategic goals that can be found in the national programmes and initiatives are generic, qualitative and do not set a time frame or deadlines.

Within Europe, it is only Austria, Germany, Italy, Romania and Sweden who have quantitative targets for material *efficiency*; and quantitative targets addressing material *input* exist only in Austria, Sweden, Hungary as well as Italy and Switzerland (EEA 2011a; EIO 2012), gaining in importance in non-European countries, too. While targeted macroeconomic consumption reduction goals are still rare, or sector-orientated or their realisation due to lack of implementation fairly unrealistic, it is not true, however, that there are no or only few quantitative or operationalized resource-related targets.[13] Due to the selected sample for country screening, it is not possible to provide a complete overview of all

[13] In contrast to BIO IS (2012) the working paper identifies a number of objectives that could be of interest for further discussion.

[13] See the information of the Estonian environmental ministry: “Mineral resources charges rates increase considerably during 2010-2012. Oil shale extraction charge increases 20% annually; construction minerals charge rates increase 10-25% annually in average. Considerable increase is foreseen for peat – the charge rate will be in average on the level of 20EEK/ton from 2010. From 2013 the rates of most of the minerals increase 5% annually“.

objectives that theoretically refer to resources or could have an impact on them. A selection is shown in Table 3.

The core objective of the **Austrian Resource Efficiency Action Plan (REAP)** is to decrease resource consumption and improve resource efficiency for metals, minerals, biomass and fossil materials. The REAP defines different resource efficiency goals at different time periods whereas 2050 is seen as a long-term goal for Austria. In 2050, Austria seeks to improve resource efficiency by 4 to 10 times (Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management 2011, p. 20). Due to this long-term approach, the REAP can be viewed as an on-going process which will be further refined in the next years. Although the REAP defines a number of action fields and measures, other strategies, programs and initiatives which deal with resource efficiency are involved within the framework. Therefore Austria expects to detect interfaces and to generate synergies between the different strategies (Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management 2011, p. 33)

Resource productivity, as a quantifiable indicator measuring the efficiency of domestic material consumption, has been embedded in **Germany's** National Sustainability Strategy of 2002, as well as in the subsequent progress reports in 2004, 2008, and 2012. Until 2020 resource productivity is supposed to double (in comparison to 1994). The Federal Government's Raw Materials Strategy (2010) stresses the security of supply of raw materials by combating trade barriers and the distortion of competition and by measurements that diversify sources of supply. Thereby, synergies arising from sustainable economic activity and an increase in material efficiency shall foster raw material efficiency, which constitutes the third pillar of the Raw Materials Strategy (BMWi 2010).

The national **Resource Efficiency Programme (ProgRess),** which was adopted by the Federal Government in February 2012, brought forward the issue of resource efficiency and the potential measures for its increase in **Germany** (BMU 2012). The German Federal Cabinet adopted the Resource Efficiency Programme (ProgRess) in 2012. ProgRess describes a total of 20 strategic approaches on the entire value chain and presents specific examples of material flows, areas of life and technologies (BMU 2012) aiming at continuously improving the raw materials productivity in the German industry, as well as at extracting and using resources sustainably. Thereby, it seeks to accomplish a further decoupling of economic growth from resource consumption and environmental impacts. The focus is on abiotic, non-energetic raw materials (ores, industrial and construction minerals), as well as on the material use of biomass. Quantitative obligations do not form part of ProgRess.

In **Hungary,** resource efficiency is addressed within the National Environmental Programme. In its National Environmental Technology Innovation Strategy (NETIS 2011), **Hungary** strives for an 80% reduction of material intensity until 2020 in comparison to 2007[14]. The reduction is measured as the relation between DMC and GDP.

The **Netherlands** has not introduced an integrated resource efficiency policy framework yet.

Box 1: Quantified targets of Austria, Germany, Hungary (further specification and indicators see Table 3)

Austria
Increase RE of all materials by 50% by 2020 and by factor 4-10 by 2050
2% reduction of final energy consumption by 2010, and 16% by 2016 the average of (2001–2005)
Thermal rehabilitation of all 1950-1980 buildings by 2020
Increase ecological farmed areas 20% by 2010

[14] For the Hungarian National Environmental Technology Innovation Strategy (NETIS) see http://www.toosz.hu/digitalcity/servlet/PublishedFileServlet/AAABPMFR/netis_2011.12.07-09.16.55.pdf

Germany
Increase of RP by factor 2 of abiotic resources (minerals) by 2020 and increase of RE of abiotic resources[15]
Increase the per cap consumption of wood/wood products from sustainable forestry to 1.3 m^3
Reduction of land use daily growth of 30 ha by 2020[16]
Doubling energy productivity by 2020 as compared to 1990

Hungary
Decrease of material intensity of all materials by 80% by 2020
Yearly energy saving of 1% between 2008 and 2016

From the extended country sample the following countries are worth mentioning:

Finland was leading the Eco-Innovation Scoreboard of 2011 and 2012. The country is characterised by best performance in Cleantech Investments and R&D quotas, while at the same time scoring low in resource productivity (EIO 2013). Although the National Resources Strategy (2009) strives for an intelligent use of resources without formulating a quantitative goal, the Minerals Strategy (2010) foresees an increase of extraction of 4 to 70 million tons (2008-2020) in regard to critical metals.[17]

Romania's National Sustainable Development Strategy (2008) regards an increase of resource productivity by 3-4% per year through structural adjustments and a shift to less material intensive products, processes and economic activity as feasible. Although this is not formulated as a goal, but as potential, it shall be mentioned here, since the quantification allows for a monitoring. Furthermore, the Romanian sustainability strategy appears, due to the formulation of interim goals and operational tasks until 2013, 2020, and 2030, well thought-through[18] (Government of Romania 2008). Additionally, Romania seeks further reduction opportunities in expanding the service sector up to 60% of the GDP-share until 2020.

Sweden's limit of consumption for the raw material gravel of 12 m tons/year is outstanding. The introduction of the taxation of 1,50€/t on gravel in 1996 complemented it with an efficient incentive. Furthermore, Sweden aims at a minimum recovery rate of 60% phosphate in wastewater until 2015. In comparison, the EU envisions a recovery rate of 100% until 2020.

A further example outside the country sample is Italy, which formulated impressive consumption reduction objectives. In its sustainability strategy (2002), representing a reduction by a factor of four until 2030 (-25% until 2010, -75% until 2030, -90% until 2050). Additionally, consumption is measured by TMR.[19] Thus, the strategy strives for a complete collection of data and attempts to consider all possible problem shifts. Although the goals are implemented by the sustainability strategy, further reporting duties do not exist and a decent monitoring has been lacking ever since. Consequently, it remains unclear to what extent progress has been reached. In its Cleantech Masterplan (2011), Switzerland regards the introduction of Footprint One as a measurement for the future development in the area of resources. Footprint One stands in direct relation to the Ecological Footprint, i.e. the global land use of a person or a country in ha/capita or country and year. Thus, Footprint One can be interpreted as a limit to maximum

[15] GDP/(DMI - biomass)

[16] Domestic settlement and infrastructure area

[17] This strategy has to be seen against the background of China's export policy, for which Finland provides geological capacities in regard to critical metals.

[18] „physical and energy resource productivity", see National Sustainable Development Strategy Romania 2013-2020-2030, http://www.insse.ro/cms/files/IDDT%202012/sndd-final-en.pdf

[19] Total Material Requirement: amount (in mass or material flow unit kg, t, t/a) of all Materials, including all hidden material flows, which directly and indirectly enter into a reference system (UBA 2012).

consumption. Outside Europe, Japan[20] belongs to the most progressive countries in regard to the development of targets, as this process has been on-going since 2000 already (Bahn-Walkowiak et al. 2008). The second Fundamental Plan for a Sound Material-Cycle Society (2008) includes a Resource Productivity target of 3,700 EUR/t (6,700 EUR/t without rocks and earths), additionally a maximum land filling limit of 23 m tons, and a recycling rate of 14-15% in regard to the DMI[21] of 2015. The progress is measured and the targets are revised on a regular basis. The plan makes a distinction between fossil and metallic resources, non-metallic minerals and biomass, as well as between domestically extracted and imported raw materials. Furthermore, the Law on the Effective Utilization of Resources (2001) pursues a sector specific approach, including corresponding instruments and requirements, such as the Construction Materials Recycling Law (2002), which foresees a minimum recycling of specific construction materials of 95% until 2010. Additionally, Japan's Rare Metals Strategy (2009) addresses the recycling and material substitution of critical metals. Moreover, it has to be mentioned that China, in the 12th National Five Year Plan for National Economic and Social Development, set up an increase in resource productivity by 15% while striving for a 6% rate of economic growth, thus aiming at absolute decoupling. For now, this is a non-binding orientation goal whose feasibility is tested on a provincial level. Furthermore, China's export restrictions of 30,000 t on rare earths (REE) provoked complains by trade partners, which resulted in a WTO-Dispute Panel in 2011.

A detailed presentation of the identified approaches and targets of nation states in regard to materials can be found in the table 3.

Raw materials strategies
Technologies such as photovoltaic technologies, which are used for high-tech products to increase the quota of renewable energies in the energy sector, and battery technologies and catalysts, which are used in the transport sector for more sustainable transport modes, and further future technologies like electrical/electronic equipment increasingly rely on the utilisation of rare, critical minerals and this has led to a sharp rise in demand and growing competition for certain minerals, with prices showing an "unprecedentedly high volatility, which is often perceived as an economic threat" (Bleischwitz et al. 2012). Those technologies are not per se resource or energy efficient; on the contrary, photovoltaic is rather material intensive compared to e.g. wind power.

In November 2008, the European Commission introduced its **Raw Materials Initiative**. This communication analysed the demand for non-energy related raw materials inside the EU. While the EU is self-sufficient in producing construction minerals, a high import dependency was recognised especially for „high tech" metals such as cobalt, platinum, rare earths, and titanium (often termed as critical[22]). These metals play a crucial role for the development of technologically advanced products and a shift towards a more sustainable and environmental-friendly production (EC 2008, p. 3).

These risks were proposed to be tackled on in a EU integrated strategy that consists of three pillars:

1. Ensure access to raw materials from international markets under the same conditions as other industrial competitors;
2. Set the right framework conditions within the EU in order to foster sustainable supply of raw materials from European sources;
3. Boost overall resource efficiency and promote recycling to reduce the EU's consumption of primary raw materials and decrease the relative import dependence (EC 2008, p. 3).

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[20] For the Fundamental Plan for Establishing a Sound Material-Cycle Society (Tentative Translation by Ministry of the Environment) see; http://www.env.go.jp/en/recycle/smcs/2nd-f_plan.pdf (26.03.2013)

[21] DMI= Domestic Material Input = domestically used extraction + imports

[22] The "Critical Raw Materials for the EU" report identified a total of 14 materials as critical in 2010. Materials are classified as critical if both their supply risk and their impact on the economy are valued as strong. Most of these materials are sourced from a limited number of countries, predominantly: China, Russia, the Democratic Republic of Congo and Brazil, some of theme from so-called "failing states" (Bleischwitz et al. 2012).

Following the Raw Materials Initiative in 2008, two adhoc groups were installed on a mandate basis from the Raw Materials Supply Group which presented their recommendations to the European Commission in 2010 in the following reports: “Improving framework conditions for extracting minerals for the EU - Exchanging Best Practice on Land Use Planning, Permitting and Geological Knowledge Sharing” and “Critical Raw Materials for the EU”. Among other recommendations, the first report concluded that due to the Member States different political and geological conditions, an integrated EU approach was not practical (Weber et al. 2012, p. 39). Therefore, both minerals policy and the supply of raw materials should remain within the competence of individual Member States. A similar approach has already been taken in the case of energy policy concerning the energy mix, energy foreign policy, and the exploitation of energy resources, which has remained at the national level (Langsdorf 2011, p. 6).

When the European Commission published its updated Strategy on Raw Materials in 2011, the 3 pillars of the Raw Materials Initiative as well as the recommendations of the adhoc groups were further reiterated. The strategy asks for monitoring of raw materials and for updating the list of critical materials in at least every three years (DEFRA 2012, p. 5-6). The strategy also mentions that private companies are primarily responsible for securing access to raw materials while the Member States are responsible for setting the needed framework conditions and strategies. The focus on the EU level on the other hand is on issues such as trade and development policy (Federal Ministry of Economics and Technology 2010, p. 6). Generally, EU Member States seek to intensify efforts on diplomacy and resource efficiency to increase supply security (DEFRA 2012, p. 12).

Almost all EU Member States depend highly on metallic minerals since domestic production is only 3% of world production. Finland in that regard can be seen as an exception, as it has nearly established self-sufficiency for most metallic ores. Additionally, Finland and Sweden provide approx. 80% of worldwide underground mining technology, which represents the technological capabilities of EU Member States. This technological expertise may provide a significant counter balance. The EU has already recognized this. So far, a number of EU Member States has deployed activities on raw materials strategies or initiatives, Austria, Denmark, Finland, France, Germany, Greece, Netherlands, Portugal, Sweden, and United Kingdom.

Austria

The Austrian Minerals Strategy resembles the Raw Materials Initiative of the European Commission in the sense that is based on three pillars:

1. Securing minerals supply from domestic sources (realisation of the Austrian Minerals Resources Plan)
2. Securing minerals supply from Non-EU countries (raw materials partnerships)
3. Promoting resource efficiency (substitution, recycling, development of new methods with reduced minerals input)

The task of the first pillar was to classify mineral deposits according to conflict free and "no-go" areas. The identification of areas containing mineral deposits helped authorities of the provinces to better manage land use planning. As a result more than 245 safeguarding areas of metallic ores and industrial minerals have been identified and are now available for extraction. Alongside raw material partnerships of the European Commission, Austria is entering raw material relationships with countries on the bilateral basis (second pillar). The Federal Ministry of Agriculture, Forestry, Environment and Water management published cooperation with several stakeholders the Austrian Action Plan on Resource Efficiency in 2012 (third pillar). The Austrian raw materials policy has received positive recognition within Austria and the EU as the European Commission labelled it “best practice” in 2010 (Weber et al. 2012, p. 246).

Germany
Ahead of the 2008 Raw Materials Initiative, the Germany had elaborated first elements of a raw materials strategy in 2007 on the basis of a dialogue between policy makers and the German industry. An interministerial Committee on Raw Materials was established later that year which identified potential problems of the German economy resulting from raw material bottlenecks (BMWI 2010, p. 6).

After the Economic Ministry launched a renewed dialogue with German policy makers, industry representatives, the raw materials processing sector, the recycling sector and trade unions on raw materials, several new factors were taken into account, such as a rising competition on raw material access with emerging markets, changing demand profiles for raw materials due to advances in technology, potential output losses and impeded innovation capacities due to raw material bottlenecks. Finally, the adoption of the raw materials initiative by the European Commission calls for an integration with the national German raw material policy. The core objectives German raw materials strategy is:

- reducing trade barriers and distortions of competition
- helping German commerce to diversify its sources of raw materials
- helping commerce to develop synergies from sustainable economic activity an enhanced materials efficiency
- developing technologies and instruments to improve the conditions for recycling
- establishing bilateral raw materials partnerships with selected countries
- doing research into substitution and materials in order to open up fresh options
- focussing research programmes relating to raw materials
- creating transparency and good governance in raw materials extraction
- integrating national measures with European policy on raw materials (BMWI, p. 7).

All in all, Germany has been quite active in pursuing and refining its raw material strategy.[23]This has been backed by research efforts in Germany that helped policy makers to analyse Germany's raw material situation. For instance, the German KfW banking group assigned the Institute for Future Studies and Technology (IZT) and Adelphi to analyse a total of 52 materials in order to evaluate Germany's dependence on foreign raw materials from a business perspective. The study evaluated the different raw materials according to their supply risk and their impact on the German economy. Therefore, the methodology and approach of this study was similar to the "Critical Raw Materials for the EU" report. All raw materials were then summarized into 6 different groups. 10 raw materials were classified as highly critical while germanium, rhenium and antimony are the "most critical" (KfW Bankengruppe 2011, p. 5).

Netherlands
Unlike Germany and Austria, the Netherlands has not yet a clearly defined raw material strategy. However, a policy document on raw materials has outlined three action points what the Government is going to focus on in the "short and medium term". The first agenda focuses on the supply side by making "optimum use of raw materials in the Netherlands and the EU" while the second agenda focuses on the demand side by restricting national demand for raw materials. The third agenda intends to promote an efficient and sustainable consumption of raw materials within the Netherlands (Dutch Government 2011, p. 13-14).[24]

[23] This has been backed by research efforts in Germany, which helped policy makers to analyse Germany's raw material situation. For instance, the German KfW banking group assigned the Institute for Future Studies and Technology (IZT) and Adelphi to analyse a total of 52 materials in order to evaluate Germany's dependence on foreign raw materials from a business perspective. The study evaluated the different raw materials according to their supply risk and their impact on the German economy. Therefore, the methodology and approach of this study was similar to the "Critical Raw Materials for the EU" report. All raw materials were then summarized into 6 different groups. 10 raw materials were classified as highly critical while germanium, rhenium and antimony are the "most critical" (Erdmann & Behrendt 2011, p. 5).

[24] As stated in the Dutch policy document on raw materials, the government of the Netherlands bases its position and analysis on all 41 raw materials which were assessed by the EU plus phosphate, gold and tin (Dutch Government 2011, p. 7).

Table 3: Overview on resource targets in national programmes, strategies and regulations for resources

Target	Resources	Region/ country	Strategy/ programme	Target year	Base year	Governance level	Quantitative vs. qualitative	Absolute reduction vs. efficiency	Indicator(s)	Part of a target system	Macro economy	Sectoral targets	Interim targets	Implementation/ reporting duties	Validity
Increase of resource efficiency	Minerals, Metals	Europe	EU Roadmap (2011)	2020	2011	international, EU	quantitative	Efficiency	GDP/DMC	yes	yes	yes	yes	in part	yes
Increase of resource productivity and consumption reduction	Minerals, Metals, critical metals	Europe	Raw Materials Initiative (2008/2011)	n/a	n/a	international, EU	qualitative	Efficiency	k.A.	yes	yes	no	no	yes	yes
Recycling quota 100%	abiotic (Minerals) (Phosphate)	Europe	EP resolution on a resource-efficient Europe (2012)	2020	2012	international, EU	quantitative	Efficiency	%	yes	yes	no	no	no	yes
Increase of resource productivity by Factor 4	All Materials	**Austria**	NSTRAT (2002)	2008/ 2012	1990-1997	national	quantitative	Efficiency	MFA/NAMEA	yes	yes	yes	yes	yes	yes
Increase of resource Productivity by Factor 4 to 10	All Materials	**Austria**	REAP (2012)	2050	2008	national	quantitative	Efficiency	GDP/DMC	yes	yes	no	yes	yes	yes
Increase of resource efficiency by 50%; Reduction of Consumption by 20%	All Materials	**Austria**	REAP (2012)	2020	2008	national	quantitative	Efficiency	GDP/DMC	yes	yes	no	yes	yes	yes
Resource efficiency	Raw materials	**Austria**	Minerals Strategy		2010	national	qualitative	Efficiency	none	yes, partly	unclear	no	no	no	yes
Consumption reduction	abiotic (Sand, gravel, tones etc.)	Denmark	Tax on raw materials	n/a	n/a	sectoral	quantitative	Efficiency	t/yr	no	no	yes	in part	in part	yes
Consumption reduction	Minerals	Estonia	Mineral resources extraction charge	n/a	n/a	sectoral	quantitative	Efficiency	t/y	no	no	yes	in part	in part	yes
Limit of consumption 20 Mt Oil Shale/ year	Fossil fuels (Oil Shale)	Estonia	National Development Plan (2008-2015)	2015	2008	national	quantitative	absolute	t/yr	yes	yes	no	yes	yes	yes

Target	Resources	Region/ country	Strategy/ programme	Target year	Base year	Governance level	Quantitative vs. qualitative	Absolute reduction vs. efficiency	Indicator(s)	Part of a target system	Macro economy	Sectoral targets	Interim targets	Implementation/ reporting duties	Validity
Increase of efficiency + substitution	Construction Minerals	Estonia	National Development Plan for the Use of Construction Minerals 2011-2020	2020	2011	sectoral	qualitative	Efficiency	n/a	yes	no	yes	no	yes	yes
Intelligent use of resources	All Materials	Finland	National Resources Strategy (2009)	n/a	2009	national	qualitative	Efficiency	none	yes	yes	no	no	yes	yes
Increase of extraction up to 70 Mt (2008-2020)	Minerals, Metals, critical Metals	Finland	Minerals Strategy (2010)	2020	2011	sectoral	quantitative	absolute	t/y	yes	no	yes	no	no	yes
Increase of resource efficiency	abiotic resources & material use	**Germany**	Resource efficiency programme (ProgRess) (2012)	2020	2012	national	qualitative	Efficiency	GDP/DMI + DMC cap + TMC + RME	yes	yes	yes	yes	yes	yes
Increase of resource efficiency	critical minerals	**Germany**	Raw material strategy		2010	national	qualitative	Efficiency	none	no	no	no	no	no	yes
Increase of resource productivity by factor 2	Abiotic resources	**Germany**	Sustainability Strategy (2002)	2020	1994	national	quantitative	Efficiency	GDP real EUR / DMI abiot (t)	yes	yes	no	no	yes	yes
Consumption reduction	Construction Minerals	United Kingdom	Aggregates levy	n/a	n/a	sectoral	quantitative	Efficiency	DMC/GVA	yes	no	yes	in part	in part	yes
Smart consumption	All Materials	United Kingdom	SD Strategy (2005, 2010)	2010	1990	national	qualitative	Efficiency	DMC/GDP	yes	yes	no	no	in part	yes
Minimum input 25% responsible sourcing (cert. quarries)	Construction Minerals	United Kingdom	Sustainable Construction Strategy (2008)	2012	2008	sectoral	quantitative	Efficiency	%	yes	no	yes	yes	yes	yes
Reduction of material intensity to 80%	All Materials	**Hungary**	National Environmental Technology Innovation Strategy (NETIS) (2011)	2020	2007	national	quantitative	Efficiency	DMC/GDP	yes	yes	yes	no	yes	yes

Target	Resources	Region/ country	Strategy/ programme	Target year	Base year	Governance level	Quantitative vs. qualitative	Absolute reduction vs. efficiency	Indicator(s)	Part of a target system	Macro economy	Sectoral targets	Interim targets	Implementation/ reporting duties	Validity
(Possible) increase of resource productivity by 3-4% / year	All Materials	Romania	National SD Strategy (2008)	2013	2008	national	quantitative	Efficiency	n/a	yes	yes	yes	yes	no	yes
Limit of consumption 12 Mt/Year	Minerals (Gravel)	Sweden	Taxation of Gravel	2010	n/a	sectoral	quantitative	absolute	t/y	no	no	yes	in part	in part	yes
Minimum Recycling quota (60% from sewage)	Minerals (Phosphate)	Sweden	Interim Target	2015	n/a	national	quantitative	Efficiency	%	yes	n/a	n/a	yes	no	yes
Stable Level of Consumption	All Materials	Spain (Basque Country)	Environmental Strategy (2002-2020)	2006	1998	regional	quantitative	absolute	GDP/DMC (€/Kg) (TMR)	yes	no	no	yes	no	no

Responsibilities

Responsibilities of **Austria's** environmental policy are separated between the federal, the regional and the local level. This has created a rather complex set of environmental laws, which however cover a broad variety of environmental issues including resource efficiency (EEA 2011a, p. 10). The primary legal basis for domestic raw materials is the Mineral Resources Act (1999). Resource efficiency is mainly driven by Austria's Resource Efficiency Action Plan (REAP), which also represents the country's contribution to the 2020 resource-efficient Europe flagship initiative (Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management).

For Austria a high number of different strategies and initiatives with references to resource efficiency has been identified.

Table 4: Austrian strategies/ initiatives with references to resource efficiency

Strategy/ initiative	Development/ coordination
Resource Efficiency Action Plan (REAP) (2012)	Ministry of Agriculture, Forestry, Environment and Water Management
Raw Material Plan / Minerals Strategy (2014)	Ministry of Science, Research and Economy
Strategy 2020 - Research, Technology and Innovation (2009)	Ministry for Transport, Innovation and Technology
Energy Strategy (2010)	Ministry of Agriculture, Forestry, Environment and Water Management Ministry of Science, Research and Economy
Masterplan Green Jobs (2010)	Ministry of Agriculture, Forestry, Environment and Water Management
Masterplan Environmental Technologies (2008)	Ministry of Agriculture, Forestry, Environment and Water Management

To sum up, responsibilities in the field of resource efficiency on the federal level in Austria are shared by:

- Federal Ministry of Agriculture, Forestry, Environment and Water Management
- Federal Ministry of Science, Research and Economy
- Federal Ministry for Transport, Innovation and Technology

Germany In Germany, there is no unified law for obtaining domestic raw materials. One important legal basis is the Federal Mining Law. Overall, resource efficiency is promoted on the federal as well federal state level in Germany. Since crosscutting linkages often exist between the different policies, various Federal Ministries are involved in policy formulation and introduction of these strategies/ initiatives, namely

- Federal Ministry of Economy and Technology
- Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
- Federal Ministry of Education and Research
- Federal Ministry of Food, Agriculture and Consumer Protection
- Federal Ministry of Economic Development and Cooperation (EEA 2011b, p. 12).

Table 5: German strategies/ initiatives with references to resource efficiency

Strategy/ initiative	Development/ coordination
Resource Efficiency Programme (2012)	Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
Raw Material Strategy (2010)	Ministry for Economic Affairs and Energy
Ecological Industrial Policy for Ecological Structural Change (2008)	Ministry for the Environment, Nature Conservation and Nuclear Safety

National Strategy for the Sustainable Use and Protection of the Sea (2008)	Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
Biomass Action Plan (2009)	Ministry of Food, Agriculture and Consumer Protection Ministry for the Environment, Nature Conservation and Nuclear Safety
National Policy Strategy on Bioeconomy (2014)	Ministry of Food and Agriculture
Framework Programme Research for Sustainable Development (FONA) (2009)	Ministry of Education and Research
National Research Strategy BioEconomy 2030 (2011)	Ministry of Education and Research

Hungary's framework of different programmes sets sustainable development at its context and integrates current and future strategies (EEA 2011b, p. 8). The primary legal basis for domestic raw materials is the Raw Material Law (1993). In general, development and implementation of policies on resource efficiency are coordinated at ministerial or inter-ministerial level by:

- Ministry of Rural Development
- Ministry of National Development
- Ministry for National Economy (EEA 2011c, p. 14).

For Hungary, the following strategies with references to resource efficiency have been identified:

Table 6: Hungarian strategies/ initiatives with references to resource efficiency

Strategy/ initiative	Development/ coordination
National Environmental Programme (2009-2014)	Ministry of Rural Development
National Sustainable Development Strategy (2007-2025/2050)	Ministry of Rural Development
National Climate Change Strategy (2008-2025)	Ministry of Rural Development
New Hungarian Development Plan (2007-2013)	National Development Agency
New Széchenyi Plan (2011)	
National Reform Programme (Europe 2020 strategy)	Ministry for National Economy
New Hungarian Rural Development Programme (2007-2013)	Ministry of Rural Development

In the **Netherlands** a set of different policies is undertaken which represent potential components of future action plan/ policy framework (Energy research centre of the Netherlands 2013, p. 6). There are no overarching strategies on resource efficiency or raw materials. Some of the policies have been identified below:

Table 7: Dutch strategies/ initiatives with references to resource efficiency

Strategy/ initiative	**Development/ coordination**
Nature Policy Plan - The Caribbean Netherlands (2013-2017)	
Dutch biodiversity policy (2008-2011)	Government of the Netherlands
Sustainable timber procurement policy (2010)	Ministry of Infrastructure and the Environment
Sustainable Food Strategy (2009)	Ministry of Agriculture, Nature and Food Quality
Biofuels policy (n.d.)	Ministry of Infrastructure and the Environment
Sustainable trade initiative (n.d.)	Minister for Foreign Trade and Development
Sustainable procurement (n.d)	Ministry of Infrastructure and the Environment

The Ministry of Economic Affairs, Agriculture and Innovation is responsible among others for raw materials. The Ministry of Infrastructure and Environment is responsible for resource efficiency, sustainable materials management, sustainable production and consumption, sustainable procurement and climate change policy. Finally, the Ministry of Foreign affairs is responsible for Human Rights, Development Policy, and Coordination. All three ministries cooperate on the topic of resources; the lead varies with the focal point. While Ministry of Infrastructure and Environment takes the lead on resource efficiency from a sustainable development point of view, Ministry of Economic Affairs, Agriculture and Innovation takes the lead from a security of supply point of view (EEA 2011d, p. 9).

Evaluation of national policies for resource efficiency

In general, national strategies can be assumed to contribute to overcoming barriers by reducing orientation and information deficits. They are instruments drawing on consultation and deliberative processes and they provide a diagnosis of systemic and structural strengths and weaknesses and future opportunities and threats[25] (OECD 2012). However, a division of strategies into rather economically driven and rather ecologically driven policies has emerged at the European level (Öko-Institut et al. 2012) and was partly reproduced in other countries, such as Austria, Germany, Finland, Japan (DEFRA 2012, BMWi 2010). Securing access to raw materials and availability problems as well as the opportunities of eco-innovation of an energy transition that partly requires more demand for certain materials, may produce conflicts of interests and trade-offs, not only at strategic level (Werland 2012; Bleischwitz et al. 2012).

The development of resource efficiency strategies is lagging behind on the national level **(non-action)**. This can be interpreted as a weakness in connection with recent developments, pointing to political risks of a high raw material dependence on imports. The raw material initiatives, meanwhile, have been heavily criticized by NGOs for being too access and supply oriented disregarding severe impacts on the environment and the livelihood of people at the place of production (e.g. Traidcraft and Oxfam et al. 2010) (**insufficient vertical policy coherence**).

Strategies need co-ordination and accountability. A division of responsibilities between ministries along the above mentioned motivations could be observed. Also, trade-offs may occur in the institutional embedding of those strategies. This can, for example, be the case if a resource efficiency programme is based at the Environment Ministry, the raw materials strategy that aims to secure access and foster exploration is based at Ministry of Economy, and strategic commodity partnerships as measures addressing critical metals are based at the Foreign Ministry. It may however contribute to a coherent policy, if one of the strategies is superior and equipped, at best, with quantitative goals. Dedicated resource efficiency agencies or ministries come therefore next in the ranking of arrangements that contribute to policy coherence. There is evidence of a growing movement to establish organisations, such as efficiency agencies, but they are very heterogeneous at European scale and “tend to focus narrowly on their area of jurisdiction, usually a single sector or resource type“ (EEA 2011a, p. 46).[26] Further aspects are, for example, competition for competences and responsibilities (**insufficient horizontal policy consistence**).

In a political-administrative multi-level system, objectives can be set at all levels and for various scopes of responsibilities – at a global, regional, state or municipal level, at the company or organisation level, for sectors, for specific (environmental) policy areas or ultimately in regard to single resources or raw materials. Thereby, the development or formulation of objectives is not only a challenge in itself, but can even become a policy objective by itself, which e.g. may constitute the centrepiece within a policy mix of different measures and instruments, contributing to the agenda setting. Moreover, the process of policy formulation can be a political process, including all the different stages in a policy cycle. From a barriers perspective, resource goals can serve society and economy by removing **orientation and information**

[25] http://www.oecd.org/sti/outlook/e-outlook/stipolicyprofiles/stipolicygovernance/stigovernancestructuresandarrangements.htm
[26] In the European countries, the different raw materials are usually tackled in different ministries.

deficits. Furthermore, they can initiate or at least prepare a change in behaviour (BIO IS et al. 2012c, p. 27).

It is possible to rank and differentiate targets along various criteria, such as target lines, if they are qualitative or quantitative, absolute reduction or efficiency targets, as regards the coverage of the included indicators, if they are part of a wider target system, concerning their stage of specification (as regards sectoral and further derived objectives), interim targets and milestones, and reporting duties. Due to their controllability and higher liability, quantitative targets are regarded as more effective than qualitative targets that often remain vague and tend to lead to inactivity. In addition, they can be operationalized and reviewed in contrast to possibly soft, qualitative visions of the future (Bahn-Walkowiak & Steger 2013).

The analysis of the programmes, measures, initiatives and regulations concerning targets in regard to resources reveals that only a relatively limited number of decided, concrete resource targets exist so far. Absolute reduction targets do not exist at all at national level but various relative consumption reduction targets were introduced. Some absolute reduction targets have been implemented at sectoral or regional level. Three countries formulate specific goals aiming at increasing resource productivity/ resource efficiency (Germany, Austria, Hungary). The majority of the goals described in sustainability strategies or environmental programmes are formulated qualitatively, either indicating prevailing **cognitive barriers** (Shu & Bazerman 2010) or a fundamental **principle-agent problem** due to vested interest (Kassim & Menon 2003). Tews et al. (2002) found the diffusion of sustainable development strategies, for example, was largely an additive process but it was also flanked by including “the existence or non-existence of a comprehensive environmental plan among criteria for assessing the environmental performance of member states” by the OECD (Tews 2002). From today's perspective, the relatively advanced strategies of Germany and Austria can be assessed as pioneering, with Austria being the only country so far indicating figures and timelines and Germany seizing the roadmap ideas. The unclear responsibilities in both countries, however, would require greater efforts in terms of the horizontal and vertical policy coherence. The trade-offs are not resolved.

3.2.3. Incentives and side policies

The following section is based on EEA/OECD Database on instruments used for environmental policy, Eurostat Taxation statistics, and the Policies and Measures Database of the International Energy Agency (IEA). In addition, the following reports, commissioned by the European Commission, were consulted: COWI 2011, RPA 2014. The main focus is on measures and instruments related to resource efficiency.

Market incentives: Resource taxes and support for RE investments

Resources taxes

According to a Eurostat definition, environmentally related taxes are defined as those taxes whose tax base is usually a physical unit (or a proxy of it) when a specific negative impact on the environment such as pollution is evident (Eurostat 2013, p. 41). Taxes such as excise duties on energy products or products in general, e.g. taxes on transport vehicles can as well be based on monetary or economic units. Accordingly, resource taxes can be divided into ad quantum (physical) and ad valorem (monetary) taxes. A further distinction is made as regards the intervention point, e.g. extraction tax, material input tax, or consumption tax.

With roughly 6% of the total tax revenue in 2011, the share of environmental taxes in total tax revenue in the EU has to be classified as low. Out of these, ca. 75% of the environmental taxes stem from energy, 21% from transport (excluding fuels) and 4% from taxation of resources / pollution.[27] Despite long-standing debates considering environmental taxes as creating scope for labour tax cuts that can deliver a double dividend for employment *and* the environment, and a number of country examples having

[27] The conventional approach is to look at environmental taxes as a share of GDP (2.4% in 2011).

introduced environmental tax reforms[28] (Ekins & Speck 2011; IEEP 2013), one can view the contribution of environmental taxes as consolidated, but must assume that there is no crucial or dynamic incentive being set. In addition, the proportion of genuine resources taxes is negligible; most countries raise taxes below a one-percentage threshold of the overall tax revenue (EU average is 0.3%). Concerning the taxation schemes with regard to consumption, labour, capital, and corporate taxes of Member States, it is worth considering whether they belong to the conditions or to the incentives. Taxation on labour, at present, sets strong incentives towards wastage of natural resources and a shortage of employment (Bleischwitz 2011, Weizsäcker et al. 2009).

In the sample referred to here, low, average and good performers are presented. The **Netherlands** rank 2 (10.1% of total taxation) in the category environmental taxes, and rank 1 in the category pollution/ resources (1.9% of total taxation), which are mainly fed by waste disposal, sewage treatment, and water pollution taxes. **Hungary** is in the middle field ranking 15 with 6.8% of total taxation for environmental purposes and 12 with an average EU quota of 0.3% for within the category pollution/ resources, mainly from charges for specific products (such as electronic products, tyres), water abstraction charge. More or less lagging behind is **Germany** ranking 22 with a 5.8% share of environmental taxes in total taxation and 16 concerning the pollution/ resources category (collected from toll collection system for freight, water abstraction charges). Finally, **Austria** ranks 23 with a 5.8% quota of environmental taxes in total taxation and 22 with a very low quota of 0.1% in the pollution/ resources category (through toll collection systems on motorways, tree protection charges) (Eurostat 2013; OECD/EEA database; Ecorys 2011a).[29]

Due to a relative widespread distribution in the field of energy resources and water, market-based instruments are still considered as quite established (EEA 2011a). Taxes on energy products (fossil fuels) are harmonised in the EU and water charges are frequent, but the use of taxes for other resources such as minerals, metals or biomass is less common. Countries that have introduced resource taxes for some sorts of materials, such as Bulgaria, Denmark, Estonia, France, UK, Italy, Croatia, Lithuania, Sweden, Czech Republic and Cyprus for construction minerals (see table 8), find themselves at the forefront of resource taxation. It is quite controversial among economists though whether these taxes can be considered an incentive to reduce consumption of resources, when their main purpose is the generation of public income (Söderholm 2011). In order to better steer behaviour in line with a particular environmental goal, market-based instruments have to be flanked by timeframes, quantitative targets, and monitoring activities.

Table 8: Taxes and levies on minerals in EEA countries 2013

Country	Tax / Fee[1]	Object of Taxation[30]	Year of introduction	Taxation rate[2]
Bulgaria	Mining charge	Clay, Quarry stone, Sand, Gravel	1997	0,05–0,15 €/m³ 0,03–0,08 €/m³
Croatia	Extraction charge Mining charge	Gravel, Sand Mineral Raw Materials	1996 1959	0,41 and 0,55 €/m³ 2,6% of revenues
Cyprus	Materials extracted from quarries	Extracted Material	1990	0.26 € per tonne
Czech Republic	Fee for extracted minerals	Minerals	1992	Up to 10% of market price
Denmark	Duty on raw materials	Mineral raw materials	1990	Since 1990 fixed on 5 DKK pro m³ = 0,67 €/m³

28 In particular having introduced CO_2 and energy taxes in the years 1990 to 2012, DK, FI, DE, NL, NO, SE, UK

29 The presentation as percentage of total tax revenue (and not, as usual, as percentage of the GDP) has been chosen deliberately to illustrate the order of magnitude.

30 The German „resource tax“ is decentralized and therefore no uniform federal resource tax (the same is true for other countries, such as Italy). The beneficiaries are the federal states. In addition, the tax only exceptionally involves construction materials such as gravel and sand, namely, when it is stipulated by the „Länder“ legislation.

Country	Tax / Fee[1]	Object of Taxation[30]	Year of introduction	Taxation rate[2]
Estonia	Mineral resources charge	Dolomite, Granite, Gravel, Sand, Limestone, Clay, Peat, Phosphate Stones, Oil Shale	1991	Between 0,57 €/m^3 for rubble and 3,03 €/m^3 for high-quality Dolomite
France	Tax on extracted minerals	Granulate	1999	0,20 €/tonne
Latvia	Materials extraction charge	Clay, Ton, Dolomites, Sand, Gravel, Limestone, Quartz Sand, Plaster, Soil	1995	0,01–0,35 €/m^3
Lithuania	Minerals extraction charge	Plaster, Chalk, Limestone, Clay, Dolomites, Sand, Gravel, Soil	1991	0,04–0,22 €/m^3
Poland	Tax on the extraction of minerals	Copper Silver	2012	992,7€/t 122€/kg
Sweden	Natural gravel tax	Gravel, Sand, Boulder, Pebble	1996	1,44 €/tonne
UK	Aggregate levy	Aggregates	2002	2,30 €/tonne

[1]: Designation used in the database
[2]: Conversion factor of sand, gravel, pebble ≈ 1.8 tonne per m^3, limestone ≈ 2.8 Tonne per m^3
SOURCE: OECD/EEA database on environmentally related taxes, fees and charges, other economic instruments and voluntary approaches used in environmental policy and natural resources management 2013

Estonia, for example, has been raising the Mineral Resources Charge for construction materials, oil shale and peat since 1991[31]. Regarding construction material, the tax level is scaled along the quality of the stone with a maximum of 3 € per m^3 for the extraction of high-quality dolomites. The aim of the tax is, according to the Estonian authorities, to create an incentive for companies to produce more efficiently and invest in equipment that minimises environmental impact. A fine that is five times as high as the tax rate sanctions non-payment. The National Development Plan (2008 – 2015) sets a consumption limit of 20 Mio t for the here mentioned oil shale, which is an energetically used mineral raw material. Lithuania, like Estonia, claimed an environmental aim as introduction purpose for their minerals tax (EEA 2011a).

By nature, the absolute amounts of revenues vary significantly between the countries. As regards the impact for behavioural response, however, the percentage points can indicate priorities. Most of the levied fees and taxes are so low that an actual impact is unlikely (Ecorys 2011a). A direct relation to a specific consumption reduction has only been indicated for UK, Sweden and Denmark (COWI 2011; Bahn-Walkowiak et al. 2012, 2010). At the same, tax approaches must be evaluated against the background of EU member states receiving substantial state aid for the construction of infrastructure (Usubiaga et al. 2011).

Policy imperfections of resource taxes

From an economic perspective, taxes are usually second-best policies due to their inherent impreciseness (Söderholm 2011); from an environmental perspective, taxes are a step towards reflecting the full external and social costs of resource extraction and use. In general, the implementation of resource taxes or fees creates an incentive to reduce resource use (depending on the range of the rate) or substitute the primary material; it collects data on the extracted quantities and thus implements a monitoring mechanism. Similarly, they contribute to correct the market failure of **price distortions and the externalising of cost**. However, economic instruments are often implemented **without clear timelines or support through quantitative targets**, mainly in order to generate national income and they often do not serve any behavioural goals in terms of environmental objectives or resource efficiency targets (EEA 2011a).

Concerning energy taxes, "pusher strategies of pioneer countries" (which were the Scandinavian countries and Netherlands at that time) came along with European Commission's proposal to introduce a common energy/carbon tax in the 1990s. Despite long-standing debate and the fact "that the environmental effectiveness of eco-taxes is widely recognised among scientists as well as policymakers and that these instruments have actively been promoted by many of the most influential international organisations such as the OECD, the UN and also by the EU for many years" a successful dissemination of resource taxes has failed. The analysis that this could be due to "high **conflict potential due to their redistributive effects**" and is therefore less likely to rapidly diffuse can still be considered as valid (Tews 2002, p. 29). Resource taxes are confronted with a bundle of structural barriers: the **market power of key sectors** (see framework conditions and power asymmetries among them), the lack of information and cognitive barriers on various levels (industries, consumers, politics), split incentives in value chain, between companies, between different resources

In general, environmental taxes and charges are overwhelmingly implemented selectively; they cannot yet be considered as large-scale instrument sending a clear-cut signal to consumers, except for the context of energy and petroleum. From today's perspective, one can hardly speak of good practice concerning resource taxes. Mainly, single resources are addressed by rather low rates. Contribution to overall tax revenues is marginal. Potentials are not exploited; the tax shifting aim (major shift from taxation of labour towards environmental taxation) is not tackled at all.

Incentive programmes

Besides a reluctant use of economic incentives such as taxes, more and more policies aim to combine the dynamics of innovation with a targeted support for eco-technologies. Those policies are assumed to have advantages in achieving economic objectives and increasing resource efficiency, in terms of a broad definition, (COWI 2011; EIO 2013), by being a fusion point of innovation and environmental policies. "While environmental policy has been insufficiently oriented towards technology development and innovation, innovation policy has often been too broad to address specific environmental concerns appropriately" (OECD 2009, p.183). Incentive instruments and programmes are established, and yet focused, in the field of energy. According to Ecorys (2011a) „instruments concerned with resources and aiming in particular at resource efficiency are not widespread and are poorly developed in comparison to other areas, providing a significant opportunity for improvement and wider deployment". Key activities of the four countries are briefly listed below.

Austria shows a supply-side policy focus, especially in R&D support in public sector and industry, networks and partnerships. The main **programmes** for resource efficient eco-innovations are

- Programme on Technologies for Sustainable Development (2000) [Building of Tomorrow - Factory of Tomorrow - Energy Systems of Tomorrow]
- Climate and Energy Fund (KLIEN) (2007) [29,000 projects for developing and testing environmental technologies];
- ÖPUL - Environmental Agricultural Program (Grant for e.g. integrated production, alpine agriculture, environmentally sound agriculture ("biological") - agriculture sector (Austria organic sectors is at 16%!)

Institutions offering financing and financial support are, for example,

- Austrian Promotion Bank (Austria Wirtschaftsservice, AWS - offering a broad range of company-specific investment promotion programmes and services, such as loans, guarantees, grants, equity, and consultancy services)
- Austrian Research Promotion Agency (FFG - is the national funding institution for applied industrial research)
- Environmental Fund, by Kommunalkredit Public Consulting (KPC - finances market uptakes)

Germany: For over a decade, the so-called Market Incentive Program (MAP) has been the central instrument to promote the use of renewable energies in the heat sector in Germany. The funding was enacted by the Renewable Energies Heat Act (EEWärmeG), which came into force in 2009, and added a mandatory use of renewable energy in new buildings. The financial support for small solar thermal and biomass facilities and for heat pumps for households are handled by the Federal Office of Economics and Export Control (BAFA) and for all other and larger systems by the German Bank for Reconstruction (KfW). BAFA exclusively grants investment subsidies, while the KfW grants loans with repayment bonuses.

Further financial incentives are provided by **programmes** such as:
- Municipal directive for the support of climate protection projects (Grant for Climate protection concepts and -management of Local governments)
- Municipal directive for the support of climate protection projects (Grant for Energy saving programmes in nursery schools of Local governments)
- Municipal directive for the support of climate protection projects (Grant for Investment in climate protection measures of Local governments)

Institutions offering financing are:
- KfW Energy-efficient Redevelopment – for municipalities for the purpose to improve energy efficiency in public schools and universities (volume €3.3)
- Governmental Programme for Electric Mobility (2011) providing financial incentives for R&D and market introduction of electric vehicles - target line is 1 Million by 2020; status is less than 100,000 cars
- Federal Office of Economics and Export Control (BAFA)

In addition, the so-called Energy check-up provides assistance for low-income households (2011) and the PIUS-Check and the German Material Efficiency Agency (demea) as well as further institutions at regional level provide consultancy for SMEs.

Hungary states a rather low demand for eco-innovation among both consumers and businesses investment difficulties (e.g. difficulties obtaining bank loans, scarcity of venture capital investments) due to overall insufficient financial resources. Three programmes including financing mechanisms are:
- Green Investments Scheme - Climate Friendly Home Program (2009) (Grant for households) is financed by the revenues from international emissions trading and sets an incentive for efficiency measures in households.
- Light bulb change programme (Grant for Households)
- Spatial development based on renewable resources provides direct subsidies for renewable energy pilot projects that have substantial impacts on spatial development

Netherlands stands out by a tax-oriented approach including the following schemes:
- Green Fund scheme (Income tax exemption for dividends from Green Funds - Tax reduction for households) managed by several Dutch banks[32]
- Green Fund scheme (Loans for green projects - Soft loan for households, local governments)
- Energy investment allowance (Tax reduction for all enterprises)
- Accelerated depreciation for machinery on the MIA/VAMIL list (Tax reduction for all enterprises)
- Groen Beleggen implies tax reduction on supposed return on investments for certain very eco-innovative or green business activities
- Tax relief for investments in environmentally friendly technology (Tax reduction for all enterprises)
- Subsidy scheme for the production of renewable energy (Grant for renewable energy producers)

[32] The Green Funds Scheme is discussed as a successful tool that achieves demonstrable economic and environmental effects. The Dutch model is especially designed for the integration of small investors in the goal of sustainable development. The current use in the Netherlands is concentrated in the areas of energy and greenhouses; in the latter area, the scheme has deployed significant innovation and contributed to significant improvements in energy efficiency (Scholtens 2011).

– VAT-reduction for installation activities for reduction of energy in houses

The Rewarding Sustainability contains an extra budget within the Recovery programme for sustainable production and energy saving in houses, electric cars development and infrastructures. Organisational support is given for participation of Dutch stakeholders in "platforms" on eco-innovation (e.g. the Water Supply and Sanitation Technology Platform (WSSTP) and the ERA-net SUSPRISE (the Sustainable Enterprise).

By and large, the policies and financial mechanisms across the EU28 form a rather complex and intricate policy environment that overwhelmingly focuses at energy and climate issues, while „Monitoring and data relating to market based instruments is typically weak" (Ecorys 2011a). Using a wide definition of the resource efficiency term, the EEA has identified 127 different environmental protection and resource efficiency policies across the EU32 for SMEs alone (EEA 2011a) ranging from improving material efficiency in SMEs through dissemination of information on best practices to strict environmental regulation while mostly concentrating on specific resources (see Figure below) (COWI 2011). However, a lack of coherent resource efficiency policies is identified in the majority of Member States (RPA-report 2014).

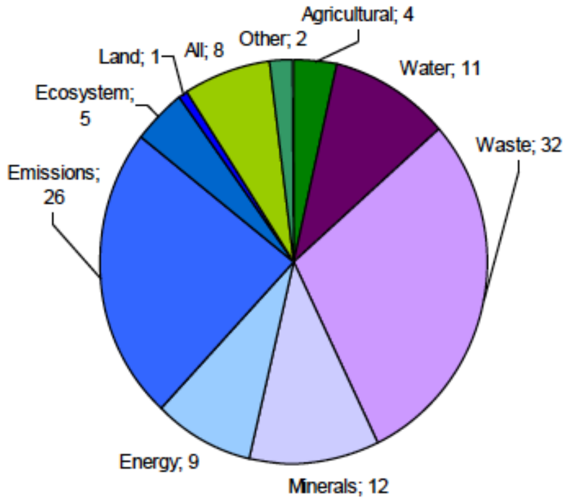


Figure 11: Resources addressed in identified policies; Source: Ecorys 2011a, p. 11

Support for SMEs (consultancy)

The Small Business Act (SBA) of the European Commission stresses in its 2011 update the central role of SMEs for achieving a resource-efficient EU economy[33]. Increasing resource efficiency is thus one of the ten key principles of the SBA. According to the Flash Eurobarometer, most SMEs (34%) state that grants and subsidies would help to make their company more resource efficient, 25% indicate consultancy on improving resource efficiency and 22% prefer advice on funding possibilities for resource efficiency investments (TNS 2013). It can be observed indeed that policies and interventions in order to support SMEs for becoming more resource efficient „range from centrally planned strategies, such as 'one stop shops' and communication hubs, to sectoral- or industry-based initiatives" and are increasingly becoming widespread. Here, Germany is at the forefront by introducing the PIUS-Check of the Energy Efficiency Agency (efa) at federal level of North Rhine-Westphalia and the German Material Efficiency

[33] „Principle IX: The EU and Member States should enable SMEs to turn environmental challenges into opportunities. They should provide more information, expertise and financial incentives for full exploitation of the opportunities for new "green" markets and increased energy efficiency, partly through the implementation of environmental management systems in SMEs" (Small Business Act for Europe) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0394:FIN:EN:PDF

Agency (demea), a governmentally induced initiative (2006), where providing information is combined with administrative support and capacity building in resource or energy efficiency management in enterprises at low or no extra cost. Those institutions have been one of the first and served as a model of other material efficiency agencies. In the number of „general programmes providing information, grants, etc." (which are including help with EMAS scheme and efficiency audits) Germany is leading with 13, supplemented by 24 „direct hands-on support programmes", followed by Spain (15 / 10), UK (10 / 10), Netherlands (8 / 7), and Austria (4 / 9).

In the country sample referred to here, it can be noted however that in the majority of Member States (with the exception of Austria and Germany), concentration is rather on providing information and generic support than those providing direct, hands-on support (RPA-report 2014).

Another important tool for SME consultancy is the National Industrial Symbiosis Programme (NISP) that devises and manages industrial symbiosis by providing capacity-building support to partners and helps to develop their own programmes. This is usually financed by the partners involved. It has been installed in many European countries to-date, such Hungary as well as the Netherlands for the Province of Limburg. From the larger sample also Finland, Poland, and UK have implemented national industrial symbiosis programmes. Results are summarised in the table below.

Table 9: Identified market-based incentives and programmes providing resource efficiency support for SMEs, Source: Ecorys 2011a; RPA 2014, p. 132

Member States	MBIs*	Number of general programmes providing information, grants, etc.	Number of direct hands-on support programmes
Austria	13	4	9
Germany	13	13	24
Hungary	1	2	--
Netherlands	7	8	7
Estonia	0	3	--
Finland	2	3	1
Poland	9	--	4
Spain	1	15	10
Sweden	2	3	3
UK	7	10	10

*including price-based and quantity-based instruments

Discussion of incentive programmes

The overall objective of financial incentives and support programmes is to influence specific production or consumption decisions or encourage longer-term innovation processes, technology introduction and diffusion processes associated with a decrease or avoidance of environmental pollution in the sectors addressed. Public policies such as funding in R&D, low-interest loans, direct financial support is particularly useful when environmentally friendly alternatives are available, but not (yet) economically viable. Examples are subsidies for farmers to convert to organic agriculture, reducing the use of fertilizers, consideration of biodiversity, introduction of renewable energy or energy saving measures (Wilts 2014).

A closer examination of the countries Austria, Germany, Hungary and the Netherlands shows parallels, both in terms of the measures implemented and the effects associated. In the area of direct financial incentives and support programs one can assume that the barriers for introduction are rather small. There are hardly any distributional conflicts and the cost of implementation, administration and evaluation lie with the public. Information deficits, adaptation deficits, initial capital deficits can be easily targeted. In particular, the specific combination of resource efficiency innovation and technology driving market incentive programs and information transfer in the form of targeted counselling proves to be quite effective. This is particularly well documented in the field of energy efficiency measures in the building sector. The assessments differ, however. Due to a combination of stricter building codes and regulation, higher efficiency standards for new construction and renovations with the EU Directive of 2002, certification schemes and national support programmes Nelson et al. (2010) find that the niche green buildings has already become mainstream. BIO IS however find barriers to energy efficiency in buildings not as a set of discrete problems, (...) but as „dynamic interplay of actors“ (BIO IS 2013, p. 124) having reduced the potential energy efficiency gains in the last years.

To conclude, support programmes and financial incentives reduce **information deficits and cognitive barriers and encourage learning processes** with good diffusion results. The overall picture is, however, inconsistent and regionally fragmented. In general, subsidies or tax breaks tend to remain in the tax system. Once they are established it is usually not easy to abolish them, they are quasi “resistant to reform as the recipients have amassed political clout on a par with the pay-outs they receive” (Halweil and Nierenberg 2008). Subsidies are proposed to be sharply focused and limited in duration. This principle has to be taken into account.

Recovery Programmes

The following section is based on data provided by European Commission (CE & Ecorys, Pollitt et al. 2011), Research and Innovation performance 2013, Innovation Union Scoreboard 2013 (Maastricht Economic and Social Research Institute on Innovation and Technology - UNU-MERIT), the OECD Science and Technology Outlooks for countries, and the Eco-Innovation Observatory and country reports and the Clean tech Index (WWF/Clean tech group).

In the wake of the recession (2009), Austria Germany, Hungary and the Netherlands have launched economic recovery programs. All contain both economic and environmental components. Although the recovery programs differ, of course, in their absolute magnitudes, and the proportion of green elements varies between 5 and 50%. In all four countries there is a focus on energy efficiency measures and in public and private buildings. Other areas include the transport sector with incentives regarding the further development of electric vehicles (Austria, Germany, Netherlands), a revision of the motor vehicle tax (Germany), new railway infrastructure (Austria), resources for advanced electric vehicles (Germany, Netherlands). The Car Scrappage Scheme, first launched by Germany, has been followed in a number of European countries, although the long-term environmental benefits are disputed and also the economic benefits rather short-lived and exclusive.

Austria
GDP €283 bn, total stimulus package 1.9 bn (2009-2012), green measures €1.07 bn (56%)

- Transport (ca. 70%) Railway infrastructure investments, Vehicle scrappage scheme
- Buildings (ca. 20%) Thermal improvements for private interests and companies, Investment on thermal renovation of public buildings
- General (ca. 10%) Global loan environmental projects for energy-efficiency, emission and waste reduction and environmental technology projects,

Germany
GDP €2,428 bn, stimulus share 3.2% of GDP, green measures €10.6 bn (13.3%)

- Transport (ca. 70%) Car scrappage scheme, revision motor vehicle tax, R&D of hybrid and other clean car technologies
- Buildings (ca. 30%) Energy efficiency in public buildings, primarily school and university buildings

Hungary:
GDP: €106.4 bn, total stimulus package: n/d, green measures, ca. 6.5€ m

- Buildings: Energy efficiency of buildings with wider use of RES
- Energy efficiency: Production of electricity from RES combined heating and biomethane, Regional development programmes based on RES, Heat and electricity production based on geothermal energy, Reconstruction of the district heating system

- Recultivation of regional municipal solid waste disposal sites

Netherlands:
GDP €594 bn, total stimulus package €17.3 bn, green measures €2.9 bn (17%)

- Energy efficiency (ca. 83%) off-shore wind energy
- Buildings (ca. 8%) Energy saving in houses
- Transport (ca. 5%) car scrappage scheme, development of electric cars
- Investment incentives (4%) sustainable production and sustainable production facilities

Summarising, the share of green elements in the recovery programmes is altogether rather low, compared the overall expenditure for recovery. Within those shares, there is a clustering of expenditures for transport and energy efficient buildings.

In this context the example of **Korea** is worth mentioning because of its “Green” minimum investment quota of 2% of the GDP for a period of 2009 to 2013 and the substantial green recovery plan (83,6 bn USD), which encompasses 4% of the GDP. Likewise, **China** plans to double its green investments in clean technology, recycling and renewable energies (468 bn USD). The effects of a green investment programme, which comprises an investment of such magnitude on resource consumption, cannot be estimated, yet. However, the geographic and economic reach of targets could be a criterion for evaluations.

Discussion of recovery programmes

Pollitt et al. conclude that, due to increased economic activity and the associated material requirements, the short-term ecological effects of the Green Recovery Programmes are rather negative. In the long term, ecological effects through green elements of stimulus programs seem to be positive, particularly the efficiency measures in the building sector and the associated decline in emissions as well as the infrastructure measures aimed at renewable energy. Obviously, there has to be thought of possible **rebound effects**. Investments in railway infrastructure are assessed as positive when they evolve a positive impact on commuter behaviour and decreasing private transport. The authors state, “Although many of the countries assessed had similar policies, the most successful packages in economic terms were tailored to take into account local requirements, domestic sectoral composition (e.g. size of the car industry) and addressed gaps in domestic infrastructure (Estonia’s water system, Australia’s rail network)” (Pollitt 2011, p. v). The authors suggest a good **balance between long-term and short-term goals** as well as economic and environmental objectives, while short-term goals might be rather shaped by the economic consideration, the long-term goals rather by environmental objectives. Since the pace of implementation may have played a significant role in the selection of measures, it is proposed to list cost-effective measures, which could be called at short notice. “The narrow focus on energy efficiency and climate measures may reflect the importance of these issues, but may also reflect the less developed nature of policy for other resources such as water, material consumption and land use. This possibly suggests a requirement to advance policy in this area more widely” (Pollitt et al. 2011, p. vi).

In summary, environmental benefits are often smaller than expected due to minor savings, rebound effects, **windfall gains**, higher material costs and emissions by the induced economic activities. An assessment concerning key advantages and key disadvantages (according to Pollitt et al. 2011) of the single measures implemented as green elements in various Recovery packages in the wake of the recession of recent years are summarised in the table below.

Table 10: Summary of policy types in economic recovery programmes and their key advantages and disadvantages, Source: Pollitt et al. 2011

Policy types	Key advantages	Key disadvantages
Investment in energy efficiency	• short-term benefits to construction sector • long-term increase in energy	• May not be implemented quickly • Energy savings could be small

Policy types	Key advantages	Key disadvantages
	efficiency	
Vehicle scrappage schemes	• Immediate boost to car industry and suppliers • Leveraging effects means efficient use of public money	• Probably few long-term benefits
Investment in rail infrastructure	• Benefits to large engineering and construction firms • Possible social and economic benefits from reduced journey times	• May not be implemented quickly • Negative environmental impacts on land use and materials • Impacts on energy use unclear
Investment in renewables	• Short-term boost to engineering firms (if domestic) • Reduction in dependence on imported fossil fuels • Reductions in emissions	• Can be expensive, could displace private investment • Other possible negative environmental impacts
R&D in new eco-technology	• Could provide long-term economic and (global) environmental benefits	• Short-term benefits limited • No guaranteed success

Innovation policies

According to the OECD, green innovation goals are increasingly part of national innovation strategies (e.g. in Finland, Germany), energy strategies (e.g. in Austria), or green growth strategies or action plans (Hungary, Sweden). There are two major innovation reports recently published: the "EU Innovation Union Report" by Directorate General Enterprise and the "Research and Innovation Performance" Report of the DG Research and Innovation. Both are providing complex indices, benchmarks and country profiles. In addition, there are reports in particular on clean tech and eco-innovation, for example, the "Global Cleantech Innovation Index" and, as referred to before, the "Eco-Innovation Index". These reports are also providing country profiles.

Austria is ranked as innovation follower (rank 9) (EC 2013a). Its main strategy 'Becoming an innovation leader' (2011-2020) seeks for new orientation of the framework conditions and governance structures, thus creating adequate mechanisms for defining focal points, a clear and transparent structuring of the funding system. Hot spots in key technologies according to the EC (2013b) are energy, environment, and transport technology. The target for R&D spending is at 3.76% of GDP by 2020.

The focus of green innovation (according to OECD) is based on the 2010 Energy Strategy, an Energy Research Initiative (ERI) is planned to support the development of technologies notably for the production of renewable energy sources and the storage of CO_2. A Cleantech Initiative was launched to provide risk capital for innovative enterprises in energy and environmental technologies. The Austria Wirtschaftsservice Bank's capital injection of USD 8.3 million is expected to make around USD 42 million available in funding. Priority is also given to the development of a more sustainable and efficient transport system though initiatives such as E-Mobility.

Germany is ranked as an innovation leader (rank 2) (EC 2013a). One of its main strategies is the High tech strategy 2020 (2006) with Hotspots in key technologies such as automobiles, environment, energy, and new production technologies. Germany has no R&D tax credits and the R&D quota is at 2.84%.

As regards green innovation Germany is considered strong. The Framework Programme Research for Sustainable Development (FONA) (2010-15) was launched in 2010 and focuses among others on climate, energy and sustainable resource management. The CLIENT project helps to establish international partnerships in environmental and climate protection technologies and to trigger the development of lead markets.

Hungary is assessed to be a moderate innovator (rank 21) (EC 2013a) with Hot spots in key technologies health, environment, automobiles, and biotechnology (EC 2013b). Hungary's Strategy on research and innovation policy (2007-13) focuses on ICT, biotechnology, nanotechnology, renewable energy and natural resources, environmental technologies. Its intermediate target is to increase the R&D expenditure rate of 1.5% of GDP by the mid-decade.

According to OECD, green economic development is one of the seven focus areas of the New Széchenyi Plan. Hungary's National Sustainable Development Strategy (2007) encourages R&D in future energy sources. Other green initiatives include the Hungarian National Renewable Energy Action Plan, the National Environmental Technology Innovation Strategy (2011-20) and the National Energy Strategy (2030).

Netherlands is considered to be an innovation follower (rank 5) having Hot-spots in key technologies such as food and agriculture, energy, ICT, nanotechnology, security, health. The main national innovation strategy is "Naar de top" identifying 9 top sectors which are chemistry, creative industry, energy, high-tech systems and materials, life sciences and health, agro and food, logistics, horticulture and propagating stock, and water. A national target is also to increase the Dutch R&D efforts to 2.5% of GDP by 2020.

Green innovation is a priority in the Netherlands. A number of programmes support R&D in energy transition with a budget of USD 79 million. The Green Fund Scheme and the Venture Capital Scheme (TechnoPartner SEED facility) provide tax rebates for investing in authorised green funds.

Table 11: Innovation performance of selected countries

	Austria	Germany	Hungary	Netherlands
DG Sustainable Growth, DG Enterprise: **Innovation Union Scoreboard** (EU28)	Innovation follower (rank 9)	Innovation leader (rank 2)	Moderate innovator (rank 21)	Innovation follower (rank 5)
DG Research and Innovation: **Research and Innovation Performance** (EU28)	Hot spots in key technologies: Energy, Environment, Transport technology	Hot spots in key technologies: Automobiles, Environment, Energy, New production technologies	Hot spots in key technologies: Health, Environment, Automobiles, Biotechnology	Hot spots in key technologies: Food/agriculture, Energy, ICT, Nanotechnology, Security, Health
Cleantech Group/ WWF **Clean tech Index** (38 OECD countries)	Rank 17	Rank 6	Rank 22	Rank 14
Strengths	*Strong general innovation inputs* *Solid government policies* *High density of public cleantech companies*	*Strong general innovation inputs* *Little money raised in cleantech funds* *Strong government policies* *Attractive infrastructure for renewables* *High number of environmental patents* *Strong cleantech manufacturing* *Good density of public companies*	*Relatively strong government policies* *Some environmental patents* *Reasonable renewable energy consumption*	*Strong general innovation inputs* *Strong entrepreneurial culture* *Emerging cleantech innovation* *Good number of local investors* *Many environmental patents*
Weaknesses	*Lack of entrepreneurial culture* *Lack of attractive infrastructures for renewables* *Weak cleantech revenues*	*Lack of entrepreneurial culture*	*Lack general innovation inputs* *Public cleantech R&D funding* *Local cleantech investors* *Lack of public cleantech companies*	*Falls behind commercialised cleantech innovation* *Mediocre public R&D spending* *Low cleantech revenues*
OECD: Government **R&D budgets** for energy and the environment as a percentage of total government R&D budget	4%	7.1%	3.8%	2.8%

Eco-innovation and clean tech play a minor role in the large EU Innovation Progress Reports[34]. This deficit is partly compensated for by other indices such as the Eco-innovation Index and the Cleantech Index. There is still is a lack of data as regards the relative and absolute size of the eco-industries, in terms of employment, contribution to value added, etc. allowing for comparisons with the huge innovation complex. The OECD provides a ranking of countries on the indicator "Government R&D budgets for energy and the environment as a percentage of total government R&D budget" (GERD) (see table below) (OECD 2012) showing that the planned investments are altogether small: Austria 4%, Germany 7.1%, Hungary 2.8%, and Netherlands 3.8%. From the wider sample, it is Estonia (13.9%) and Finland (12.5%) who have a larger part for green eco-innovation (Japan is at 14.5% in 2011).

There is no green equivalent for BERD yet, which is the "Business enterprise Expenditure on R&D". Here studies often rely alternatively on self-reports of the companies expressing ambitions to introduce resource efficient technologies or production processes (EIO 2013). The Socio-economic outcome of the Eco-innovation Index of the Eco-Innovation Observatory (which comprises the Exports of products from eco-industries (in % of total exports), the Employment in eco-industries (in % of total workforce), and the Turnover in eco-industries) shows a rather distinct downtrend for Austria and Germany, while Hungary and the Netherlands show an uptrend concerning employment and exports.

Discussion of eco-innovation drivers and barriers

Overall, the situation is unclear. Eco-innovation efforts and output have a niche role in the overall complex innovation policy. It is not transparent how specific sectors drive innovations via sector-specific modes and technological regimes, which innovations those are, how long or short innovation cycles are and which paths are determined like this. The last Sectoral Innovation Watch report is from 2008. It understands eco-innovation as a subsector. In a broader sense, the technological progress path European countries follow is characterised by a constant output of new innovative products and services that do not distinguish between environmental and non-environmental innovations for the time being. This is being reflecting in the budgeting for eco-innovation in recovery, R&D efforts and innovation policies, pointing to a fundamental "Mislabelling of sustainability as purely environmental", a barrier stemming from the political sphere (SD Commission UK 2011).

The market is supposed to separate "good" from "bad" innovations. In this respect, "improved technology may be the enemy of truly sustainable technology", Mulder stresses (2007). This might be illustrated by an example of the food sector: The most innovating sectors worldwide in the year 2004/2005 dealt with innovations of dairy products, water and soft drinks and frozen foodstuffs (CIAA 2007). All three product categories, however, belong to the categories with the strongest environmental impacts (Moll *et al.* 2008). It may be disputed whether the market and the consumer will abstain from using these new products, in particular when they are strongly advertised and information (or labelling) on the associated environmental impacts does not exist. Whether innovations stimulate the luxury aspirations or move within the barriers that could lead to **unsustainable lock-ins and path dependencies** or facilitate resource efficiency is not a big issue at EU level at present. It seems to suggest however an industrial policy enabling markets to direct their innovation activities towards resource efficiency and to stabilise market development after niche markets and early markets might have been created.

Further important aspects to innovation and eco-innovation such as accelerated technological innovation and substantially shorter product life cycles are hardly addressed, neither by policies nor research. The acceleration of consumption due to those aspects however is a serious problem not only regarding increasing household wastes but also rebound effects outweighing efficiency prosperities (Cooper 2005). A rising disparity between the product prices (some of which tend to decrease or increase at a slow rate) and the repairing charges (which rose excessively in recent years, partly due to VAT and increasing

[34] The UNU MERIT Report includes the number of PCT patent applications in environment-related technologies and health as an indicator.

labour costs) result in the fact that many discarded appliances are still functional or are not being repaired if they are damaged. The impact mechanism describes Binswanger (2001) as a result of a combination of high wages and comparably low energy prices that "encourage the use of time-saving but energy-intensive devices", thus causing a double rebound effect, in time use and in energy use (Jalas 2002 for service-orientation) and setting an incentive for the development of time-saving innovations. According to Binswanger this is similarly true in the mobility sector and the food sector (travelling longer distances because of faster transport modes, eating in fast-food restaurants, as the name implies) (Baedeker et al. 2009).

Some countries are establishing institutions and agencies to co-ordinate and manage the diverse array of green growth strategies, programmes and initiatives created to improve **vertical and horizontal policy governance** for green innovation. It is less clear though if these institutions coordinate with responsible institutions and ministries for resource efficiency and raw materials. The main barrier to better co-ordination of national innovation policy however is a complex and dense structure of autonomous or semi-autonomous institutions in Austria, in Hungary the fragmentation of the society and of the political system, and the weak culture of collaboration and in the Netherlands the different policy interests of different ministries, while a new Government Agreement includes new co-ordination mechanisms for better policy co-ordination between ministries and other stakeholders (OECD 2012). For Germany, a recent study on "Drivers and barriers for the transformation of the Germany economy into a green economy" points to a missing regulatory framework for steering the market in the right direction (Adelphi & Borderstep Institut 2013).

The following overview summarises types of instruments with a number of characteristics such as the barriers, sectors and resources addressed and the related costs and benefits. In addition, the incentive that is set by the implementation of the instruments is displayed.

Table 12: Policies influencing resource use and selected national examples

Instrument / Policy	National examples	Main barrier addressed	Economic actor targeted (sector / demand area)	Resource(s) concerned	Behavioural response intended	Possible economic and other costs	Possible economic benefits
RE Targets							
Resource efficiency targets (e.g., sustainability strategy, road maps)	Double resource productivity by 2020 (basis 1994) (DE) Increase of resource productivity by 4-10 by 2050 (basis 2008) (AT) Decrease of material intensity to 80% by 2020 (basis 2007) (HU)	Orientation deficits, information deficits	All sectors	All resources	Change behaviour, sectoral adaptation processes	Development expenses and consultancy costs	Superior orientation for the public and industries
Market-based instruments for RE							
Resource taxes / charges	Minerals Tax, (implemented in 12 European Countries) (BG, CR, CY, CZ, DK, EE, FR, LV, LT, PL, SE, UK); (DE, IT) on federal level	External costs	Mining & quarrying and downstream industries	E.g. minerals, petroleum	Resource use reduction, substitution of material, recycling If market is strongly competitive rebound effects may occur	Administrative costs, monitoring (if infrastructures are not given) Potential reduction of employment in raw materials industry	Public income generation Employment in recycling and substituting industries Stabilisation of world market prices Clear cost signals Valuable for capacity building – help to provide information
Tradable permits	White certificates schemes (BE, DK, FR, IT, UK) for energy efficiency measures	External costs	Mining & quarrying, energy, agriculture, fisheries	E.g. fish, (CO_2 emissions), energy	Reductions in use of resources	Administrative costs and burdens Need for monitoring, verification and enforcement	Appropriate allocation
Subsidies	KfW Energy efficient construction (DE) (2009); Renewable Heat Incentive (RHI) for householders, communities and businesses, (UK) (2014)	Adaptation deficits	All sectors	Energy resources	Technology introduction & diffusion	Public expenditure	Lower costs (Risk of being in place for too long and creating vested interests that are difficult to abolish)
Differentiated VAT rates - Products - Product groups - Sectors	In most European Member States, usually not implemented for resource efficiency reasons, apart from tax reduction schemes in CZ from 1993 to 2003 PT since 2001 UK since 2000	External costs, asymmetric information	E.g. Food & beverages industry Public utilities Mobility, e.g. railroad traffic vs. automobile traffic	All resources - mainly food & beverages, water, public transport	Behaviour changes	Public expenditure for reduced tax rates Resistant to change	Public income from standard tax rates

Instrument / Policy	National examples	Main barrier addressed	Economic actor targeted (sector / demand area)	Resource(s) concerned	Behavioural response intended	Possible economic and other costs	Possible economic benefits
RE innovation and technology driving instruments							
Recycling / circular economy (3R laws)	Circular Economy Law, China Construction Material Recycling Law (JP), Act for Promoting Closed Substance Cycle Waste Management and Ensuring Environmentally Compatible Waste Disposal (1994/2006) (DE)	Adaptation deficits	Waste industry, recycling sector	Construction and demolition materials - wood, timber, concrete, asphalt	Reduction of resource use and increase of secondary input	Investments in infrastructure Compliance costs	Reduction of waste
RE fund	Aggregates Levy Sustainability Fund (UK) (closed by 2011), Environmental Protection and Energy Efficiency Fund (CR) (revenues from resource taxes/charges),	Adaptation deficits (path dependencies, market power vs. niche markets)	Forestry, agriculture	Wood, land, crops, construction materials	Research & development, dissemination of innovations	Public expenditure	Competition edges, cut in resource use
Governmental Loan programmes and tax breaks	Green Investment Scheme (2009) (HU), Green Investment Scheme (NL); Technologies for Sustainable Development (AT) Innovative Technologies for Resource Efficiency – Resource-Intensive Production Processes (DE) Technology Strategy Board (UK)	Information deficits, adaptation deficits, capital deficits	R&D, investors	All resources, all sectors	Technology introduction & diffusion	Public expenditure (Has to be re-approved with each budget cycle)	Competition edges, capacity building
RE Research programmes	MaRess, PolRess (DE); POLFREE, Dynamix (EU); Eco-innovation Observatory (EU)	Information deficits, adaptation deficits, capital deficits	R&D	All resources, all sectors	Technology development & diffusion	Public expenditure	Competition edges, capacity building
Sectoral policies / covenants / voluntary sectoral agreements	Phosphate Value Chain Agreement (2011) (NL), Construction commitment (UK) Courtauld Commitment (in the sector of food and packaging) (UK)	Coordination failure	Steel, paper, chemical and non-ferrous metal industries	Steel, paper, chemicals, non-ferrous metals	Market introduction & diffusion	Public expenditure (depending on how strong involvement of sectoral actors is) Compliance costs	Sectoral benchmark
Dynamic standards / top runner	Top Runner Programmes (JP)	Adaptation and Information deficits	Electric appliances	Product-specific minimum standard (of secondary input)	Reduction of primary material use, increase of secondary material use	Administrative and Monitoring costs	Product benchmark
Voluntary Top Ten	Euro-Topten Plus (2009-11) will be expanded to 16 countries and include 20 partners	Adaptation and information deficits	Buildings, mobility, electronics,	Energy	Market introduction & diffusion, change in purchasing behaviour	Monitoring costs	Product benchmark

Instrument / Policy	National examples	Main barrier addressed	Economic actor targeted (sector / demand area)	Resource(s) concerned	Behavioural response intended	Possible economic and other costs	Possible economic benefits
			appliances				
Green purchasing	(…)	Adaptation and information deficits	Electric appliances	Machinery (office equipment)	Market introduction & diffusion, change in purchasing behaviour	Compliance costs	Product benchmark
Informational instruments and Information Transfer							
Strategies	Mineral Strategy (FI), Natural Resources Strategy (FI), Resource Efficiency Action Plan (REAP) (AT), Resource Efficiency Programme (ProgRess) (DE)	Information and orientation deficits, cognitive barriers	All sectors	All resources	Awareness raising	Development expenses and consultancy costs, administrative costs	Valuable for capacity building - help to provide information
Information Networks	Environmental Sustainability Knowledge Transfer Network, (UK) Plan C, (BE-Flanders) Cleaner Production Centres, (CR, DE) DEMEA consultative programmes on material efficiency (DE) (2004) Resource efficiency network (2006) (DE)	Information deficits, cognitive barriers	All sectors	All resources	Change in consumption and production behaviour, market introduction & diffusion	Development expenses and consultancy costs, administrative costs	Valuable for capacity building - help to provide information
Information Services	Information service for product integrated environmental protection in industries (PIUS) (DE), CO2-calculator for household appliances (BE-Wallonia) WRAP (Waste & Resources Action Programme) (UK) Greening the daily life (HU)	Information deficits, cognitive barriers	All sectors	All resources	Change in consumption and production behaviour	Development expenses and consultancy costs, administrative costs	Valuable for capacity building - helps to provide information
Dialogues (with industry)	Resource productivity and resource conservation (…) (dialogues with copper, steel, construction industry in the year 2007/2008) (DE)	Information deficits, cognitive barriers	All sectors	All resources	Change in production behaviour	Administrative costs	Valuable for capacity building - bridge the gap between environmental and industrial policy, participatory
Events and awards	Sustainable weeks (AT) DEMEA Material Efficiency Award Scheme (first awarded in 2004) (DE)	Information deficits	All sectors	All resources	Awards pioneer role, example for imitation	Improves standards	Competitive edge
Labelling schemes	Blue Angel (Established 1978) (DE), Eco Label (EU), Nordic EcoLabelling	Information deficits	All products	All resources	Change in consumption and production behaviour, market introduction & diffusion	Development expenses and consultancy costs, administrative costs	Valuable for awareness raising - help to provide information

Source: Bahn-Walkowiak within the COWI study, updated and adapted 2014; basing on Bringezu/Bleischwitz 2009: 228ff.)

Environmentally harmful subsidies in resource intensive consumption areas

The following section is mainly based on data provided by European Commission (IEEP & IVM 2012), Member States Factsheet on Agricultural Key data provided by DG Agriculture and Rural Development, European Parliament, Policy Department Economic and Scientific Policy (Usubiaga et al. 2011), and Eurostat data on Taxation.

Another significant debate in the context of resource efficiency focuses on the reduction of subsidies contributing to pollution (Wilts 2014). Subsidies are often associated with environmental disadvantages; many of them are "resource-relevant". There is also a large spectrum of research in particular focusing on environmentally harmful subsidies (EHS); the issue has been given high priority on the political agenda of the roadmap. The purpose here is to take a look at the areas meat, heating and cars, which have been identified as particularly resource intensive product groups (Joint Research Centre 2006). It turns out, however, that there is neither a consensus on the definition of subsidies in the political debate, nor which resources term to use as regards resource-related subsidies. The more focused the concept of subsidy and resource term is, the smaller the number of subsidy facts is that must be removed or adapted for the purpose of environmental relief (Münch and Jacob 2014, p. 1). Thus, there are many definitions of EHS depending on a particular context.

A useful definition that is widely used draws on the OECD term EHS as "a result of a government action that confers an advantage on consumers or producers, in order to supplement their income or lower their costs, but in doing so, discriminates against sound environmental practices" (OECD 2005). IEEP rightly indicates that the definition refers to "action" only. "In some cases non-action, e.g. not applying road pricing to cover costs of roads, not applying VAT on food or excise taxes on certain fuels, or not internalising externalities, leads to prices not reflecting environmental and social costs and hence creates implicit subsidies" (IEEP 2012, p. 2). In this sense, it is useful to apply a broad understanding of subsidies including any kind on "non-action" leading to environmental damages and increased resource use that are evident. Within the scope of this study it is not possible view all subsidies with resources relevance, in particular because of the area of non-action is largely unexplored. However, this section could help to highlight patterns.

Transport

Not only are direct benefits and transfer payments are relevant but also incentives created by non-taxation and exemptions. This field is common practice, in particular in the field of transport. Virtually all countries inspected have a Fuel duty relief for agricultural vehicles, the volume of which, however, certainly is not marginal (IEEP calculates a loss of revenue of about € 500 for UK only). This subsidy does not only harm the environment because it sets no incentive for saving fuels, but has, according to the impact analysis, also contributed to an over-mechanization of agriculture (IEEP 2012).

The intra-community and international air transport is not VAT charged by any European country. A number of countries, including Netherlands and Spain apply a reduced VAT rate for long-distance passenger transports by rail; Germany and Austria do not, they use a standard rate. As regards domestic public transport, 14 European Member States collect reduced or zero tax rates. Eight countries use a standard rate of more than 15%. Rail transport is strongly competing with road transport, particularly concerning freight. In the current design of the VAT system in Germany, for example, public transport is favoured by 7%, long-distance rail transport, the purchase of an automobile and gasoline are subject to the standard rate of 19%, while flight transport is exempted. An air ticket charge was introduced in 2010, similar to UK or the Netherlands (FÖS 2008).

Subsidies granted in **Germany** (UBA 2010; Rave 2008), include a VAT exemption for international flights entailing a loss of EUR 1.56 billion—a disguised transport subsidy promoting an unsustainable means of transport. In 2002, the German government tried to include the passenger air transport in the VAT at

European level. It failed at that time due to the necessary unanimity voting in tax matters. In Germany itself, the approach in the tax reduction law failed in 2003 because of the resistance of the Federal Council. The EP states “that the transport sector is experiencing market distortions, since some modes of transport such as bus and train are subjected VAT while others are exempted. This creates an uneven playing field since all modes of transport are competing for the same crossborder transport services” (EP 2011, p.5). In Germany, heavy trucks are required to pay a fee at least for highways; an extension is under discussion.

The **Netherlands** experience foregone revenue through "no road pricing", in Germany there is "no road pricing for passenger cars.[35] Tax deductions for commuters exist in Austria, Germany and Hungary; the Netherlands has abolished the subsidy in 2001. A favourable company car taxation is also quite common: we find it in Germany and Netherlands (and UK and many further countries), both leading to increasing emissions and private car mileage by externalising costs and setting an incentive to live further away from work. The motorisation rate in Europe seems to be growing inexorably (see figure below), with Austria, Finland and Germany leading in 2009 concerning the registered cars per 1,000 inhabitants. If one looks at the growth rates, it is mainly the New Member States trying to catch up: Romania, Poland, Estonia with extraordinary growth factors of 3.3, 2.9, 2.6 and Hungary rather low with 1.6, thus leading to an average growth factor of 1.8 (within the country sample).

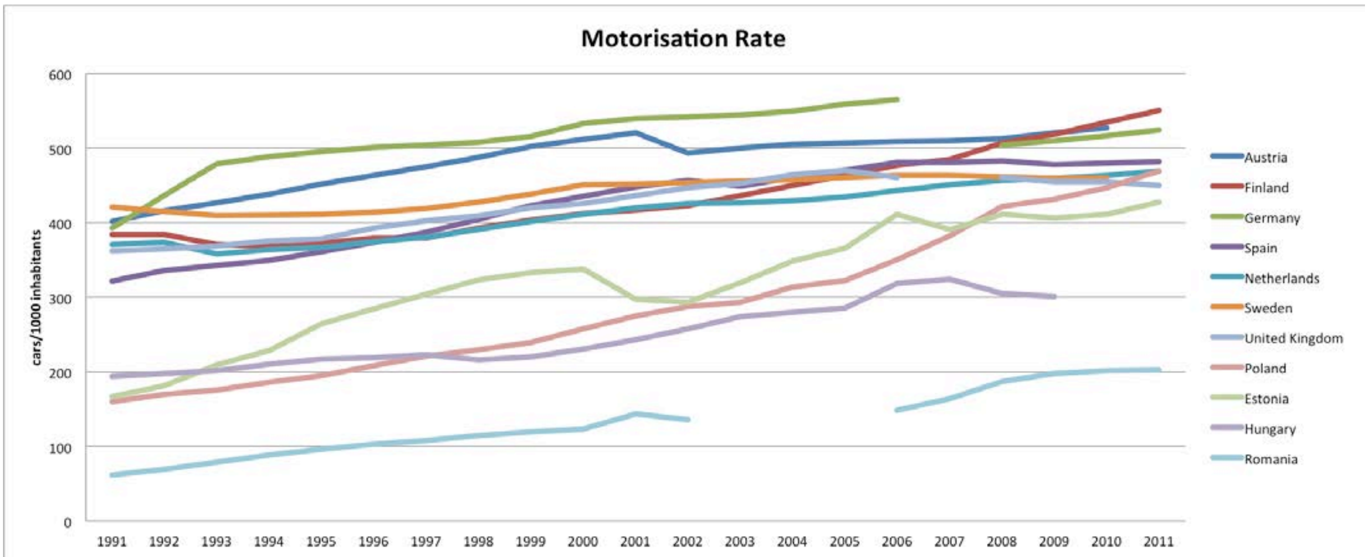


Figure 12: Development of motorisation rate in selected countries, cars per 1,000 inhabitants; Source: Own compilation (Schefer/Wuppertal Institute), on the basis of Eurostat data

Austria

- Fuel duty relief for agricultural vehicles
- Tax deductions for commuters

Germany

- Fuel duty relief for agricultural vehicles
- Tax deductions for commuters
- No road pricing for passenger transport
- Favourable company car taxation

[35] At least 17 countries in Europe are collecting any sort of tolls: Austria, Belgium, Croatia, Denmark, France, Germany, Greece, Hungary, Italy, Netherland, for Westerscheldetunnel, Norway, Portugal, Spain, Sweden, United Kingdom, Serbia and Slovenia. Some countries like Austria, Bulgaria, Czech Republic, Latvia, Hungary, Romania, Slovakia, and Switzerland have introduced the vignette system.

- Environmental aspects taken into account in car registration taxes costs in a distorting manner

Hungary
- Fuel duty relief for agricultural vehicles
- Tax rebate for commuting costs
- Environmental aspects are not taken into account in car registration taxes (except for hybrid and electric cars)

Netherlands
- No road pricing for freight and passenger transport
- Favourable company car taxation

EU Interface: Transport infrastructure subsidies

The trend is supported by EU subsidies directed toward road investments (Usubiaga *et al.* 2011). A large item is the European Structural and Cohesion Funds aiming to reduce social and economic disparities between the European regions. The cohesion policy earmarked €344 billion for the programming period 2007-2013. When the overall budget is examined, it is striking that a large proportion is granted for transport infrastructure investments (24%), comprising both sustainable and unsustainable transport modes. Out of these, 49% of the investments are selected for motorways and roads (national and regional roads), thus dedicating a major part of the resources to a long-term investment in the unsustainable practice of individual transport and heavy freight traffic (see Figure 13).

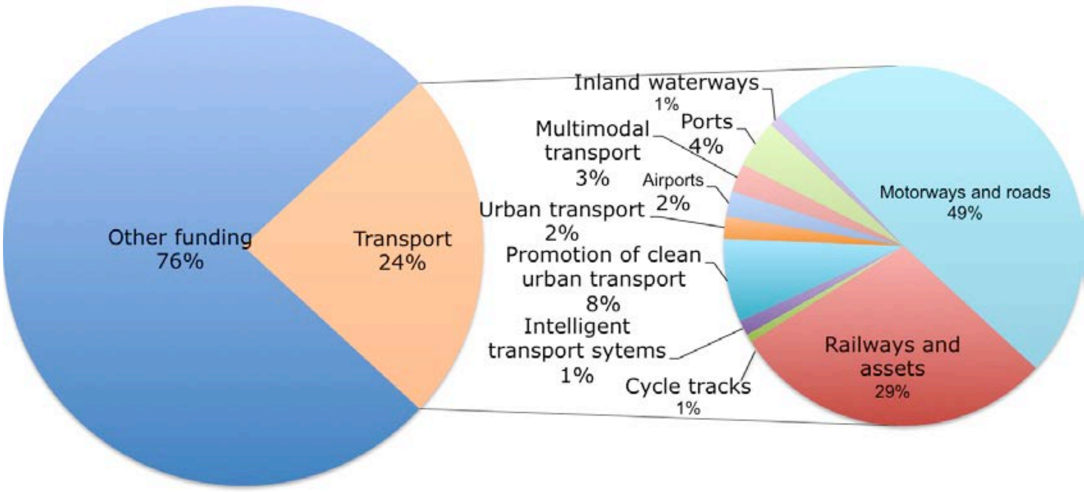


Figure 13: Breakdown of EU (planned) investments for transport in EU-27 according to mode, 2007-2013; Source: Bahn-Walkowiak in Usubiaga et al. 2011

In general, environmental expenditure within the EU Structural and Cohesion Funds budget is on a record high and amounts to €105 billion (2007-2013). 21 out of 86 categories have an ecological focus, such as such as promotion of clean urban transport, renewable energy (wind, solar, biomass, hydroelectric, geothermal and other), energy efficiency, assistance to SMEs for the promotion of environmentally-friendly products and production processes (eco-innovation in SMEs), cycle tracks, etc. The proportion however needs revision of priorities.

Food – Meat

The food and drink sector is the largest manufacturing sector with view of value added, turnover, and employment and belongs to the key sectors of Europe. At the same time, the sector is one of the most innovative sectors in Europe in terms of developing new products. Here, it is all above convenience products which show the largest growth and turn over numbers, in particular, frozen products, dairy products, ready-made meals and meat (FoodDrink Europe 2012).

There is strong evidence that social reasons for reduced VAT rates in the meat and dairy products no longer seem appropriate. Westhoek et al. (2011) indicate that the European meat consumption is twice as high and the consumption of dairy products is three times higher than the world average. An analysis of meat and dairy products revealed that the sector—while constituting 6% of the economic value of the total final consumption—contributes 24% of the environmental impacts in EU-27 (JRC 2008). In **Germany** the milk and dairy and meat production is very high and while 30% of the products are produced for export. With a total turnover of EUR 24.2 billion the German dairy industry is one of the key sub-sectors. The meat production noted a record high in 2011 achieving a turnover of almost EUR 34.5 billion (BVE 2013) while meat from organic production has a share of not more than 4%, with slightly increasing numbers due to the fact that even discounters are increasingly taking up the marketing of organic products (Balz 2007). The carbon footprint and the material input of meat and butter are extraordinarily high compared to food products such as wheat, potatoes, apples, while meat has an particularly high water footprint too.

Simulations of IVM (2008) have shown that an increase in VAT for conventional meat and dairy products to the standard rate in all Member States would result in a consumption decrease of 2-7% for meat and 2-5% for dairy products (IVM 2008). Taking into account possible shifts in organic products and conventional foods, this would result in a CO_2 reduction of 12-21 million tonnes of CO_2 per year. Most Member States currently use one or more of the reduced tax rates. Bulgaria, Denmark, Estonia, Lithuania, Romania and Slovakia all raise standard rates of at least 20% on food. The taxation of meat and dairy products at standard rate in those Member States taxing these products per reduced rate would create additional revenues of EUR 14 billion for dairy products and meat products for EUR 21 billion per year in the EU (IVM 2008).[36]

From the extended sample, only Estonia and Romania are taxing food regularly, all other countries have a completely or partially reduced tax rate.

Kanerva (2013) states a considerable rise of almost 70% over the last half a century of the per capita consumption of all meats but signs of stabilisation in the last 20 years. It is important to note that the data used here refer to the FAO meat supply data, as data on actual consumption is not available. In this respect, they have to be taken as representing economic developments. In the years 1961-2007 the meat supply for a group of 8 EU countries (Germany, France, Italy, Spain, UK, Netherlands, Hungary, Finland) has doubled in the EU (Kanerva 2013, p. 8). In the sample of four (see figure below) variation can be seen in the patterns. Since data for real average per capita consumption is not available, it is unclear whether the differences may be explained by cultural patterns or due to shifts between economic sectors or relocation of industries. Kanerva examines different factors to explain the variations of countries and developments, e.g. standard of living, urbanisation, industrialisation of production, globalisation, and, last but not least the cost of factors and retail prices where she assumes influences in connection with industrialisation of production, available income and policies (Kanerva 2013, p. 23f.).

[36] More on potential effects of economic instruments from PBL (2011) EU Resource Efficiency Perspectives in a Global Context - Policy Studies, and e.g. Stehfest et al.; see the IRP report Assessing Global Land Use

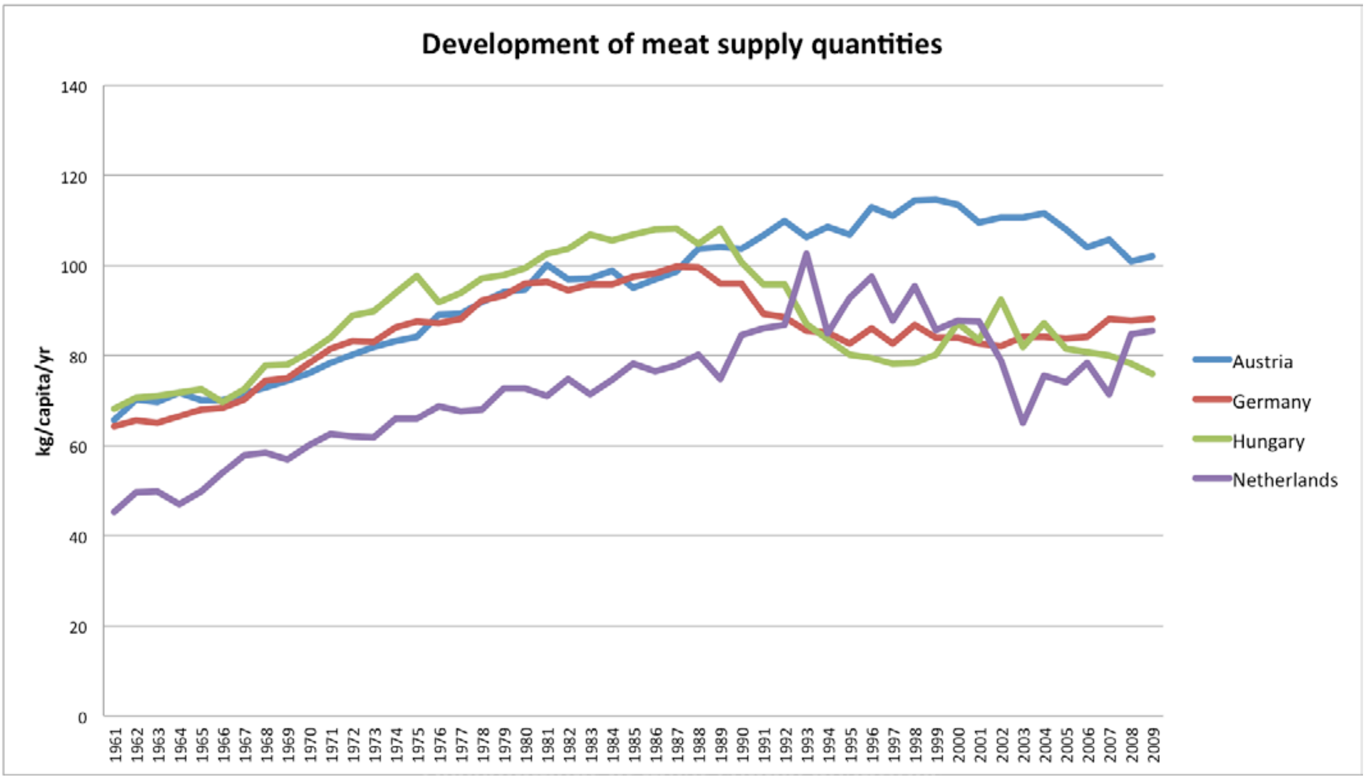


Figure 14: Development of meat supply quantities in selected countries, per capita; Source: Own compilation on the basis of FAO data 2014

EU Interface: Agricultural subsidies

Agricultural and fisheries subsidies form over 40% of the EU budget. One of the largest items of EU budget is the **Common Agricultural Policy (CAP)**. It comprises market related expenditure and direct aids (so-called first pillar, €42.5 billion) as well as expenditure on rural development (second pillar, €14.4 billion) in 2011. The 2003 CAP reform made a widely non-controversial step towards removing EHS by decoupling agricultural support from production levels and thus reduced incentives for over-production and intensification of farming methods. In addition, the support-scheme is now subjected to "cross-compliance", i.e. environmental, food safety and animal welfare conditions. Environmental benefits delivered by these standards, however, are disproportionately small compared to the provided payments because most of the Member States still orient their payments towards former production levels, favouring conventional large and intensive producers instead of small farms.

The data situation is non-transparent. Direct payments to single farmers are not to be published and therefore it not possible to conclude on proportions to livestock farming.

Austria
National: food: reduced VAT rate; 10% organic farming (16%)
EU: CAP subsidies 1.6 bn - Animal output of agricultural production = 2 bn EUR (29% of total output)

Germany
National: food: reduced VAT rate 7%
EU: CAP subsidies 7.3 bn - Animal output of agricultural production = 14.3 bn (27% of total output)
European Fisheries Fund subsidies for modernisation of fishing vessels

Hungary
National: food: reduced VAT rate milk & dairy 18%, other food standard rate 27%

EU: CAP subsidies 1.5 bn EUR - Animal output of agricultural production 1.8 bn EUR (23% of total output)

Netherlands
National: food: reduced VAT rate 6%
EU: CAP subsidies 0.9 bn EUR - Animal output of agricultural production 5.8 bn (21% of total output)
European Fisheries Fund subsidies for modernisation of fishing vessels

Further subsidies are granted to the fishing industry within the scope of the **Common Fishery Policy (CFP)** - another debated item of the EU budget. In fact, the overall value of the EU and its Member States contributions is unknown. Some subsidies have been eliminated, such as the construction of new vessels, and funds have been redirected to programs aimed at reducing fleet capacity, but the overcapacity has not been sufficiently reduced to date. Fish stocks have further decreased. The challenge to align the management and control systems in such a way that fisheries subsidies do not cause harm to fish resources would urgently require an improvement of the regulatory framework and transparency.

Discussion of subsidy policies

Regarding subsidies within resource-intensive sectors and product groups, a remarkable homogeneity can be noticed depicting fewer variations than within the RE instruments in place (see Chapter 3.2.3), which are characterised by a relatively large heterogeneity. In the sectors food and mobility, there is a two-level subsidisation, i.e. providing several incentives counteracting resource efficiency.

In the context of food it can be considered a first step towards RE to tax meat at standard rates (e.g. Hungary) as a first step. In the context of transport, first steps are having or introducing a road pricing system (e.g. Austria), to abolish commuter deductions (e.g. Netherlands), to give up or refrain from favourable company tar taxation schemes (e.g. Hungary) and fuel tax reliefs for (agricultural) vehicles and to integrate environmental aspects in car registration procedures (e.g. Hungary) instead.

“These partially contradictory provisions reflect the complexity and ever-changing nature of political priorities. Furthermore, decisions on taxation issues at the EU level require unanimity voting within the Council that reduces the speed and nature of decision-making in this area. This is evident in current discussions on the revised Energy Taxation Directive. The Commission’s proposal seeks to inter alia introduce a single minimum rate for CO_2 emissions for all sectors not covered by the EU ETS and for minimum tax rates for energy to be based on the energy content of a fuel rather than volume. The proposal has however been met with significant resistance and there are concerns that it will be diluted in the course of negotiations” (IEEP 2012, p. 43).

The 2012 IEEP EHS-study[37] identifies the following barriers to EHS reforms

- Strength of special interests and rent-seeking behaviour
- False perceptions and fear of change
- Lack of political will and concerns related to competitiveness and social impacts
- Lack of transparency, information and awareness
- Legal, administrative and technological constraints
- Establishment of a culture of ‘entitlement’ to subsidies (IEEP 2012, p. 44ff.)

Suggestions for overcoming those obstacles comprise the increase of the transparency of subsidising, the change of misconceptions and popular beliefs such as “indispensability of a subsidy”, the reducing of

[37] Covering questionnaires with 170 experts from relevant authorities, academics, NGOs, the private sector, and pertinent experts’ networks examining EHS across nine sectors agriculture and land, climate change and energy, fisheries, food, forestry, materials, transport, waste, and water and further literature reviews

the lobbying power of special interest groups, the recognition that a range of options is available to meet societal objectives besides subsidies, the diffusion of innovative schemes, a better targeting of existing subsidies and an improved subsidy design, and creating windows of opportunity, as well as transitional measures (IEEP 2012, p. vf.).

3.2.4. Configurations of resource policies with respect to Roadmap requirements

Results of country sample

The following figures illustrate and summarise the results of the country review with regard to the dimensions: institutional set-up and incentives and side policies following the topics formulated within the chapter Transforming the economy in the EU Roadmap (EC 2011a).

Following this, countries are assessed according to their fulfilment of the criteria indicated below. The assessment system ranges from 0 for a low fulfilment or low value to 4 for a high fulfilment or high value (0 = no activities; 1 = low degree of activities; 2 = moderate degree of activities; 3 = above-average degree of activities, 4 = high degree of activities). The results are represented in so-called network diagrams, where the degree of fulfilment corresponds to the visual representation in the form of a web, i.e. the larger the web, the better the various criteria are fulfilled. This visual presentation allows the reader a comparative overview of the different policy areas and their characteristics.

Methodologically, it has to be noted however that it is not an evaluation with precise quantified values, but a (subjective) assignment of characteristics to particular criteria. This means, for example, that a measure based on an evaluation criterion (e.g. "Resource efficiency programmes") can of course not be assigned to real effects but serves for assessing the and (current) priorities of countries and the variations between them.

The judgements are based on the following evaluation studies: Ecorys 2011a, RPA 2014, TNS 2013, IEEP 2012. The scoring was carried out by the team of the Wuppertal Institute.

Table 13: Assessment scheme of the institutional set-up, incentives and side policies criteria and scoring; Source: Wuppertal Institute

Pillar	Criterion	Assessment	AT	DE	HU	NL
Institutional set-up	Resource efficiency programme (RP)	no 0 / stand-alone programme 1 / qualitative targets 2 / quantitative targets 3 / backed by measures 4	3	2	0	0
	Raw material initiative	no 0 / stand-alone programme 1 / qualitative targets 2 / quantitative targets 3 / backed by measures 4	2	2	0	1
	Coordination (institutions involved in policy formulation)	more than three 0 / three 1 / two institutions 2 / one institution 3 / integrated management 4	1	1	1	1
Incentives	Environmental taxes	no 0 / yes 1 / valuable effects 2 / considered successful 3 / more than one resource group 4	1	2	2	3
	Resource taxes	no 0 / yes 1 / valuable effects 2 / considered successful 3 / more than one resource group 4	0	0	0	0
	Direct financial support	no 0 / yes 1 / valuable effects 2 / considered successful 3 / more than one resource group 4	3	4	2	3
	Support for SMEs (consultancy)	no 0 / yes 1 / valuable effects 2 / considered successful 3 / more than one level 4	2	4	1	3
Side(effect) Policies	Economic recovery programmes - green elements	no 0 / yes 1 / valuable effects 2 / considered successful 3 / more than one level 4	2	2	1	2
	Innovation policies - green elements	no 0 / yes 1 / valuable effects 2 / considered successful 3 / more than one level 4	2	3	1	2
	Phasing out of environmentally-harmful sectoral subsidies (focus: meat)	0 = no activities; 1 = low degree of activities; 2 = moderate degree of activities; 3 = above-average degree of activities, 4 = high degree of activities	0	0	3	1
	Phasing out of environmentally-harmful sectoral subsidies (focus: cars)	0 = no activities; 1 = low degree of activities; 2 = moderate degree of activities; 3 = above-average degree of activities, 4 = high degree of activities	2	1	1	3

The graphics below shall illustrate the current country-specific priorities and activities with respect to the roadmap. The remaining dimension in particular the outcomes are summarised in the following table.

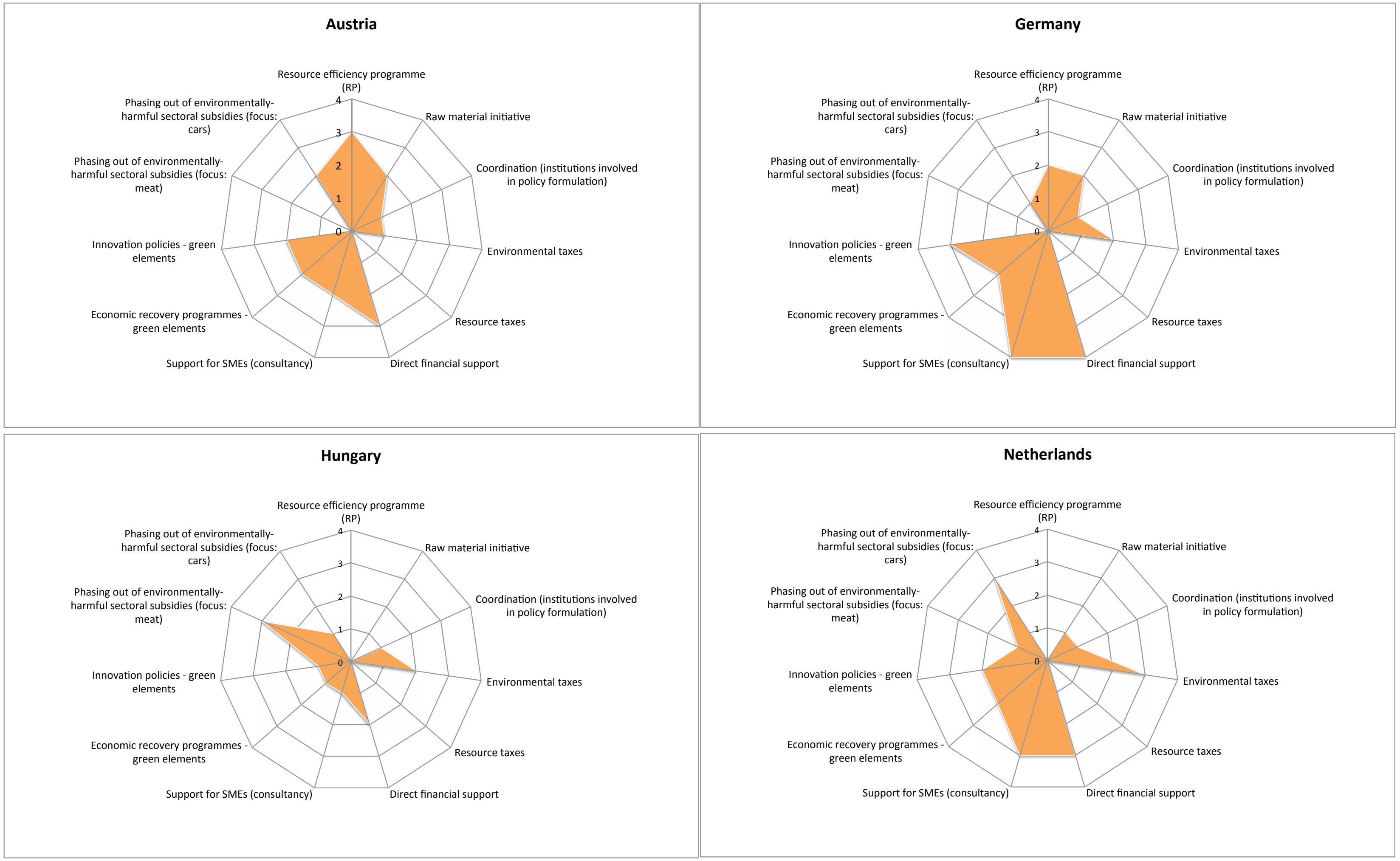


Figure 15: Configurations of resource policies with respect to Roadmap requirements

It turns out that, on the one hand, Austria and Germany are the leaders in terms of the development of resource efficiency agendas/ action plans, and have a focus in the field of financial incentives and support programmes for the industry, on the other hand. At the same time, aspects as the phasing out of EHS or shifting labour taxation to resource taxation are weakly or not at all pronounced, as both countries raise no resources taxes (apart from energy taxes and water charges). Other focal points in the field of innovation policy, which is good to very good pronounced, but show a downtrend according to the Eco-Innovation Index for Austria and an uptrend for Germany. The socio-economic outcomes comprising exports of eco-industries, employment and turnover of eco-industries show a downtrend for both countries.

Resource taxes are not charged by the other two countries either, Hungary and the Netherlands but the Netherlands has a leading performance as regards environmental taxes.

With view to innovation and green components of innovation policies, activities are notable in Austria, Germany and the Netherlands but rather low in Hungary. The public R&D budgets for energy and the environment are highest in Germany and less than half of that in Hungary.

As regards EHS, the Netherlands has developed first activities regarding the phasing out of EHS, such as tax deductions for commuters. Hungary stands out with raising the standard VAT rate on meat. There are no such activities to be noted in Austria and Germany.

Overall, Hungary is ranging at a much lower efficiency (i.e. resource productivity) level, but, at the same time, shows a comparatively low per capita consumption of resources and an absolute decoupling in terms of the average annual growth rates in DMC and GDP (2000-2009). This suggests that Hungary (still) has more frugal production and consumption patterns. The Netherlands shows also absolute decoupling and the lowest per-capita resource consumption of the country sample but it has hardly launched activities on the institutional side such as the development of resource efficiency action plans or the corresponding advisory institutions. For the Netherlands, all outcomes are show improvements and also the Eco-Innovation Index shows an upward trend. This is true, moreover, for Hungary, where an upward trend in the Socio-economic outcomes of the Eco-Innovation Index is recorded, but not in the relative ranks of the composite index.

Table 14: Specific outcomes of selected country in the review on resource policies

Indicator		AT	DE	HU	NL
Resource use	per capita tonnes average (DMC) (2000-2011); EU = 18t	23.2	16.2	13.3	11.6
Resource productivity trend	time-series (2001, 2006, 2011) PPS EUR per kg	1.18 / 1.26 / 1.59 = increasing	1.55 / 1.76 / 1.93 = increasing	0.43 / 0.58 / 1.00 = increasing	2.24 / 2.99 / 3.12 = increasing
Decoupling	Average annual growth rates in DMC and GDP (2000-2009)	relative	absolute	on the edge	absolute
Eco-innovation Index	Index of the EIO: composite of input, activities, output, environmental outcome, socio-economic outcome (in the years 2011-2013)	ranks 4 - 6 - 9 - down	ranks 7 - 4 - 3 - up	ranks 16 - 21 - 23 - down	rank 11 - 10 - 13 - down
Socio-economic outcome	Selection of EIO monitoring: Exports of products from eco-industries (% of total exports), Employment in eco-industries (% of total workforce), Turnover in eco-industries (in the years 2011-2013)	138 / 112 / 102 - down	121 / 95 / 93 - down	77 / 120 / 125 - up	92 / 123 / 142 - up

Note: The shading indicates an above-average performance compared to the European average.

3.2.5. Barriers for resource efficiency

Institutional frameworks, strategies, regulation and information, instruments, innovation strategies and the resulting prices within a market economy have strong influences on resource use. They matter for the direction of individual but also entrepreneurial choices and the resulting quantities of those. Various institutions pose their constraints on individual and industrial behaviour and channel decisions in certain directions. When the overall clarity of the institutional framework and the ensuing regulations is inconsistent, and consumers as well as resource efficiency stakeholders have to interpret prices and translate them into full life-cycle costs of goods and services, this is a strong barrier. Analysing the whole range of potential barriers is thus an indispensable component for analysing consumption and performance patterns.

Referring to Geels & Kemp (2007) and the multi-level perspective, the following table summarises barriers that were deduced from the interplay of geological and economic framework conditions, institutional and policy patterns in the member states analysed. It is suggested to distinguish between systemic and structural barriers: Structure-related barriers can be assigned to a certain system and follow regularity while evolving specific attributable effects (e.g. lack of information, trade-offs between policy fields, lack of transparency, lack of coordination, etc.). System-related barriers relate to higher-level bureaucratic and political systems and processes which, although separated from the environment, touch a number of subordinate structures and subsystems in terms of their impacts (e.g. tax systems, web-bound infrastructures, rebounds, policy cycles, competition principle). Thus, a different amount of actors is involved in both cases, and one can also speak of a distinct strengths and persistence of the respective barriers. While system-related barriers affect several socio-technical systems and political levels in any case, the overcoming of structural constraints is, at least theoretically, conceivable within one socio-technical system. As a result, a change of system-related barriers would require much more effort, possibly a fundamental paradigm shift and it seems virtually impossible that ground-breaking changes can be achieved through technological niche innovations.

Table 15: Transformation levels, drivers and main barriers in resource policy

Transformation levels and institutional and policy drivers		Barriers
Geological framework conditions (Natural assets and associated import dependencies)		**System-related**: raw material dependencies, > prevailing infrastructures, technology choices > lock ins, path dependencies
Framework conditions - *socio-technical landscape level*	Economic framework conditions (key sectors, infrastructures, tax system, stage of economic development, competition advantages)	**System-related:** economic dependencies on strong economic sectors such as food, transport, construction; path dependencies + lock-ins, decentralisation of competences; tax structures
	Societal	**System-related:** Four or five year parliamentary cycles impede long-term thinking; lack of consensus on targets
Institutional set-up - *socio-technical regime level*	Resource efficiency programmes/ action plans Waste programmes/ action plans	**Structural:** trade-offs between policy fields, targets, programmes; no action; vested interests of market actors, split incentives; lack of quantitative targets
	Agencies + competences (responsibilities) Laws, advisory, monitoring, networks, key agents	**Structural:** power asymmetries, trade-offs between agents, unclear and too many responsibilities, lack of transparency
Incentives + Disincentives - *socio-technical regime level*	Market incentives (taxes /charges, financial support)	**Structural:** market power of key sectors, lack of information, weak incentives, split incentives in value chains, + between companies, price distortions + external effects

	Side(effect) policies Economic recovery programmes (Implicit) supply side sectoral subsidies Uncoordinated innovation policies Demand-side tax breaks/ exemptions Pressure groups and key agents shaped by key sectors and high tech hot spots	**System-related:** rebounds and overcompensation of efficiency improvements, windfall gains, asymmetric opportunities for influence **Structural:** trade-offs between policies, sector specific market power, transparency deficits; double-favouring of important economic sectors, low budgets for green elements, balance between short-term and long-term goals
	EU interface - multi-level interactions Waste/ recycling Common Agricultural Policy Cohesion Fund/ Regional Policy	**System-related**: competition for financial resources **Structural:** uncoordinated multi-level decision-making for long-term developments leading to path dependencies; non-use of leapfrogging opportunities
Outcomes - *niches*	Eco-innovation Resource efficiency improvements + non-consumption	**Structural:** Deficits in R&D, generic lack of financial resources for market launches, information deficits, insufficient measuring + parameters

Source: Own compilation

The empirical analysis of resource management regimes and their specific characteristics in different EU Member States underlines the importance of a country specific perspective in order to understand why the EU as a whole still uses resources not as efficient as desired. The analysis points to largely unexploited potentials as regards innovation and particularly eco-innovation and related investments. The different institutional set-up in the countries as well as the diversity in policy choices highlights a lack of ambitious goals and uncertainty in the general transformation to an improved resource management.

The web of constraints is strongly shaped by different interactively linked regimes, not at least with regard to innovation pathways. Large challenges lie in a more coherent treatment and more specifically directed guidance at European level and a synchronous coordination of stakeholder and industrial interests at national level. The transposition of the EU roadmap in national law and activities is in its infancy to varying degrees. The effects on resource efficiency therefore differ and are apparently dependent on the choice of national instruments and priorities with regard to resource-intensive sectors. However, that does not necessarily mean that new framework conditions are needed for resource management. Rather, it is about a much more consistent and coordinated use of existing structures, institutions and potentials.

Referring to the less advanced countries in their respective fields of action (be it environmental taxes, consulting institutions, incentives for investment, etc.) this would mean the cross-fertilization of the EU countries and policy diffusion and a consistent utilization of good and proven practices for policy formulation at EU and national level.

3.3. Waste Policy – Country review and comparison

Focus: AT, DE, HU, NL, EE, FI, PL, ES, SE, UK

According to the Roadmap to a Resource Efficient Europe (EC 2011a), the EU should achieve a state where waste is managed as a resource by 2020. Waste prevention is at the top of the EU waste hierarchy, followed by reuse, recycling, other recovery (e.g. energy recovery) and disposal. This priority order aims at the reduction of environmental burdens as well as the conservation of natural resources.

Following this, in terms of barriers for resource efficiency in the waste sector, the central question can be specified as followed: What are hindering institutional and policy factors for a movement of waste treatment up the waste hierarchy?

All operation levels of the waste hierarchy can be influenced not only by direct and specific policies but also by indirectly influencing instruments and waste management system aspects. For instance, a policy promoting recycling e.g. through the setting of specific recycling targets can only be fully effective, if the waste management system is “ready” or “willing” to manage the potential waste flow for recycling (UNEP 2013). A lack of source separation in order to produce a high quality waste flow for the recycling or high capacities of waste incineration, which are dependent on a constant input flow, can considerably influence the effectiveness of the policy.

Against this background this section will conduct a barrier analysis of waste policy and institutional aspects dealing with waste as a resource, which allows considering the interplay of different policies and aspects. On the basis of comparative analyses of the waste management sectors in ten countries, a bunch of influencing factors – addressing the whole waste hierarchy in order to cover the interacting policies within the waste sector – shall be taken into consideration in order to single out the specific role of waste policy hindering resource efficiency.

The European waste management is especially affected by the main European institutional framework for waste policy: the Waste Framework Directive (WFD) (for several waste categories supplementing Directives exist) and the extended producer responsibility (EPR) as a central policy approach and a framework, in which producers bear a significant degree of responsibility for the environmental impacts of their products throughout the product life-cycle. In order to gain a comprehensive picture on effects of waste management policies, the investigation focuses on a waste stream, which is only covered by the WFD and is a non-EPR waste stream (namely bio-waste), on the one hand, but also on an EPR-waste stream for which a supplementary individual directive is in force (namely end-of-life vehicles), on the other hand. The rationale for this scope are the action fields described in the Roadmap to a Resource-Efficient Europe, addressing the inter-linkages between mobility and food as key sectors and waste as a resource. Municipal solid waste[38] (MSW) is also considered in the analysis, in addition to the specific waste streams, in order to take a waste stream into account, which consists of a multitude of different waste types. The MSW treatment up the waste hierarchy is, due to the complexity of the composition of the different waste types as well as their respective value, challenging.

The investigation approach results in two pillars: the policy and institutional factors (pillar 1) influencing the technical set-up (pillar 2). In the course of the country review, both pillars are analysed with regard to different dimensions and indicators. The following table depicts the chosen indicators, which have influence on a movement of waste treatment down or up the waste hierarchy and describes them in more detail. The direct indicators referenced to the related waste treatment operation throughout the waste hierarchy are highlighted through a cross.

[38] Municipal waste is mainly produced by households, although similar wastes from sources such as commerce, offices and public institutions are included (Definition of Eurostat)

Pillar	Dimension	Indicator	Waste hierarchy					Rationale
			Prevention	Reuse	Recycling	Recovery	Disposal	
Institutional set-up and incentives / programmes	Targets	MSW Recycling target			x			Indicates whether national interests have changed towards an ambitious pathway in terms of recycling.
		ELV target		x	x	x		
	Regulatory framework	Existence of a waste prevention programme (WPP) in accordance with Art. 29 WFD	x					Key tool to transpose waste prevention as the priority of the five step waste hierarchy into the national waste management system. The extent and type of integration (stand-alone programme vs. integration in WMP) depicts the country-specific handling of waste prevention.
		Number of waste management plans or concepts / Levels of target setting national/regional/local	x	x	x	x	x	One of the important tools to monitor the level of compliance with EU legislation, because it must e.g. contain an analysis of the current waste management situation. The levels of target setting depict the characteristic of national waste management systems and the actuality of the WMP the extent of the national attention to waste management.
		Specific law for biogenic waste	x	x	x	x	x	Depicts the regulative strength of the national bio-waste management.
	Agencies and competences	Existence of an agency for environmental issues including waste issues	x	x	x	x	x	Depicts the power and capacity of institutions for pushing waste issues forward.
	Policy instruments for waste management	Economic recovery programmes	x	x	x	x	x	Command and control instruments are usually substantiated by their environmental efficacy, as they are based on the coercion mechanism. In relation to technological change, it is argued that they induce first eco-innovation activities but continuity in investments is related to expected
		Waste charge systems	x	x	x	x	x	
		EPR on ELV	x					

		WPP instruments	x						strictness of future regulation. In this sense, anticipation and stringency in establishing a clear signal seem important factors influencing the efficiency of regulation in promoting R&D. In order to promote diffusion, a suitable time frame and a certain degree of flexibility seem also relevant factors. Market based instruments are preferred by economists because of its static and dynamic efficiency. In our review, there is evidence that they promote more incremental innovation and diffusion of existing technologies than new paths of technological development. This fact is attributed in some cases to the lack of tradition in the use of these instruments or to its weak stringency. In general, instruments based on incentives need to be complemented with strict controls to be more effective.
Technical set-up	Technical infrastructures	MSW incineration capacity				x	x	Depicts whether there is an established network of waste management installations. The comparative performance at the country level indicates hindering factors for resource efficiency around technical infrastructure systems.
		Access separate bio-waste collection		x	x			
		ELV treated per authorized treatment facility (ATF)		x	x	x		
	Outcomes	MSW Recycling rate			x			Depicts the national waste management performance.
		MSW landfilling rate					x	
		ELV rates		x	x	x		

The overview shows, that the indicators in the technical set-up as well as in the institutional pillar address nearly all waste management operations. Waste prevention is only focused in the second pillar, since the technical pillar is solely based on quantitative facts (how to measure something what is prevented?). Nevertheless, this report aims to integrate waste prevention adequately through including indicators addressing waste prevention policy.

Overall, this indicator-based approach allows, due to the consideration of the following aspects, a comprehensive country analysis in order to identify contributing policy and institutional factors in terms of hindering resource efficiency in the waste sector.

- **bio-waste**, **ELV**, **MSW** as waste streams (depicts the character of waste policy),
- the **technical set-up** as well as the **institutional and policy factors** as pillars (provides insights on problem areas as well as good practice and possible contributing policies in the waste sector) and

- the indicator-coverage of all treatment operations of the **waste hierarchy** (highlights the indirect influence of technical infrastructures or policies addressing one waste management operation (e.g. policies for diverting waste from landfill) on other management operations (may not result in the increase in recycling, if other policies promote the establishment of recovery operations such as waste incineration).

In the following sections the identified indicators are discussed for each pillar with regard to the EU interface and, in a second step, the results of the indicator analyses for each country are presented. Finally, these findings are discussed in a comparative assessment.

3.3.1. Institutional set-up and incentives / programmes

The institutional set-up and the existence of appropriate incentives and programmes is the basis to promote an environmental sound and resource efficient waste management. Against this background, the institutional set-up is discussed in terms of the EU interface and the country reviews in the following.

EU interface: legislation, targets, incentives

Targets

The reinforced waste hierarchy is one of the key elements in the Waste Framework Directive 2008. Waste prevention is at the top of the EU waste hierarchy, followed by preparing for reuse, recycling, other recovery (e.g. energy recovery) and disposal. Therefore waste treatment options with a high potential for resource efficiency and less environmental damage are clearly preferred. In order to achieve these objectives, inter alia, technical quantitative reuse and recycling ***targets*** are set moving up the waste hierarchy away from other recovery operations and disposal. The key EU waste legislation quantitative targets focus on municipal and similar waste, construction and demolition waste, batteries and accumulators, ELVs, packaging waste and WEEE.

With regard to ***municipal and similar waste***, in Article 11 of the WFD the Member States are obliged to achieve the following targets: “by 2020, the preparing for re-use and the recycling of waste materials such as at least paper, metal, plastic and glass from households and possibly from other origins as far as these waste streams are similar to waste from households, shall be increased to a minimum of overall 50 % by weight”. In addition, the Landfill Directive (1999/31EC) set targets for progressively reducing the amount of biodegradable municipal waste landfilled in the period to 2016, which marks also a shift from landfill towards the EU waste hierarchy. Facing the growing awareness of landfill's environmental impact, notably emissions of methane and other gases, and pollution of groundwater, surface water and soil, the Member States must reduce the amount of biodegradable municipal waste going to landfill

- to 75 % of the total amount of biodegradable municipal waste generated in 1995 by 2006;
- to 50 % of 1995 levels by 2009;
- to 35 % of 1995 levels by 2016.

For “Member States which in 1995 or the latest year before 1995 for which standardised EUROSTAT data is available put more than 80 % of their collected municipal waste to landfill may postpone the attainment of the targets set out […] by a period not exceeding four years” (Article 5, Landfill Directive).

Addressing the environmental harmful disposal of ***end of live vehicles***, the ELV Directive obliges EU Member States to ensure that “no later than 1 January 2015, for all end-of life vehicles, the reuse and recovery shall be increased to a minimum of 95 % by an average weight per vehicle and year. Within the same time limit, the re-use and recycling shall be increased to a minimum of 85 % by an average weight per vehicle and year” (Article 7, ELV directive). Except for vehicles, which are produced before 1 January 1980, the Member States can lay down lower targets (not lower than 75 % for reuse and recovery and not lower than 70 % for reuse and recycling).

Regulatory framework

Article 4 of the Waste Framework Directive 2008/98/EC (WFD)[39] states that waste prevention measures should be considered a top priority when developing waste policy and legislation in the EU and its Member States. The policy approach of waste prevention targets at-source waste production; it aims to reduce the amount and toxicity of waste before recycling, composting, energy recovery and landfilling become options..

Waste prevention also includes measures to reduce the adverse impacts of the generated waste on the environment and human health.

Facing ever-increasing amounts of waste, the European Commission has seen the need for more comprehensive policy approaches to make waste prevention a top priority. Thus, among the ***measures incorporated in the WFD to promote waste prevention efforts*** is the adoption and implementation of waste prevention programmes for all Member States (COM(2011)13 final). Article 29 of the WFD obligates all Member States to establish their waste prevention programmes by 12 December 2013. The WFD specifically stipulates that - within their national waste prevention programmes - Member States shall describe concrete measures that support the qualitative or quantitative prevention of waste. However, the Member States are able to implement article 29 in different ways.

In order to monitor the overall waste performance of the Member States the ***Waste Management Plan*** is an important tool. In Europe the Waste Framework Directive (WFD) obligates all Member States to develop waste management plans, which include “an analysis of the current waste management situation in the geographical entity concerned, as well as the measures to be taken to improve environmentally sound preparing for re-use, recycling, recovery and disposal of waste and an evaluation of how the plan will support the implementation of the objectives and provisions of this Directive” (Article 28, WFD).

The Member States can establish one or more waste management plans, as long as the entire geographical territory of the Member State is addressed.

The management of ***bio-waste*** is solely covered by the WFD. In Article 22 of the Directive the Member States are prompted to encourage the separate collection, the environmental friendly treatment of bio-waste and the use of environmentally save materials produced from bio-waste.

Agencies and competences

Beside the establishment of an infrastructure network manifested and developed in waste management plans, Member States have to establish, according to the WFD, ***competent authorities*** for pushing obligatory waste issues forward. In this connection the European framework leaves Member States free to decide on the structural organisation and levels of responsibilities.

Policy instruments for waste management

Against the background of the polluter-pays principle, which indicates that “the costs of waste management shall be borne by the original waste producer or by the current or previous waste holders” (Article 14, WFD), a bunch of policy approaches exist to implement the principle. One of the central concepts, is the ***extended producer responsibility (EPR)***, which places partial or total responsibility on producers to manage their product the entire life cycle, including the take-back and the subsequent treatment. The EU legislation requires the implementation of the EPR scheme for packaging, WEEE, ELV and Batteries. Furthermore Member States consider differentiated ***waste fee systems and***

[39] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives.

programmes, which implement the polluter-pays principle, enforce the overall objective to reduce waste generation and aims to comply with the legislative EU framework. The pay-as-you-throw-system (PAYT), landfill fees, taxes or bans and incineration taxes are examples, which have aroused growing interest. However, these instruments are implemented by the Member States in very different forms.

3.3.2. Empirical results of the country review

MSW recycling targets

In order to analyse the transposition of the EU targets in national law, the country's MSW recycling targets are analysed, based on country factsheets addressing the national waste management developed by the European Topic Centre for Sustainable Consumption and Production (ETC/SCP 2011, ETC/SCP 2006). In principle, all Member States comply the EU 50%-recycling-target setting by 2020. Nevertheless, some of the considered countries on POLFREE work package 1.3 implemented more ambitious targets.

Against this background, the results of country reviews show that Austria implemented the EU target exactly as it is formulated in the WFD and Hungary as well as Finland implemented the 50 % target, but it has to be reached already before 2020. Germany, the Netherlands, and the UK even set more ambitious targets above 50 %. For Estonia, Spain and Sweden only targets for specific waste streams can be found, which contribute to achieving the MSW recycling target. Therefore, it is assumed that the overall MSW recycling target of these countries corresponded to the EU target and is not above.

Table 16: MSW recycling target

	MSW recycling target
Austria	50 % by 2020
Germany	65 % by 2020
Hungary	50 % by 2012
Netherlands	60 % by 2015
Estonia	No overall MSW recycling target
Finland	50 % by 2016
Poland	No overall MSW recycling target
Spain	No overall MSW recycling target
Sweden	No overall MSW recycling target
UK	55 % by 2020

ELV recycling target

Based on a report on the implementation of the ELV Directive by the European Commission, the transposition of the reuse, recycling and recovery targets for ELV are investigated (Schneider et al. 2010).

The country analysis in respect to this indicator shows that all of the considered countries implemented the EU targets as it is formulated in the ELV Directive. The Netherlands first set a rather ambitious recovery target for 2007, but postponed it to 2015. In Hungary, Poland and the UK , lower targets are allowed for those vehicles produced before 1 January 1980, but not lower than 75 % for reuse and recovery and not lower than 70% for reuse and recycling.

Table 17: End-of-life vehicles targets by countries

	ELV	
	Reuse and recovery target	**Reuse and recycling target**
Austria	95 % by 2015	85 % by 2015
Germany	95 % by 2015	85 % by 2015
Hungary	95 % by 2015 (use of exemption: 75 % vehicles produced before 01.01.1980)	85 % by 2015 (use of exemption: 70 % vehicles produced before 01.01.1980)
Netherlands	95 % by 2015 (first until 2007, but postponed)	85 % by 2015 (first until 2007, but postponed)
Estonia	95 % by 2015	85 % by 2015
Finland	95 % by 2015	85 % by 2015
Poland	95 % by 2015 (use of exemption: 75 % vehicles produced before 01.01.1980)	85 % by 2015 (use of exemption: 70 % vehicles produced before 01.01.1980)
Spain	95 % by 2015	85 % by 2015
Sweden	95 % by 2015	85 % by 2015
UK	95 % by 2015 (use of exemption: 75 % vehicles produced before 01.01.1980)	85 % by 2015 (use of exemption: 70 % vehicles produced before 01.01.1980)

Waste Prevention Program (WPP)

For the purpose of analysing the compliance of the Member States requirements to develop national Waste Prevention Programmes, the following analysis is based on a review of the different national programmes by the European Topic Centre for Sustainable Consumption and Production (EEA 2014). The extent of the various programmes varies widely, from very few pages (4-6 pages) to more comprehensive plans (75-80 pages). Although the extent of the programmes is sometimes rather small, the country analyses show that all countries considered establishing a Waste Prevention Programme in accordance to Article 29 of the WFD. While more than the half of the considered countries has established a stand alone programme, Austria, Hungary, Finland and Poland include the WPP into the waste management plans. Estonia has no programme in place, but a programme is planned to be adopted by February 2014 (review was conducted until the 31 December 2013).

Table 18: Existence of Waste Prevention Programmes in selected countries

	Existence of Waste Prevention Programmes
Austria	WPP incorporated in WMP
Germany	Stand alone WPP
Hungary	WPP incorporated in WMP
Netherlands	Stand alone WPP
Estonia	No programme in place, but programme planned to be adopted by end February 2014
Finland	WPP incorporated in WMP
Poland	WPP incorporated in WMP
Spain	Stand alone WPP
Sweden	Stand alone WPP
UK	Stand alone WPP

Waste management plans (WMP)

In order to analyse the level choice of Waste Management Plans, the following analysis is based on country factsheets addressing the national waste management developed by the European Topic Centre for Sustainable Consumption and Production (ETC/SCP 2011, ETC/SCP 2006) and an EEA report reviewing the MSW managing in Europe (EEA 2013). In the course of the analysis it becomes clear that, due to poor data, the actuality of the WMP cannot be accessed in a comprehensive way.

Although all the considered countries implemented Waste Management Plans, the results show, , significant differences in levels of implementation. In addition, as stated in a report by IEEP et al. (2010) the quality and effectiveness of countries WMPs differs significantly from country to country.

Table 19: Existence of Waste management plans (WMP) in selected countries

	Existence of Waste management plans (WMP)
Austria	National, provincial/regional (federal state) and local (public waste management authority) Waste Management Plan
Germany	Provincial/regional Waste Management Plan for every Federal State and local (public waste management authority) waste management concepts
Hungary	National, provincial/regional (Regional Inspectorates) and local (public waste management authority) Waste Management Plan
Netherlands	National Waste Management Plan for the national authorities, provinces and municipalities concerning waste management in the Netherlands
Estonia	National Waste Management Plan and local (public waste management authority) Waste Management Plan (On 2007 Waste Act changed the system from three (+ provincial) to two tiered system of waste plans)
Finland	National Waste Management Plan and provincial/regional (by 13 regional environment centres) Waste Management Plan
Poland	National, provincial/regional and local (public waste management authority) Waste Management Plan
Spain	National Waste Management Plan and provincial/regional Waste Management Plan
Sweden	National Waste Management Plan and local (public waste management authority) Waste Management Plans (The municipalities' plans are coordinated by the county administrative board which then analyses the waste treatment capacity and ensures the sufficient treatment capacity within the region)
UK	National, provincial/regional and local (public waste management authority) Waste Management Plan

Specific law for bio-waste

The results of the country analyses in terms of the existence of a specific law for bio-waste is based on country factsheets addressing the national waste management developed by the European Topic Centre for Sustainable Consumption and Production (ETC/SCP 2011, ETC/SCP 2006).
Even though the European waste legislation does not implement a specific Directive for managing bio-waste, the research gives some interesting insights on the different kinds of national regulation of bio-waste. While some countries have implemented a specific ordinance on bio-waste, other countries have implemented specific strategy documents or covered the management of bio-waste in the WMP.
The following table shows the results.

Table 20: Existence of specific laws for bio-waste

	Existence of specific laws for bio-waste
Austria	Ordinance on bio-waste
Germany	Ordinance on bio-waste
Hungary	Strategy for the Management of Biodegradable Waste in Municipal Solid Waste Management 2004-2016

Netherlands	Covered in the National waste management plan and the Environmental Management Act
Estonia	Covered in the waste management plan
Finland	National bio-waste strategy 2006-2016
Poland	Covered in the waste management plan
Spain	Covered in the waste management plan
Sweden	Covered in the waste management plan
UK	Covered in the waste management plan

Agency for environmental issues including waste issues

The following analysis of agencies for environmental issues including waste issues is based on national webpages of the agencies itself (see footnotes) and the latest country-specific OECD Environmental Performance Reviews (OECD n.d.). Even though the identified list of stakeholders is not intended to be exhaustive and data gaps exist, the analysis nevertheless underlines the very different institutional settings for pushing waste issues forward (see the following table).

Table 21: Existence of agency for environmental issues including waste issues

	Existence of agency for environmental issues including waste issues
Austria	Environment Agency Austria[40], Conference of Regional Environment Ministers, Committee for a sustainable Austria, Conference of National and Regional Environment Ministers
Germany	Environmental protection agency[41] (UBA), German Advisory Council on the Environment[42] (SRU), Working Group on Waste (Bund-/Länder Arbeitsgemeinschaft Abfall[43] (LAGA))
Hungary	National Waste Management Agency[44], National Environmental Council
Netherlands	National Institute of Public Health and Environmental Protection, Central Economic Planning Agency, Central Council on Environment Protection; Environmental Impact Assessment Commission
Estonia	Estonian Waste Management Association
Finland	Finnish Environmental Institute, Pirkanmaa Centre for Economic Development
Poland	-
Spain	-
Sweden	Swedish Environmental Protection Agency, Environmental Advisory Council
UK	UK Environment Agency

Economic recovery programme

In order to analyse the implementation of waste related recovery programmes, the following analysis is based on a study assessing the implementation and impact of green elements of member states' national recovery plans (Pollitt et al. 2011). The following table shows the data. The results indicate that Austria, Germany, the Netherlands and Spain implemented a subsidy for scrapping old cars. Hungary implemented the recultivation of regional municipal solid waste disposal sites as part of its stimulus package, while Spain – besides the car scrappage scheme – funds infrastructure systems inter alia for improving the waste management system.

40 http://www.umweltbundesamt.at/
41 http://www.umweltbundesamt.de/
42 http://www.umweltrat.de/DE/DerSachverstaendigenratFuerUmweltfragen/dersachverstaendigenratfuerumweltfragen_node.html
43 http://www.laga-online.de/servlet/is/23348/
44 http://www.szelektivinfo.hu/en/

Table 22: Implementation of economic recovery programme since 2008

	Implementation of economic recovery programme
Austria	Car scrappage scheme
Germany	Car scrappage scheme
Hungary	Recultivation of regional municipal solid waste disposal sites
Netherlands	Car scrappage scheme
Estonia	no stimulus package related to waste
Finland	no stimulus package related to waste
Poland	-
Spain	car scrappage scheme; fund specifically to finance infrastructures aimed at improving energy efficiency, water management, eco-innovation, treatment and waste management, sustainable mobility, renewable energy the rehabilitation of housing, energy and climate change plus several other projects
Sweden	no stimulus package related to waste
UK	car scrappage scheme

Waste Charge Systems

The following analysis of the use of waste charge systems to promote improved waste management is based on a study in terms of economic instruments and waste management (BIO IS 2012). It is focused on landfill and incineration taxes, fees or bans as well as on Pay-as-you-throw (PAYT) schemes. In the table below the use of economic instruments per country is stated. The results depict that the use of waste related economic instruments show significant differences from country to country.
Germany is the only country, which implemented a landfill ban. The Netherlands indeed implemented an incineration tax but the tax is currently not charged. In the UK, the landfill tax was supported by the set up of the Landfill Allowances Trading Scheme (LATS), a certificate trading system whereby local authorities are given annual tradable (based on market prices) allowances for landfilling of biodegradable municipal waste. For some countries the existence of several instruments is unknown.

Table 23: Use of waste charge systems

	Use of waste charge systems
Austria	PAYT, landfill tax, incineration tax
Germany	PAYT, landfill ban
Hungary	PAYT, existence of incineration tax unknown
Netherlands	PAYT, landfill tax, incineration tax (currently no charge)
Estonia	PAYT, landfill tax
Finland	PAYT, landfill tax
Poland	landfill tax, existence of PAYT and incineration tax unknown
Spain	PAYT, landfill tax (Catalonia, Madrid & Murcia), incineration tax (Catalonia & Madrid), Spanish Waste Act allows waste authorities in different regions of Spain to apply economic incentives
Sweden	PAYT, landfill tax
UK	PAYT, landfill tax, LATS

EPR on ELV

In order to analyse the existence of producer responsibility schemes in terms of ELVs, the analysis is also based on the BIO IS study (BIO IS 2012). The study states considerable variations in the design and performance of (extended) producer responsibility (EPR) schemes. Nevertheless, all considered countries with the exemption of Hungary implement EPR on ELV. The box highlights, by referring to the packaging directive as a case study, the differences in the implementation of the extended producer responsibility schemes.

Table 24: Use of EPR on ELV

	Use of EPR on ELV
Austria	EPR on ELV
Germany	EPR on ELV
Hungary	Existence of EPR on ELV unknown
Netherlands	EPR on ELV
Estonia	EPR on ELV
Finland	EPR on ELV
Poland	EPR on ELV
Spain	EPR on ELV
Sweden	EPR on ELV
UK	EPR on ELV

Box 2: The Packaging Directive as a case study highlighting the differences in the implementation of extended producer responsibility schemes

Packaging has been one of the first waste streams addressed by the European Commission: Already in the early 1980s directive 85/339/EEC covered the packaging of liquid beverage containers intended for human consumption only but it was too vague to bring about the effective harmonisation of national policies. As a consequence, diverging national legislation appeared in several Member States – with serious market interruptions when cheap secondary materials from countries with recycling schemes that provided funding for collection and recycling appeared on the markets of other Member States where no such schemes were in place. Against this background, in 1992 the European Commission came forward with a much more concrete and comprehensive Proposal for a Council Directive on Packaging and Packaging Waste (Directive 94/62/EC). Nevertheless, the Packaging Directive can be seen as a case study highlighting the differences in the implementation of extended producer responsibility schemes: Except for Denmark, the industry in all Member States has build up organisations to comply with the obligations imposed by national packaging regulations on behalf of the individual businesses affected. In eight Member States a "green dot" system has been established. The following table shows the responsible actors for the considered countries. The data is based on country factsheets of the umbrella organisation for European packaging and packaging waste recovery and recycling schemes (PRO EUROPE n.d.).

	Responsible actors
Austria	Stock Corporation, founded in 1993 as non-profit organisation
Germany	Close Corporation
Hungary	Company
Netherlands	non-profit organization
Estonia	non-profit organization
Finland	not for profit company
Poland	not for profit company
Spain	Stock Corporation
Sweden	Stock Corporation
UK	Company

Separate collection of packing waste is carried out in all Member States, but to a very different extent. Especially for municipal packaging waste the systems established vary widely, the main differences being the extension of the system and the materials focussed upon. Differences in the extent of implementation of the concept of producer responsibility arise mainly with regard to the financial responsibility for packaging used by households. It ranges from covering the costs for recovery of glass and paper-cardboard only, to systems where industry is bearing the complete costs of collection, sorting, and recycling/ recovery for municipal packaging waste. The coverage of costs between private actors (compliance scheme) and public sector (municipalities) is mainly a result of the balance of power between these actors. Generally, three different types of systems can be broadly distinguished regarding the financing of municipal packaging waste management activities:

- Industry is fully responsible for covering all costs; municipalities can be involved in separate collection on behalf of the industry (Austria, Germany, Sweden)
- Industry and municipalities share responsibility, the industry covers costs of sorting and recycling; municipalities are in charge of separate collection and their costs are (completely or partially) reimbursed (Belgium, Denmark, Finland, France, Ireland, Italy, Luxembourg, Portugal, Spain)
- Industry and municipalities share responsibilities, the industry covers the costs of recycling; municipalities are in charge of separate collection and receive revenues through selling the collected materials (United Kingdom, the Netherlands**).**

Instrument choice for waste prevention

In order to analyse differences in the choice of policy instruments for waste prevention, the following analysis is based on abstracts of the different national programmes developed by the European Topic Centre for Sustainable Consumption and Production (ETC/SCP 2014). The analysis has also focused on future or planned measures (many programmes also describe measures that successfully supported waste prevention in the past). All in all, more than 300 waste prevention measures in accordance with Annex IV WFD have been recorded in the abstracts of the waste prevention programmes. The following box gives some concrete examples.

Box 3: Examples for waste prevention measures in the waste prevention programmes

1. The use of planning measures, or other economic instruments promoting the efficient use of resources.

Material building passes (Austria) - The Austrian waste prevention programme contains a bundle of measures related to a „material building pass“ as planning instrument to support to improve repair-ability, reuse and high quality recycling in the construction sector. Obligatory standards for these building passes will be developed and these information will be incorporated into the central building register run by the statistical agency of Austria: In future all characteristics of buildings regarding the material consistency and especially potentially hazardous substances will be recorded. First pilot projects have shown a significant increase of buildings life span by these information systems (p. 230).

2. The use of awareness campaigns or the provision of financial, decision-making or other support to businesses.

Tax incentives for green investments (Netherlands) - In the Netherlands the Random Depreciation of Environmental Investments (VAMIL) and the Environmental Investment Allowance (MIA) represent two ways for companies purchasing new environmental technologies to reduce their overall cost. VAMIL facilitates the affordability of a purchase of an environmental technology by allowing the purchaser to determine the rate of depreciation. The use of the MIA incentive is as a pure tax deduction tool, allowing a partial write-off of an investment in environmental technology against tax. The “Environmental Technologies List” is the key-supporting document for these measures and includes a series of waste prevention aspects.

The measures found in the existing waste prevention programmes show a great variety of policy instruments. With regard to the different policy approaches, four generic categories have been identified: regulatory instruments, economic instruments, informative instruments and voluntary agreements (VAs). Economic instruments in terms of this review comprise e.g. tax incentives, green public procurement and direct subventions. Typical regulatory instruments are the setting of binding standards and norms while voluntary labels together with awareness raising campaigns and pilot projects have been classified as informative instruments. Voluntary agreements seem to be a preferred instrument in some countries, mainly initiated by business associations but with clear and measurable targets.

Due to the sometimes rather short descriptions of the measures in the programmes, these categorisations are not always completely clear. However, the analysis allows providing some interesting insights how waste prevention is approached. The figure below shows that the nature of a vast majority of the instruments is informative/promotional, through the provision of information, education, awareness raising and the like. Regulative and economic instruments account for about 20% each and in sixteen cases the use of voluntary agreements has been reported (please note that in some countries also more than one example for these voluntary agreements exists, so the absolute figure of VAs might also be higher).

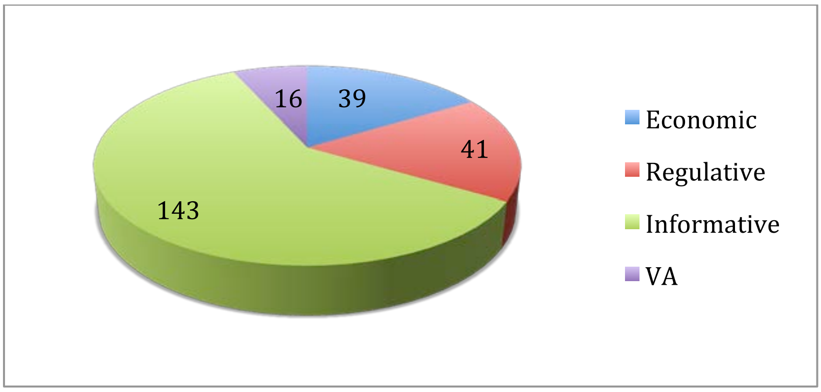


Figure 16: Allocation of instruments

Nevertheless, these shares of policy instruments vary significantly between the different countries analysed in this work package. Some countries have a clear focus on informational instruments; while others have chosen a mix of information, administrative and economic instruments, sometimes in combination with voluntary agreements. The following table shows the share of regulative and economic instruments per country in contrast to informative or voluntary agreements. Data have been collected for all countries with the exception of Estonia having missed the deadline set by the WFD. The results differ from 10% in Sweden up to 53% in Finland.

Table 25: Instrument choice for waste prevention

	regulative and economic	informative and voluntary agreements
Austria	45%	55%
Germany	45%	55%
Hungary	40%	60%
Netherlands	21%	79%
Estonia	No programme in place	
Finland	53%	47%
Poland	29%	71%
Spain	21%	79%
Sweden	10%	90%

UK	31%	69%

3.3.3. Technical set-up

Feeding waste back into the economy as a resource, reuse and recycling requires a high priority. A strong technical set-up of waste management is the basis for the practical application of the waste hierarchy. Technical outcomes as well as the technical infrastructure systems are therewith essential in order to realise an appropriate treatment of waste resources to increase resource efficiency and deliver a "European recycling society".

The pillar technical set-up is sub classified in two dimensions, which is followed by a detailed consideration of 6 indicators. This structure is discussed in the following in terms of the EU interface and the country reviews.

EU interface: legislation, targets, incentives

Technical infrastructure

The goal of the EU to become a more 'circular economy' especially sets new requirements for the planning of ***technical infrastructure*** systems. Based on the principle of proximity[45], Art. 16 of the Waste Framework Directive (WFD) requires the establishment of an integrated and appropriate network of waste treatment facilities: "The network shall enable waste to be disposed of or waste referred to in paragraph 1 to be recovered in one of the nearest appropriate installations, by means of the most appropriate methods and technologies, in order to ensure a high level of protection for the environment and public health" (WFD Art. 16.1.3). However, the revised directive opens the door to a European waste market since it states that this network "shall be designed to enable the Community as a whole to become self-sufficient in waste disposal as well as in the recovery of waste" (Art. 16), and to "enable Member States to move towards that aim individually, taking into account geographical circumstances or the need for specialized installations for certain types of waste".

Since the lack of a proper treatment infrastructure and sufficient capacity for the municipal waste generated are crucial barriers for an environmentally sound waste management, the WFD obligates all Member States to develop waste management plans that proves these capacities to be in place and covered by the waste management planning. In the course of diverting waste from landfills and shifting the focus of waste treatment up the waste hierarchy, the waste treatment path includes, in general waste, treatment operations such as material recycling, biological treatment, mechanical-biological treatment and incineration.

Incineration facilities are classified as energy recovery processes ("other recovery"), if they achieve a specified level of efficiency; otherwise they rank among disposal operations. In the Waste Framework Directive 2008/98/EC the incineration of municipal solid waste is classified as waste management operation with (R1) or without (D10) energy recovery according to the energy efficiency criteria.

Setting up schemes for separate collection of biodegradable municipal waste plays a major role for the favouring high-level treatment operations compared to disposal. Source separation is a requirement to ensure quality materials for recycling. Against this background in article 22 of the WFD the Member States are, inter alia, prompted "to take measures, as appropriate, and […] to encourage: […] the ***separate collection of bio-waste*** with a view to the composting and digestion of bio-waste".

In order to encourage the ultimate car owners to deliver their cars for disposal, Member States are obligated to ensure that systems for the collection, treatment and recovery are set up for ***end-of-life***

[45] This principle of proximity can be attributed to the primary law principle of origin (Article 174, paragraph 2 EC). The principle of origin indicates that pollution should be addressed at the source and therefore as close as possible to their point of origin. In this way, the dissemination of environmental damage should be counteracted (Wilts, 2013).

vehicles. Article 5 of the ELV directive requires that "Member States shall take the necessary measures to ensure […] the adequate availability of ***collection facilities*** within their territory".

Outcomes

In order to assess the Member State's or the EU's performance towards delivering a recycling society, the reporting of data under European Union legislation on waste is a key point for monitoring the implementation of policies. In the Waste framework directive, the Landfill Directive as well as in the ELV directive Member States shall send a report on the implementation of the Directives to the Commission at intervals of three years . The reports shall be drawn up on the basis of a questionnaire or outline established by the Commission. With the aid of the Directive on waste statistics (91/692/EEC) a framework for the production of waste management statistics is provided, which allow for a production of comparable data in order to monitor the implementation of legislation.

In the Environmental Data Centre on Waste of EUROSTAT the Member States data, which is collected from the national statistical offices, is compiled and shows the key ***outcomes*** in order to support the assessment of policy effectiveness.

3.3.4. Empirical results of the country review

In this section the empirical results of the country review are presented.

MSW incineration capacity

The results of the country analysis in terms of MSW incineration capacities are based on a recently finished ETC task of the implementation plan 2013 on the availability of waste treatment capacities in Europe for municipal waste (Wilts and von Gries 2014). The analysis is focused on waste incineration plants, which are technically and legally suitable to treat mixed municipal solid waste[46] without any pre-treatments. Accordingly, this indicator covers only Waste-to-Energy Plants (recovery) as well as municipal solid waste treatment in incinerators without the energy-efficiency-standard R1 (disposal), but excludes co-incineration plants as well as RDF plants.

Even though the partly fragmented public availability and uncertainty of data[47], the research gives some interesting insights on the nationwide picture of incineration plants and their capacities. In total, 448 incineration plants have been identified with a total incineration capacity of 76,875,128 tonnes in 2010. Nevertheless these shares of capacities vary significantly between the different countries analysed in this work package. While some countries have a clear focus on waste incineration, other countries have only a fraction of incineration capacities or none at all since they are focusing obviously on other waste management operations.

The following table shows the MSW incineration capacities per country. The data is normalised with the country-specific waste generation, in order to compare the countries with each other. The results show that Estonia has no MSW incineration capacity in 2010 and Hungary, Finland, Poland, Spain as well as the UK have an incineration capacity of less than a quarter of their generated MSW. The MSW capacity of Germany, Austria and the Netherlands range plus/minus 12 % around the half of their generated MSW, while Sweden has a capacity of more than their whole generated MSW amount.

[46] Household waste and similar commercial, industrial and institutional waste according to the European Waste Catalogue

[47] The data neither give a complete overview of how much non-MSW is incinerated in plants originally dedicated to MSW, nor is it possible to define how much MSW is incinerated as refused-derived fuel (RDF) or in co-incineration plants, making it extremely difficult to finally assess the appropriateness of existing capacities.

Table 26: MSW incineration capacity in relation to MSW generation in %

	MSW incineration capacity in relation to MSW generation in %
Austria	52
Germany	38
Hungary	10
Netherlands	62
Estonia	0
Finland	12
Poland	0.3
Spain	11
Sweden	113
UK	18

Separate collection of bio-waste

The following analysis of the separate collection of bio-waste is based on country fact sheets provided by the European Compost Network[48] (ECN n.d.) and an EEA Report (EEA 2009). Even though sometimes rather fragmented description of the countries practice in collection as well as in the biological treatment (composting, anaerobic digestion and other biological treatment processes), the analysis nevertheless shows that the separate collection of bio-waste varies considerably in the separately collected amounts.

The following table shows the access of the separate bio-waste collection per country. The data for Hungary was found in an EEA report, since no numbers were found on the ECN platform. The results show that Austria is the only country in which a nationwide separate bio-waste collection is adapted.

Table 27: Access to separate collection of bio-waste in % of capita

	Access to separate collection of bio-waste in % of capita
Austria	100 % of capita
Germany	55 % of capita
Hungary	20 kg per capita and year
Netherlands	90 % of households
Estonia	5 kg per capita and year
Finland	24 % of municipalities
Poland	--
Spain	has not been widely implemented
Sweden	50 % of municipalities
UK	--

Authorised ELV facilities

In order to analyse the density of the disposal network, the following analysis is based on a study, which discusses aspects of ELV management such as arisings, legal and illegal shipment, de-pollution and recycling & recovery of end-of-life vehicles (Schneider et al. 2010). The study, inter alia, investigates the ELV treatment sector and found considerable differences in the existence of authorized ELV treatment facilities, which meet the minimum technical requirements (according to the ELV Directive) for the treatment of ELVs. The average numbers of treated ELV in the authorized ELV treatment facilities is around 1,800, when the number of treated ELV per country is related to the respective treatment

48 Leading European membership organisation promoting sustainable recycling practices in composting, anaerobic digestion and other biological treatment processes of organic resources.

facilities.

Nevertheless, the data of the average number of treated ELV per facility varies significantly from country to country, which is underlined by the country-specific numbers in the following table. The results range from 119 up to 2,883 ELV treated per facility; 50 % of the countries treat less than 641 ELVs per facility.

Table 28: Number treated ELV per ATF (2005)

	Number treated ELV per ATF (2005)
Austria	620
Germany	1,019
Hungary	-
Netherlands	544
Estonia	214
Finland	1,483
Poland	119
Spain	1,852
Sweden	641
UK	2,883

MSW Recycling rate

The development of the MSW management in Europe is analysed with the aid of the MSW recycling rates. As a source of data, a compilation of a review managing MSW in Europe is used (EEA 2013). The data shows a shift of waste management up the waste hierarchy and depicts the clear increase of recycling. The recycling grew in the period 2001-2010 by 29 million tonnes.

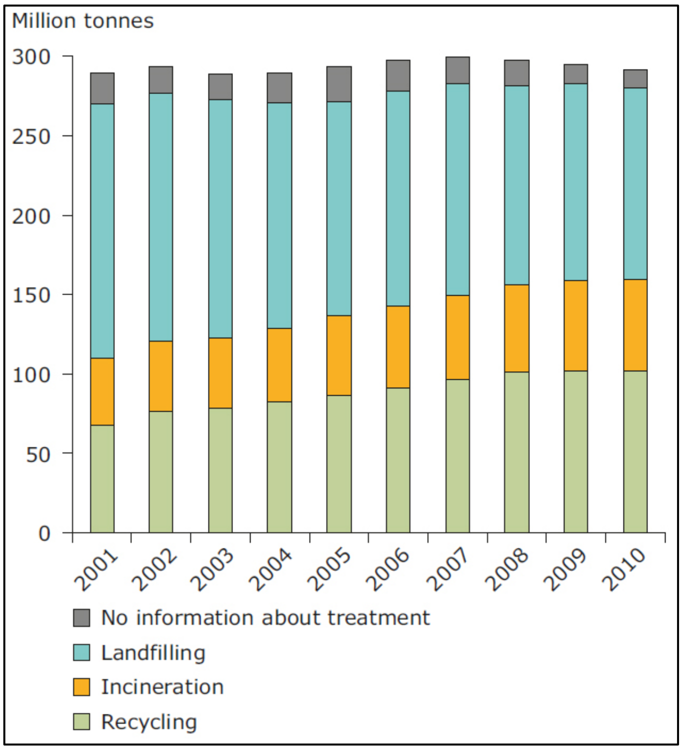


Figure 17: Development of MSW recycling rates in Europe; Source EEA 2013

Nevertheless, the recycling performance shows enormous differences between those countries with low and high recycling levels respectively. The following table presents a comparison of the share of MSW recycled in 2010. The results differ from a MSW recycling rate of 20 % in Estonia up to 63 % in Austria.

Table 29: MSW Recycling Rates in 2010

	MSW Recycling Rate (2010)
Austria	63 %
Germany	62 %
Hungary	21 %
Netherlands	51 %
Estonia	20 %
Finland	35 %
Poland	21 %
Spain	33 %
Sweden	49 %
UK	39 %

Landfilling rate of biodegradable MSW

In order to achieve a transparent picture of the waste management in Europe in addition to the recycling performance, the landfilling rate is analysed based on the above-mentioned EEA report (EEA 2013). Although the development of the European MSW waste management shows a decreasing landfilling by almost 40 million tonnes in the period 2001-2010 (figure above), half of the considered countries in this report is still landfilling more than 46 % of their MSW generated, as shown in the following table.

Table 30: Landfilling rate of biodegradable MSW in 2010 (if no remark) of generated amount in 1995

	Landfilling rate of biodegradable MSW in 2010 (if no remark) of generated amount in 1995
Austria	0 %
Germany	0 %
Hungary	46 %*
Netherlands	5 %
Estonia	49 %*
Finland	37 %
Poland	84 %
Spain	47 %*
Sweden	2 %*
UK	49 %

Note: *2009

ELV reuse, recycling and recovery rates

Based on the EUROSTAT database, the differences in reuse, recycling and recovery rates of ELV are investigated (EUROSTAT 2010). The EU-27 average shows a reuse and recovery rate of 87.2 % and a reuse and recycling rate of 83.3 %. The country analysis in respect to this indicator show a rather small deviation from the average: the differences between the lowest reuse/recycling/recovery level and the European average is less than 10 %, the differences between the highest reuse/recycling/recovery level and the European average is less than 20 %.

Table 31: ELV in 2010

	ELV in 2010	
	Reuse and recovery rate	**Reuse and recycling rate**
Austria	96.5 %	84.2 %
Germany	106.2 %	95.5 %
Hungary	86.8 %	82.1 %
Netherlands	95.3 %	83.3 %
Estonia	78.4 %	77.3 %
Finland	95.0 %	82.5 %
Poland	98.8 %	88.8 %
Spain	85.7 %	82.8 %
Sweden	91.1 %	84.4 %
UK	85.6 %	83.0 %

3.3.5. Barriers for resource efficiency

The country analyses show that all countries have largely implemented the EU law in national legislation. All the considered countries established waste management plans and waste prevention programmes (except Estonia, but planned), the targets set are transposed in the national regulatory framework. Nevertheless, the recycling level of these countries differs enormously and waste prevention as well as reuse plays a minor role in all countries to date.

As the examples of Austria and Spain show, regulatory instruments are required, if the waste management is related to costs. For instance, Austria, which has a strong setting with regard to economic and regulatory instruments, has the highest MSW recycling rate in comparison to the remaining countries, achieved the EU targets in the context of the ELV recycling and does not landfill any biodegradable MSW. In contrast, Spain has also a very strong use of economic instruments, but further regulatory instruments are missing, for instance in order to set higher targets for MSW recycling or to establish a separate bio-waste collection. The MSW recycling results of Spain are with 33 % far behind the EU target and the disposal target is barely achieved. The comparison depicts that the economic instruments are obviously ineffective, if regulations for technical infrastructures are missing. A lack of proper treatment infrastructure and sufficient capacity for the municipal waste generated is a crucial barrier for environmentally sound waste management as shown in the example of Poland, which still landfills 84 % of biodegradable MSW.

However, the example of Sweden highlights that even a well-established infrastructure bears risks: In Sweden the total amount of annually generated waste would not be enough to fill all incineration capacities. These capacities might be used to incinerate waste from non-municipal sources and by using imports. However, capacities far exceeding the amount of generated municipal waste indicate a potential competition between filling incineration capacities and achieving the 50% recycling target of the 2008 Waste Framework Directive, as well as the objectives of the EU's 7th Environmental Action Programme to further move towards a circular economy, to limit energy recovery to non-recyclable material and to reduce the generation of waste.

In terms of a comparison of the MSW recycling rates - which range from 20% to 63% and where only 3 of 10 countries show above the EU target numbers - as well as the ELV rates – which is for 90% of the countries above the EU target - the relevance of technical advices is obvious. While Article 11 of the WFD, for instance, states that the member states "shall set up separate collections of waste where technically, environmentally and economically practicable and appropriate to meet the necessary quality standards for the relevant recycling sectors", the ELV Directive sets in Annex I minimum technical requirements for the storage and treatment of ELVs. Obviously, a more specific definition of technical framework conditions contributes to achieve recycling targets.

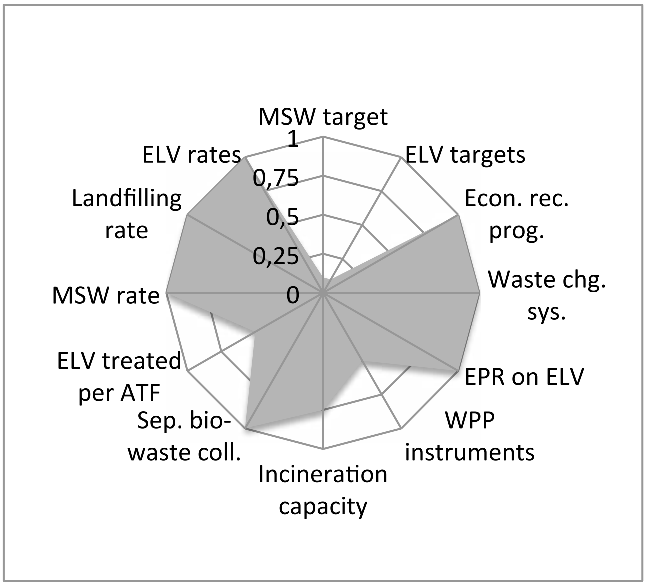
With regard to waste prevention the results show that all countries developed Waste Prevention Programmes, but the measures found in the existing waste prevention programmes show a great variety of policy instruments. Since the absence of country specific indicators of their waste prevention performance, these results do not allow to draw conclusions on the effectiveness. Nevertheless, the results of the different choices of policy instruments highlight fundamental differences in the perception of why and how policy should tackle the generation of waste.

Some countries do not see the environmental necessity of waste prevention due to their excellent waste management infrastructures built up in the past. Technical improvements of end-of-pipe technologies already in place have led to a situation where the actual waste treatment – more or less – does not cause much harm to the environment. Waste incineration plants can be seen as a typical example: During the 1970s and 1980s citizens have protested all over Europe against the establishment of these plants due to environmental burdens especially caused by dioxin and furan emissions. Today, even the German Environmental Protection Agency claims that due to excellent filtering technologies the air coming out of such a plant is cleaner than what has gone into it. In this way, the success of environmental policy in the past has caused a focus on consistency approaches and end-of-pipe technologies. As long as waste is seen as a kind of „solved problem", policy makers question why it should be necessary to prevent waste in the first place when it can be recycled or incinerated on such a high technological level (Wilts 2014).

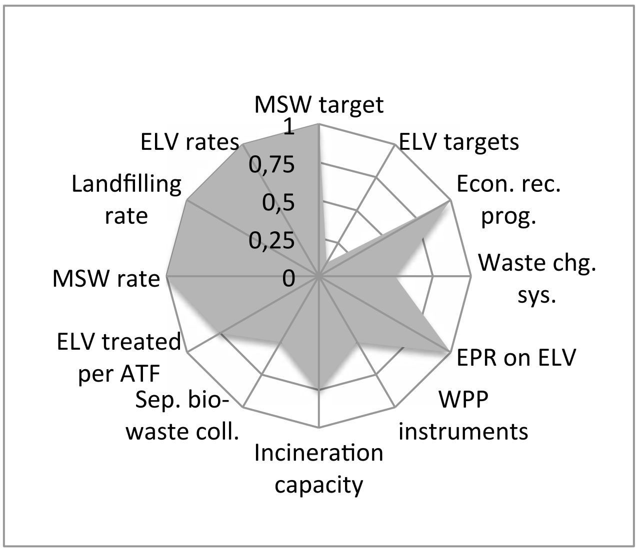
Another important difference reflected in the different shares of stringent waste prevention policies is the perception of waste prevention - and the circular economy in general - as a win-win situation. Several initiatives have highlighted the enormous market potentials of waste prevention, reuse or closed loop recycling – raising the question why companies hesitate to realise these cost savings and market potentials. Some countries clearly see the need to sensitise the market actors, disseminate research results and lower transaction costs for data gathering – and thus focus on informative instruments. The underlying rationale in this case is the perception of unexploited market potentials. At the same time, other countries clearly follow a completely different approach and see the necessity for changed legal and market framework conditions in order to avoid that waste generation externalises social costs and that waste treatment is organised based on the lowest cost level and not from a view point of resource conservation and efficiency.

The following figures illustrate and summarise the results of the country review with regard to the dimensions: targets, policy instruments for waste management, technical infrastructure and outcomes. Following this, countries are assessed according to their fulfilment (e.g. national target is above or under the EU targets) or the value (e.g. low or high incineration capacity) of specific indicators. The classification system ranges from 0 for a low fulfilment or low value to 1 for a high fulfilment or high value (see Annex). Due to the consideration of different values and not only clear rateable indicators the results have to be interpreted as characteristics and not as a scoring (e.g. what is the appropriate incineration capacity?). The scoring was carried out by the team of the Wuppertal Institute.

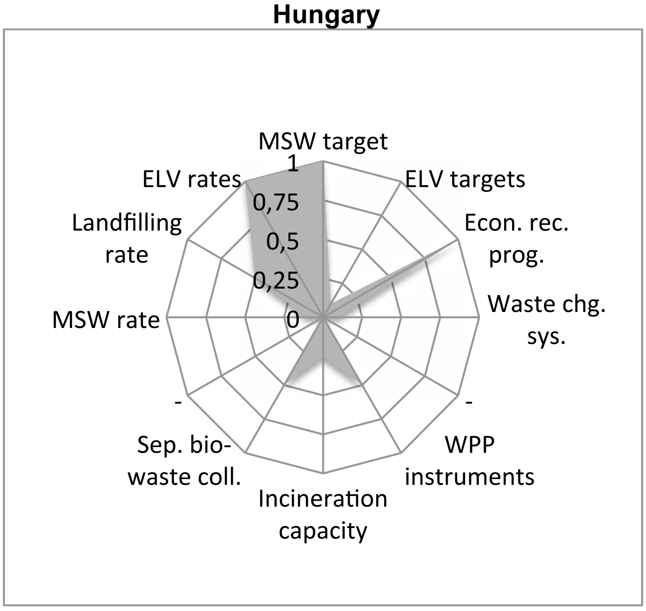
Austria



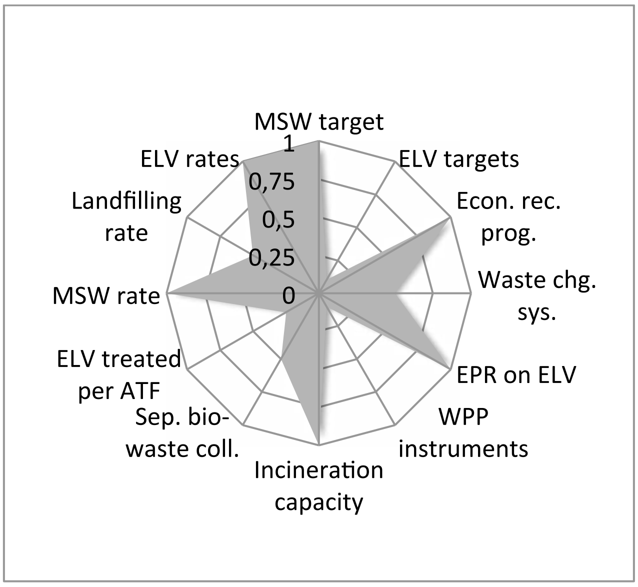
Germany



Hungary

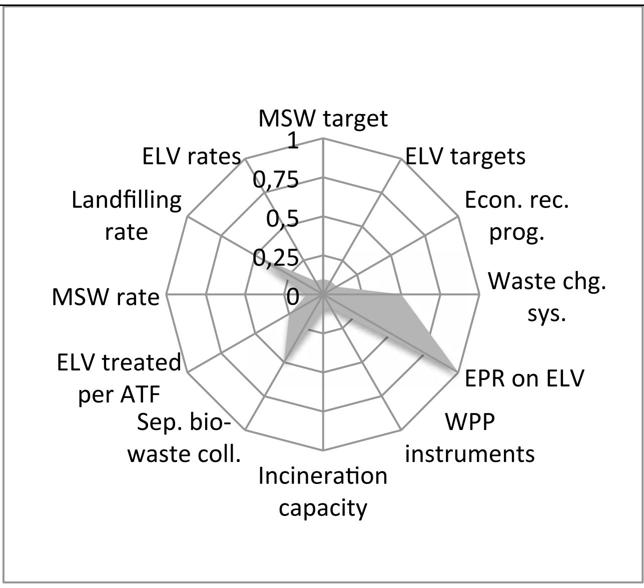


Netherlands

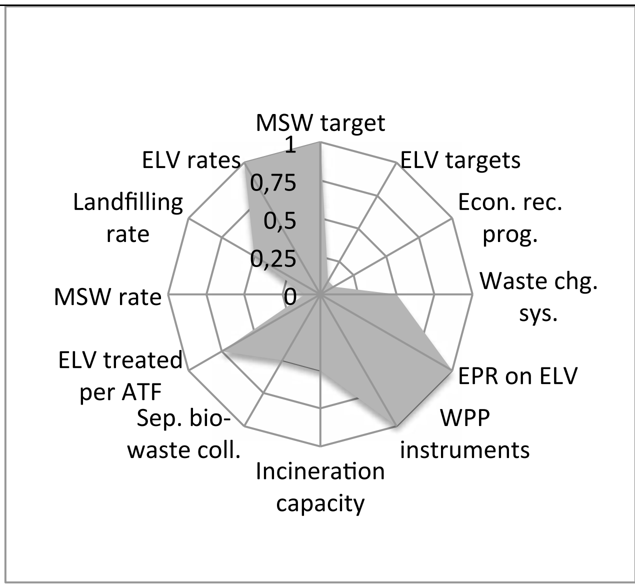


Estonia

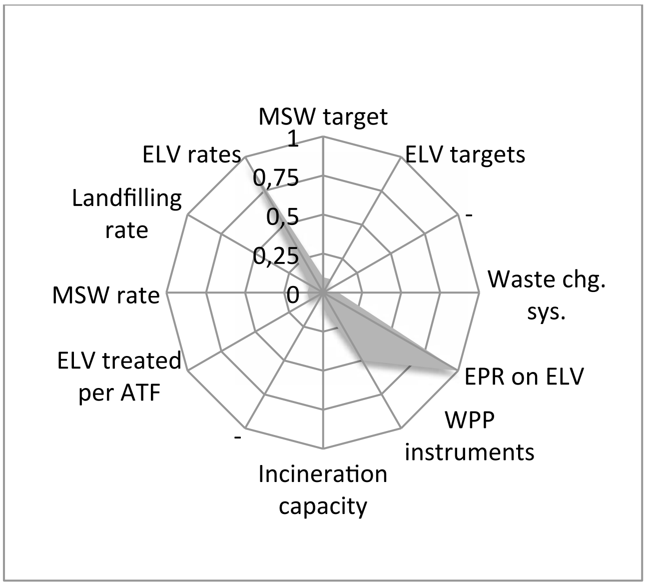
Finland



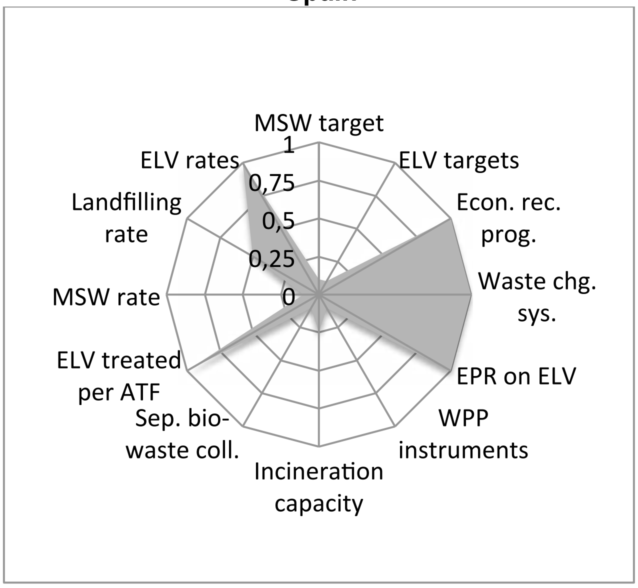
Poland



Spain



Sweden



UK

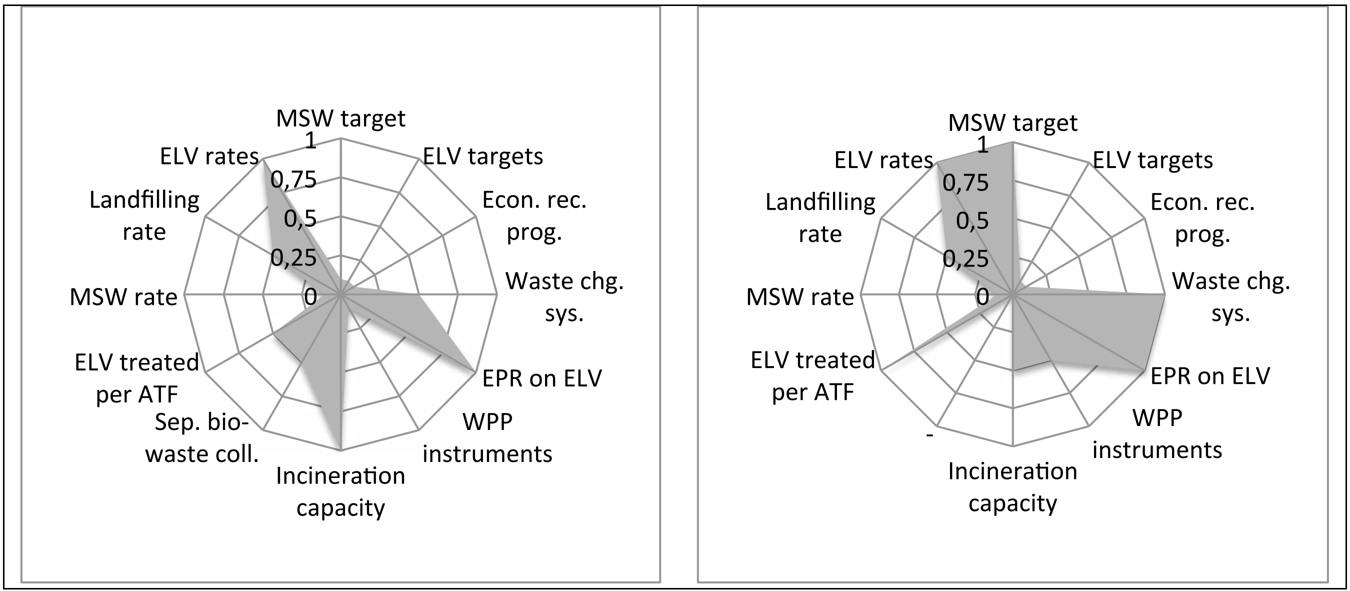


Figure 18: Overall picture of the Member States waste management performance

In the following table the grey fields highlight, whether the issue applies for the respective country. Otherwise, the fields were left blank.

	Waste Prevention Programme			Waste Management Plan			Specific regulation on bio-waste		
	Stand-alone programme	Incorporated in WMP	WPP not in place, but planned	National	Regional / provincial	Local	Ordinance	Strategy	Covered in WMP
Austria		■		■	■	■	■		
Germany	■				■	■	■		
Hungary		■		■	■	■		■	
Netherlands	■			■					■
Estonia			■	■		■			■
Finland		■		■	■			■	
Poland		■		■	■	■			■
Spain	■			■	■				■
Sweden	■			■		■			■
UK	■			■	■	■			■

Figure 19: WPP, WMP and bio-waste regulation application in selected countries

The empirical analysis of waste management regimes and their specific characteristics in different EU member states highlights the importance of a country specific perspective in order to understand why the EU still uses resources inefficiently. Especially with regard to the transition towards a circular economy, the implementation of EU legislation in national law is not sufficient in order to automatically achieve a state where waste is managed as a resource – as required by the Waste Framework Directive. The effects on resource efficiency can differ enormously and are obviously dependent on the choice of additional national instruments and their comprehensiveness with regard to transposing the waste hierarchy into the waste management structure.

However, that does not allow us to conclude that if waste should be prevented, new framework conditions are needed for reuse and recycling. For instance, given the push of the promotion of electricity produced from renewable energy sources, the energy recovery from waste may detriment recycling in one country but it is an incentive to divert biodegradable waste from landfill in another country. In addition, also general detailed technical requirements will not necessarily have the same effects on resource efficiency in every country, not to mention the feasibility or significance from an ecological, economical and social point of view.

The following aspects underline the complex interplay of technical regulations, economic framework conditions and social behaviour patterns in the different member states.

- Although the Waste Framework Directive sets very specific technical requirements and regulations (e.g. mandatory recycling quote for a variety of waste streams), the institutional setting for pushing waste issues forward differs significantly in the Member States (see Agency's). Especially waste management planning seems to be only weakly influenced by the European regulatory framework and varies significantly from country to country (see WMP, WPP) – with regard to contents, ambitions, targets or choice of policy instruments.
- The analysis of environmental outcomes indicates that - as long as waste management causes costs (instead of being a valuable "resource") - regulatory instruments seem to be more effective than economic instruments, (e.g. separate collection of bio-waste, EPR on ELV)
- The analysis of the waste infrastructures shows a lack of monitoring and integrated planning with potential detrimental effects on resource efficiency: For example the analysis of incineration capacity data indicates regional over-capacities, which might act as an incentive to use (usually capital intensive) waste incineration plants at full capacity and at the same time demotivate further recycling efforts

Especially the issue of waste incineration capacities highlights that policy approaches which do not consider every step of the waste hierarchy against the background of resource efficiency and life-cycle thinking in the respective context can lead to unwanted effects. For instance, a policy for diverting waste from landfill without the promotion of an alternative treatment and pathway up the waste hierarchy, which is environmental and economical appropriate in the specific context, can lead to treatment choices, which are either:

- per se ineffective (e.g. recycling focus on the less resource-intensive waste fractions, instead of the resource-intensive ones),
- induce unwanted pathways (e.g. investment in capital intensive incineration capacities without taking account of future shifts such as recycling) or
- have a completely counterproductive effect (e.g. illegal dumping).

The different waste management approaches in the countries as well as the diversity in policy choices highlights lack of knowledge and uncertainty in the general transformation from waste to resource management. All in all, the lack of integrated environmental and economic assessments, which would allow identifying the best waste management practice in the respective context, can be seen as a powerful barrier to resource efficiency in the waste management sector. Hence, the lack of policies, which steer waste onto routes that save most natural and economic resources (which requires the consideration of the location-specific context) and targets that focus on material quality rather than weight, is becoming apparent.

4. The web of constraints and its impact on the transformation towards a resource-efficient and circular economy

POLFREE uses the concept of a "web of constraints" as an analytical framework in order to explain why resources have been and are being used inefficiently. In this way it goes beyond the idea of physical, somehow moveable barriers and highlights the social context of technologies and resource usage: "In summary, the models on 'barriers to resource efficiency' tend to treat barriers in fairly concrete terms and to overcome the barrier typically involves a specific action that needs to be done. This may be true for some cases, but often barriers are part of a complex pattern of interaction (…), of cause-and-effects in a sector, in which reasonable actions of individual actors, unintentionally lead to unexpected outcomes. Also, underlying perspectives of relevant stakeholders - firms, consumers - are often kept exogenous to the study, a priori speaking of the subject being 'hindered' towards more resource efficiency. In the eyes of the stakeholder this may not be the case at all. As a consequence, the social context often tends to be treated in a somewhat mechanic way (identify obstacle, delete obstacle, subject will act more efficiently), which will not be as simple as that in practice" (Kemp and Dijk 2013, p. 18).

Based on the empirical results, this chapter looks at the overall picture of waste and resource policy from the web of constraint's point of view: Does the transition approach help to clarify the issue?

Chapter 4.1 aims to apply the "web of constraints" approach to resource policies and asks what constitutes this web and how do the interactions of these different barriers hinder a more fundamental transition? The second part looks forward to the policy development in WP2: How does the transition approach help us to overcome this web of constraints? What could be possible conclusions for the development of policy mixes? And what specific role could targets and a shared vision play in this process? A final Chapter 4.4 makes a general assessment of the role of the Roadmap proposals in national resource management policies and draws some conclusions for further development.

4.1. Path dependencies instead of barriers – the difficult transformation of waste management regimes

A report "Towards the circular economy" published by the Ellen MacArthur Foundation in 2013 describes the business rationale for an accelerated transition of our economy: Based on a variety of case studies, it concludes that a turn away from "our "take-make-dispose" economy would allow "an annual net material cost savings opportunity of up to USD 380 billion in a transition scenario and of up to USD 630 billion in an advanced scenario, looking only at a subset of EU manufacturing sectors "(EMF 2013, p. 6). Facing these enormous win-win-opportunities, one has to raise the question what hinders companies to exploit them? Why do entrepreneurs don´t take the chance to increase the profitability and competitiveness of their companies? According to the Ellen MacArthur Foundation companies just have to „(...) make creative and bold moves, break out of the linear system, and ensure that the underlying arbitrage opportunities are robust over time" (EMF 2013, p. 7).

Nevertheless, we still see a clear focus on end-of-pipe technologies especially in the waste management sector, one of the key sectors for a transition towards a circular economy (Ostertag et al. 2010, p. 1893ff.). Against this background, the waste management regime seems to be a very good example that there are no specific "barriers" that could be easily removed, but a very complex web of constraints that has developed over a long time, that shaped strong path dependencies and with massive economic interests embedded. In the following paragraphs this will be illustrated by using the example of the German waste management market, which can be seen as a prototype for a technology-focussed waste management approach.

The aim of the only recently amended KrWG (Closed Substance Cycle and Waste Management Act) is, according to §1, "promoting closed substance cycle waste management for the conservation of natural resources and ensuring environmentally compatible waste disposal”. Even this short description depicts the conflict of objectives between a waste management that is still oriented toward waste disposal security and one that strives for sustainable resource management:

- On the one hand, resource conservation and environmentally sound disposal are presented as equitable goals. On the other hand, however, with regard to resources, conservation is only mentioned marginally, and no specific level of protection is defined for particular resources.
- Furthermore, in the context of the cycle economy there is only talk of “promotion”. § 7 Article 4 of the Recycling Economics and Wastes Act (“The obligation of recycling wastes has to be met as far as it is technically viable and economically reasonable”) also emphasises that there are economical boundaries to the recycling priority of the waste hierarchy. Though recycling doesn’t necessarily have to be profitable, however, business costs have to be proportionate to alternative disposal costs (Fiebig-Bauer 2007, p. 150).

Especially with regard to the governance structure, both objectives differ (Fiebig-Bauer refers to it as the “governance idea” of waste management policy (ibid. p. 120).): While the aim is to ensure disposal security particularly by means of classic regulatory instruments, the KrWG forgoes such tough guidelines in favour of the objective of resource conservation. Regardless of the fundamental difficulties of a waste stream control, the legislator e.g. totally dispenses from starting with raw material extraction and exclusively concentrates on regulations at the end of the use phase. In respect of the promotion of the cycle economy through the KrWG, it is therefore more appropriate to speak of an “intensification of intrinsic motivation by means of agenda setting“ (Fiebig-Bauer 2007, p. 147): Enterprises can still decide for themselves if they choose to assess entrepreneurial potentials for the cycle economy. Yet under the given framework conditions, there is generally no sufficient economic incentive for this purpose. In many EU member states this is the case due to over-capacities – especially for waste incineration and mechanical-biological treatment. These have to be taken into account for their potential impacts on the recycling market and on waste treatment prices (Jafra Sora 2013). On a global level the thermal recovery of MSW is growing continuously. Between 2007 and 2013, nearly 300 new incineration plants were constructed, the technical capacities increased by 25 % up to more than 250 million tons per year (Döing & Loenicker 2013). With regard to Europe, the recently published European Greenbook on Plastic Waste describes a ‘vacuum cleaner effect’ (European Commission 2013) in favour of waste to energy as one of the most relevant barriers for material recycling that – from a resource efficiency point of view – would be clearly superior in contrast to waste incineration.

Up until now, qualitative aspects of flexibility of waste management infrastructures, compatibility with socioeconomic framework conditions and marketing aspects concerning the recycling of secondary raw materials only play a minor role in the planning stage. For waste political actors in particular, which have to keep the interests of their constituents in mind, disposal security still plays a dominating role. The predominant restriction to technical aspects of disposal security is equally due to the “dominance of engineers in the planning of infrastructures“ (Moss 2011, p. 83), who primarily bet on technical solutions and often don’t pay attention to alternative solutions. Out of this “gravity of familiar exploration patterns” (ibid.), massive path dependencies arise in the planning of waste management infrastructures. Particularly with regard to waste collection as direct interface to the user, it is usually difficult to force amendments. For example in most of the German cities, collection systems have been unchanged for decades; only in Eastern Germany have extensive changes resulted from privatisation: “A reason for this lies in the relatively strong position of the planners of supply and disposal enterprises themselves. Practically, technical infrastructures are primarily planned in these enterprises” (Moss 2011, p.82). Regarding environmental administration, especially the rejection of additional legislative risks which are possibly connected to recycling in contrast to a mere disposal of waste, turns out to be a constant barrier for innovation processes. Incineration, in contrast, is more centrally organised, which is the reason it is significantly easier to monitor by environmental administration and has been tested for years which makes it less risky from this point of view: “The large system offers security“ (Kubala cited in Wilts 2014, p.188). Hence, the paradigm of disposal security, which has been imparted from waste economic education up to the organisation of responsibilities for decades, constitutes one of the most influential path dependencies which complicate the transition of waste economic infrastructures towards a sustainable resource management. The safety aspects have of course to be taken seriously; thus, for the future the question arises how security or safety can be provided alternatively

These path dependencies are reflected in the innovation behaviour of the waste management and waste generating industry. A closer look into the selection of applied technologies in the waste generating industry from a business management perspective reveals that environmental obligations regarding waste in existing production facilities or consumption patterns can normally be met most easily by the direct disposal of generated waste as an end-of-pipe measure. Integrated technologies of prevention or high-quality recycling, which have already been regarded in the production process, in contrast require the conversion of long-time tested and optimised procedures or consumption patterns, which is associated with considerable technical and economic risks. Such conversions can also be connected with “regulatory risks”, especially as in waste management legislative and technical risks occurring through the use of wastes as secondary raw materials could be avoided by direct disposal. Thereby, routines for waste disposal accepted by environmental administrations are also available, while such concepts still have to be developed for prevention and recycling according to a sustainable resource management, whereas often the incalculable behaviour of consumers has to be taken into account (see Michaelis 1996, p.112).

4.2. Linking the web of constraints to policy development – strategic niche management and shared visions for a resource-efficient and circular economy

When considering the transition approach not only as an analysis framework, but also as an instrument to support systemic innovations, the development, conservation and coordination of so-called innovation niches whose sociotechnical variations have the potential to provoke a regime transformation can be interpreted as a new regulatory task.

Kemp et al. define the strategic niche management (SNM) as “the creation, development and controlled phase-out of protected spaces for the development and use of promising technologies by means of experimentation, with the aim of (1) learning about the desirability of the new technology and (2) enhancing the further development and the rate of application of the new technology” (Kemp et al. 1998, p. 186). A further component of such management approaches is the overcoming of consistent path dependencies through focused destabilisation of the existing regime: “Transitions to sustainability consequently imply a destabilizing of existing socio-technical structures as well as nurturing alternative systems that can fill the opportunities created by structural change” (Voß et al. 2009, p. 278).

A crucial element of such a transition management process is the development of a shared vision in a participatory process of all relevant stakeholders. Such a vision is supposed to concentrate differing expectations of participants and for this purpose link to the mutually identified problems from the first phase: „In effect, the vision provides an alternative selection environment compared to established socio-technical paradigms” (Voß/ Smith/ Grin 2009, p. 284). The mission statement, which has to be developed in this process, should on the one hand contain ambitious targets, while on the other hand it has to be realistically achievable. Hereto, the model also needs to include various potential solutions. The significance of mission statements is also described by Gößling-Reisemann, emphasising their identity promoting and complexity reducing function, whereas path dependencies are weakened through the discrediting of chosen development pathways, while at the same time the individually perceived complexity and thereby sensed transaction costs of a transition should be reduced (Gößling-Reisemann 2008, p. 160).

In order to make such a vision concrete and a working guidance reference, in particular, targets can play an important role. In this sense targets have a double function because they also allow for monitoring, evaluation and feedback loops as key element of an iterative transition management process. Although the European Commission has set the goal to turn Europe into a recycling society, the reality of waste management in the European Union is still far away from such closed loops or a circular economy. According to the EEA, only 35% of municipal waste was recycled in Europe in 2010: “Although some countries have rapidly increased recycling rates, Europe is still wasting vast quantities of valuable resources by sending them to landfill, and many countries risk falling short of legally binding recycling targets” (EEA 2013).

But even if waste is legally recycled, in many cases valuable raw materials are lost due to low quality 'downcycling' of waste. A recent report by the International Resource Panel (see UNEP 2013) has described in detail how until recently traditional recycling concentrated on specific materials as most products were relatively simple, following a so-called “material-centric” approach. Against this background and taking into account that products become increasingly complex, the report develops the concept of a product-centric approach: “Recycling these products became increasingly difficult as trying to recover one material would often destroy or scatter another, and it became clear that we needed a Product-Centric approach” (see ibid, p. 23).

One of the most striking examples for these developments and the failure of existing targets might be the issue of waste electronic and electrical equipment (WEEE). As a consequence of continuous modifications of function and design of appliances, electronic devices contain a highly heterogeneous mix of materials. Today up to 60 different elements are used in fabricating a single integrated circuit chip. A large number of these elements are used as compounds or alloys formed with other elements. Facing the persuasive use of electronics and especially information and communication technologies (Welfens and Lutz 2012), WEEE has become one of the fastest growing and at the same time one of the most complex fractions of municipal solid waste (cf. UNU 2008, p. 3).

The disposal structures of electrical and electronic waste in Europe are comprehensively regulated by law. The European Directive on Waste Electrical and Electronic Equipment (WEEE Directive) constitutes the legal framework and is implemented by Member States into national law. Since 2006, the Member States have to ensure a rate of separate collection of WEEE and have to establish appropriate collection points for private households free of charge. According to the recently revised WEEE Directive 2012/19/EU have to fulfil collection targets based on the physical weight of the products - depending on the put on the market amounts of products in the Member States. The minimum rate of separate collection tightened piece by piece over the next few years and is 65% from the year 2019 (Article 7, Section 1 of the WEEE Directive 2012/19/EU).

These mass-based rate calculations make sense in a world where recycling aims to reduce to the amount of waste that is sent to landfills. But from a resource efficiency point of view they miss the key point – the material recovery of the most resource intensive raw materials. Despite the tiny amounts of these materials per product, they cause a significant share of the environmental burdens in the production phase because they often occur only in very low ore concentrations and the melting process requires enormous amounts of energy. Chancerel & Rotter 2009 point out that e.g. palladium is only about 0,005% of the weight of a mobile phone, but causes 5% of the total material requirements (TMR). In comparison to the extreme resource production of primary raw materials, the recycling of these materials could lead to significant resource conservations. Saurat & Bringezu (2008) estimate that the secondary production of 1 kg palladium by recycling requires only 4% of the resources.

Right now the collection target is much faster to achieve with the collection of heavy equipment (e.g. refrigerator) than with light products (e.g. mobile phone). But an increase in the collection rate will not necessarily lead to an improved recycling of critical metals when their rates are fulfilled with products and materials with low resource relevance. But not only the collection targets, especially the regulative framework for the further steps of treatment clearly highlights how a weight based approach effects the resource efficiency of the recycling chain for waste electronic products. The European WEEE Directive sets minimum rates for the recovery of collected products. Depending on the product category, between 50 and 75% of the products shall be recycled or re-used and 70 to 80% shall be recovered. Of course, these percentage rates refer to the total weight of the generated waste and do not take into account the value or the resources that have been used in the production process of the very different products. Because of the small amounts in which these materials are used, their recovery is not necessary to fulfil these targets.

Conclusions

The example of collection and recycling targets for WEEE highlights the lack of targets that reflect the paradigm change to look at waste as a resource – the existing regulatory framework still focuses on the volume of waste, not its potential material qualities as secondary resource. It is also interesting to notice that the terms “recycle” and “recover” do not set any minimum technical requirements how to treat the waste devices. According to article 3, para 2 the definitions laid down in the general waste framework directive (WFD) shall apply. Article 3, para 15 WFD defines that “recovery means any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function (…).”

In this formulation it becomes obvious that any “useful purpose” does not necessary require to use the different materials contained in an optimal way – or even at all. According to Reuter et al. (UNEP 2013), recovery technologies are insufficient or do not exist at all for many materials contained in electronic devices. Thus, although the majority of materials might be lost during the treatment, they might count as “recycled” from a legal point of view.

4.3. Regional disposal autarchy instead of European approaches for resource efficiency: the case of transboundary movements of waste

This paper chose a clear focus on specific EU member states and their performance with regard to the efficient use of resources and their policy approaches for an increase. The observable fundamental differences between these countries, not only between frontrunners and laggards, but also with regard to strategic approaches raises the question whether these in many cases uncoordinated policy efforts can be seen as a barrier for resource efficiency in itself. This chapter takes the example of transboundary movements of waste in order to illustrate the still dominant idea of national disposal autarchy (chapter 4.3.1), the reality of a European market especially for thermal and material recovery (chapter 4.3.2) and finally the ambiguous impact of these developments on resource efficiency (chapter 4.3.3.).

The following will focus on legal exports for non-hazardous waste. Within the EU, the export of hazardous waste for recovery from the EU to countries not part of the Organisation for Economic Co-operation and Development (OECD) is prohibited, since these countries usually do not have proper and sufficient treatment capacity (EEA 2012). These main principles notwithstanding, it is a fact that the public interest focuses on illegal cases in which waste — often hazardous — has been exported to another EU country or to a developing country in order to avoid stricter treatment standards or to exploit low wages in the receiving country. But this is only a very small part of the story. The more general question would be how these exports influence waste infrastructure planning and how this increasingly important interface between national and EU waste policies affects the transformation towards a resource-efficient circular economy: “Is it possible to gauge the environmental and economic costs and benefits of the shipped waste from an EU perspective, and also to ascertain what the drivers are behind the legal shipments?” (EEA 2012, p. 7).

4.3.1. Waste infrastructure planning paradigms – "waste as resource" instead of the "not in my backyard" principle

In principle the analysis of waste management seems to highlight the importance of the national perspective: For centuries the traditional waste management planning was dominated by a paradigm of autarchy due to a "not in my backyard" thinking when it came to waste. For a long time waste management tasks exclusively concentrated on collection and disposal of wastes before the city walls due to hygienic reasons. In the course of the economic boom of the 1960s, waste generation increased dramatically (Hofmeister 1998). Besides, the developing environmental consciousness of the population was disturbed by the consequences of wild landfilling: The first environmental report of the Federal Government from the year 1970 mentioned a number of 50,000 uncontrolled dump sites in Germany, which were neither subject to approval nor monitoring at that time (Schenkel 2003).

Against this background, the legislator attached great importance to a spatial organisation in waste management for waste economic regulations, beginning with the Waste Act 1972. The law defined municipal administration units as corporate bodies obligated to organise waste disposal, to which wastes had to be turned over according to a compulsory connection and usage (Lamping 1998). The waste economic infrastructure system in Germany is therefore until today characterised by the idea that environmental burdens such as waste disposal cannot be shifted to other regional authorities. This objective is supposed to be realised through the principle of proximity, the principal of origin and self-sufficiency.

The second paragraph of Article 5 of the European Waste Framework Directive demands the installation of an integrated and appropriate network of waste disposal facilities. Through this it should be possible to dispose waste in one of the closest disposal facilities under application of methods and technologies which ensure a high level of health and environmental protection. This principle of proximity can be traced back to the principle of origin, primarily anchored in paragraph 2 of Article 174 EG. The principle of origin implies that environmental impacts should be addressed at source and thereby as close as possible to their origin. In this way, dissemination or displacement of environmental impacts is aimed to be prevented. The principle of self-sufficiency is realised on European level primarily through the Waste Shipment Regulation (AbfVerbrV), which was lastly amended in 2007. This regulation prohibits the shipment of waste from private households to other countries (see paragraph 1ª) of Article 11 AbfVerbrV).

4.3.2. The reality of transboundary waste shipments

Despite the focus on securing the disposal of waste on a national level, transboundary shipments of waste are a reality in Europe (Fischer 2012). Taking the example of aluminium, copper and nickel, the following figure shows that sharply increasing amounts of waste are exported, both within and out of the EU.

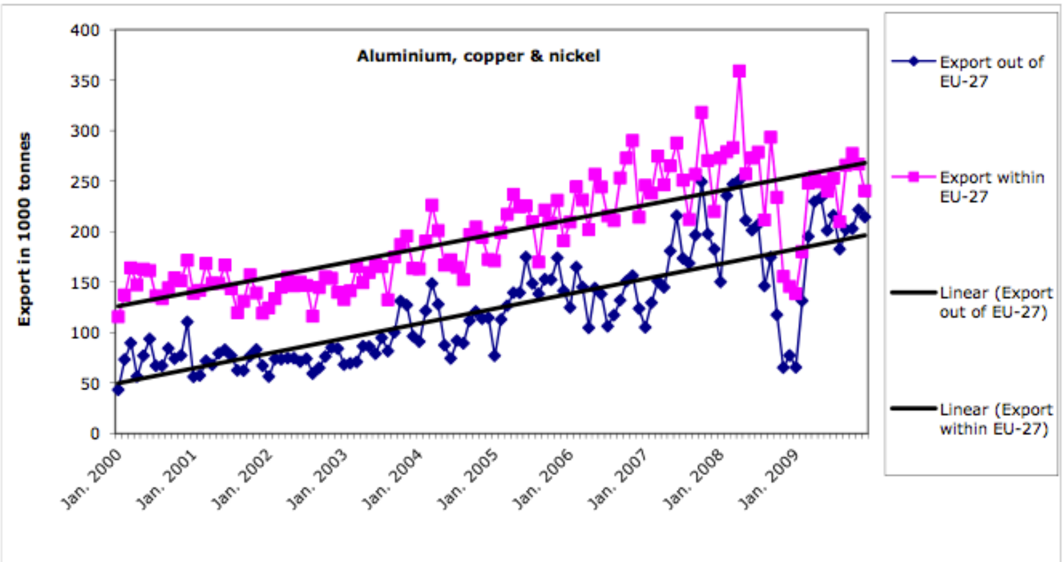


Figure 20: Monthly amount of transboundary traded aluminium, copper and nickel waste related to export out of the EU and within the EU (1 000 tonnes); Source: EEA 2012, p. 52

From the perspective of waste as a resource, this seems understandable for material recovery. Of course, shipments of waste for recovery are subject to less restrictive regulation and in general these wastes can be shipped within the EU. Recycling facilities often require large amounts of specific waste in order to be operated economically viable. In the case of integrated smelters for the recovery of precious metals, only six facilities exist around the world. The biggest one located in Hoboken, Belgium, required investments costs of more than a billion Euros (cf. Wilts 2013). Against this background the export of waste streams are often a necessary prerequisite in order to recover materials like platinum, palladium or indium.

But even in the case of waste incineration – with plants in more or less in all EU member states – low transportation costs and significant price differences between the member states seem to make the idea of autarchic waste management planning on a national level more and more obsolete. Analysing import and export waste flow data provided by Eurostat shows how the strategies of responsible actors for waste management in the different member states have changed over the last decade. Instead of investing hundreds of million Euros into waste incineration capacities, they developed a European network of facilities with a very complex network based on treaties with delivery obligations that aim to ensure the required disposal safety and at the same time to ensure the profitability of these investments. Thus, the major driving force behind waste exports is economic. Lower labour costs in developing countries, which may be combined with possibly weaker, poorly enforced or non-existent environmental and social regulations, translate into reduced costs for the disposal and treatment of waste. Many developing and emerging economies view the import of waste, even hazardous waste from the West as a way to generate revenue. In addition, waste imports can provide income and employment for the poor. As such, there are arguments in favour of the waste trade from both the import and export side (Kantor et al. 2012).

The analysis highlights a clearly increasing trend: From 2006 to 2010, the total sum of waste exported has increased by a factor five (Wilts and von Gries 2014). The following figure shows the most important imports and exports flows of waste for incineration in 2010. First, it highlights that in Sweden waste incineration capacities have an increased importance for the 'waste incineration market'. Secondly, it becomes clear that Germany has a mixture of imports and exports. It also underlines that so far only a few countries have started to engage in a common European market for waste incineration. Nevertheless, there are clear signals that the introduction of landfill restrictions and landfill taxes especially in the Eastern member states will boost this development over the next years (Döing and Loenicker 2013, p. 650). The export of waste for incineration from France to Morocco seems to indicate that for specific countries also capacities outside of the European Union might have to be taken into account for future assessments of total waste treatment capacities.

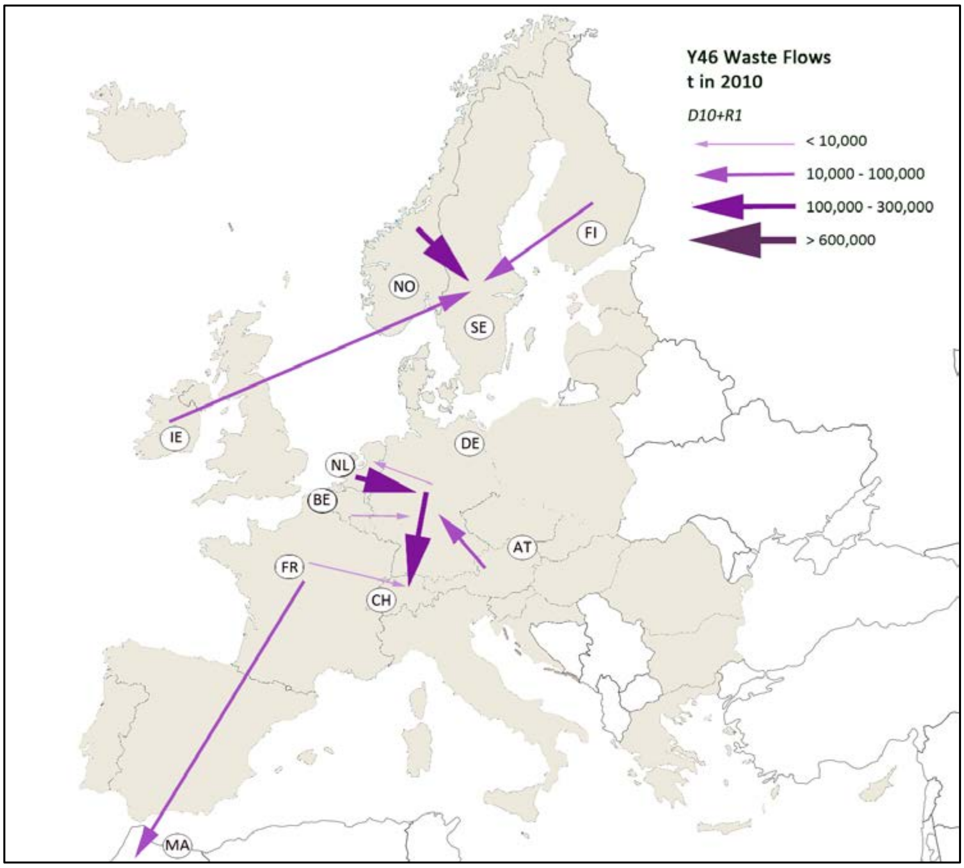


Figure 21: Largest Y46 waste flows for incineration in 2010; Source: Wilts and von Gries 2014

4.3.3. Environmental impacts and long-term effects on resource efficiency

Environmental impacts

Taking into account the autarchy principle, these increasing waste exports seem to undermine the national responsibility for waste and specifically end-of-life products: If waste can be easily exported and has to be treated elsewhere, this seems to lead to a shifting of environmental burdens and at the same time to lower incentives for the prevention of waste.

But the picture gets more complex when looking at waste as a resource instead of a potential threat for the environment and human health in the first place. In this case the autarchy principle does not necessarily seem to lead the optimal outcome with regard to resource efficiency. The application of a „differential approach“ to the cross-country net impact requires not to take account of the transportation distance possibly travelled by waste if managed inside the home country and that travelled to be managed in the destination country, but also a comparison between the conditions of management/treatment inside the borders of the shipping country and those of management/treatment in the destination country. Waste management operations (treatment, disposal, recycling) generate impacts wherever they are performed. The impact in the destination country must be compared to the impact of treating the same waste domestically.

In order to estimate the net impact of shipment by itself requires that the likely management impact in the country of origin, i.e. in the case that the waste stream would have been managed domestically, must therefore be deducted from the actual management impact in the place of destination/management: „In fact, depending on technologies and environmental rules prevailing in the home country and those at destination, international shipment may either reduce or increase overall environmental impacts at the management stage“ (EEA 2012, p.24).

Looking at the specific case of exports and imports for waste incineration the analysis shows significant regional over-capacities for waste incineration exist in Europe, but additional investments in waste incineration capacity might be useful to divert additional waste streams from landfilling on the total aggregated level. These regional over-capacities can act as an incentive to use such capital intensive waste incineration plants at full capacity and at the same time demotivate further recycling efforts. Especially the competition for commercial waste seems to lead to low price levels for energy recovery. In several Member States this leads to a spate of insolvencies in the medium-sized recycling industry, since at lower incineration prices more materials will be energy recovered rather than fed to material recovery facilities. However, according to a survey made by CEWEP (Confederation of European Waste to Energy Plants) in 2010, the total incineration capacity in Europe is foreseen to grow with round 13 million tons up to 2020 through the construction of 48 new incinerators and the increase of the capacity of some of the existing facilities (Jafra Sora 2013) – partly of course in countries that so far lack sufficient treatment capacity.

Conclusions on waste management planning at the interface of EU and national level

A view at the reality of waste exports shows that waste is no longer just transported to the next waste processing facility where they are disposed in an environmentally sound way. Different waste fractions become an important source of secondary raw materials. Wastes for recycling are no longer subjected to the disposal regime, but are traded freely according to the principles of supply and demand. Planning management is thereby more and more restricted to specifications of technical treatment standards in most member states, while it is difficult to trace from the outside which route these wastes actually take.

For this reason, it becomes increasingly clear that from the perspective of a sustainable resource management, municipal and national waste policies reach the limits of their capacities. Waste streams become increasingly international, and attempts to solve related environmental impacts on a national level increasingly lead to their displacement to development and emerging countries. With regard to waste management systems, Loeschau (2006) differs between a spatial and a life cycle approach (see Figure below).

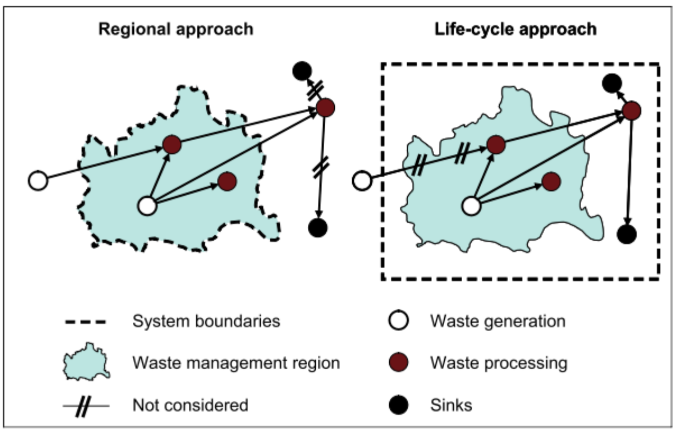


Figure 22: Spatial and functional boundaries of waste management planning; Source: Loeschau 2006

While waste is seen less and less as an environmental burden, but as a possible source for the production of secondary raw materials, the goal can no longer be to keep it within strictly limited disposal areas. The scope of waste infrastructure planning has to be broadened from potential burdens for the environment – which lead to the autarchy principle – and needs to take into account the resource efficiency potentials of recycling and closed material loops. This will require a careful balancing of risks that also needs to be considered in the future revision of recycling targets.

In the future the general purpose should be that wastes are sent to those processing facilities, which can recycle the contained material potential in the most optimal way – even if this means that longer transport routes have to be accepted. Contrary to waste incineration, which is dominant in Germany, recyclable material has to be collected separately for this purpose in most cases, so that often individual waste types have to be brought together from a variety of sources in recycling networks in order to reach the quantities that are necessary for an economically viable recycling (Goldmann 2009). This will also require the establishment of material loops at different spatial scales depending on the value and mass flows: Spatially short-cut for high volume flows with low value (e.g. construction waste), longer transport ways, even internationally for high value flows.

And indeed for base metals like steel, there is a clear trend for a globalization of recycling loops: According to the Trade Council of the International Recycling Association (BIR), 68% of the global steel production will be based in Asia, at the same time about 60% of the steel waste is generated in the US, South America and Europe (Grufman 2013). Therefore, any attempt to increase the share of recycled steel needs to take into account the necessity of global waste exports and has to develop framework conditions that ensure the above described balance of waste as an environmental threat and waste as a resource.

The analysis of waste exports also allows to draw a more general conclusion for the development of resource efficiency policies in WP 2: In a common European market, national policies will still have a relevant role to play, especially when they take into account specific circumstances like the lack of waste treatment capacities in the new member states. At the same time, instruments that have proven to be successful in the past need to be carefully checked for side effects on the European level. For example the introduction or increase of landfill taxes to divert waste from landfill might lead not to an increase of domestic recovery activities but to an additional increase of MSW exports for incineration in Europe (AMEC 2013, p. 5).

4.4. Resource policies at the national level: The need for guidance, diffusion, specification

Resources are managed by specific socio-technical resource use regimes[49], constituted by, inter alia, energy carriers - energy supply systems, energy infrastructure systems, energy utilities - electronic products and technologies and specific waste management - consumer segments, household equipment, mobility patterns, etc., as well as actors, policies and networks at all action levels resulting in a „patchwork of regimes“ (Geels 2004, p. 36) that aim to reproduce the system[50] (Geels & Kemp 2007). The high complexity of those systems is not sufficiently captured by the term production and consumption patterns because material flows, sectors, industries and consumer segments are economically interdependent and interwoven to varying degrees. The economy as a whole is highly dependent on the functioning of certain infrastructure systems (e.g. the energy system) and the maintenance of certain material flows (e.g. construction) in the context of economic cycles (Steger & Bleischwitz 2011; Eurostat 2010).

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49 Socio-technical resource use regimes are constituted by the various material flows, based on the respective resources endowment of the European countries (geological conditions), and further material imports based on the economic endowment (economic conditions), their associated key sectors and downstream industries and infrastructure systems, the derived high-technology sectors, as well as the areas of consumption and actors, policies and networks associated with them at all action levels. The term is consciously interpreted more freely in order to open it for political influences and change.

50 Note: Energy is actually across all material groups.

The present picture of resource policy (policies) is, however, that mainly single, (still) rather weak strategies (in the sense of enforcing competence) and a conglomerate of different sector-specific and/ or technology-driving instruments and policies and selective policies for innovation and green innovation meet a superiority of established socio-technical resource supply and consumption systems. Increasingly, individual instruments are quite effectively and successfully implemented (e.g. governmental loan programmes for energy efficiency investments in buildings in Germany, UK). Successful instruments partly gain a relative diffusion as good practices (e.g. feed-in tariffs) and thus evolve stronger effects. This sometimes also relates to instruments that are considered less useful for environmental purposes (e.g. car scrappage scheme). Some former successful instruments lose their legitimacy in the wake of political changes at the national level or are successfully challenged by interest groups (e.g. ecological tax reform in Germany). Fedrigo-Fazio et al. (2014) investigate a number of policy mixes implemented with varying degrees of success. In most cases, a variety of instruments, a variety of resources and sectors is addressed and depicts fragmented approaches. Some of them show indeed impressing results: UK for aggregates, Sweden and Denmark for fossil fuels as examples for a sectoral approach, Japan on domestic material use as an example for a multi-sectoral approach. UK and Japan stand for an absolute decoupling of the resources addressed, Sweden and Denmark for a relative decoupling (Fedrigo-Fazio 2014). Despite their relative success, those measures will probably not produce radical resource-efficiency improvements unless they obtain a significantly larger widespread at the European level.

Further, the individual strategies (such as raw material initiatives and resource efficiency action plans) and the individual policies are often not consistent and coherent. It is in the nature of pluralistic societies, characterised by vested interests, to move towards a common consensus in the course of tedious and time-consuming negotiation (to achieve a shared vision). However, one cannot assume that this consensus already existed. By and large, it is neither given between the different departments of the ministries, nor at interministerial level, nor in society as a whole, nor in terms of technologies and welfare between differently equipped countries. In this respect, the Roadmap can be positively understood as a minimum consensus that requires specific interpretation of the Member States and further elaboration by the EU and relevant stakeholders. "The present roadmap is not the ultimate response to all challenges. It is a first step towards designing a coherent action framework that cuts across different policy areas and sectors. Its objective is to provide a stable perspective for transforming the economy (EU 2011a, p. 23)".

The institutional embedding of resource efficiency can be described as fragmented at best, although some countries started to take on a pioneering role in developing strategies and action plans, implementing supporting mechanisms for industry, introducing effective tax mechanisms, implementing green innovations elements, and/or implementing comprehensive information-based systems for resource-efficiency improvements (see Chapter 3.2 and Table 11 "Policies influencing resource use and national examples"). "Pioneer countries function as (intellectual) leaders under conditions of uncertainty. Their solutions for general environmental problems are adopted by other countries. A necessary condition for becoming a pioneer country in environmental policy is a high domestic capacity for environmental policy-making. This encompasses institutional, economic and informational framework conditions as well as the relative strength of the green advocacy coalition of a country" (Jänicke 2005, p. 129). Nevertheless, it will be necessary to support stronger and initiate dissemination of good and best practices where necessary. The "Resource efficiency in Europe — Policies and approaches in 31 EEA member and cooperating countries" project of the EEA and the follow-up processes targeted at policy diffusion can be a helpful framework in this respect.

However, the structural-conserving and system-stabilising capacity of large-scale resource use regimes and their associated infrastructures, be it in the policy or in the technology sphere, cannot be overestimated and become apparent in a limited responsiveness to attempts of political regulation and governance (Monstadt 2007). A dynamic conception of how the various elements would interact with each other shows the figure below.

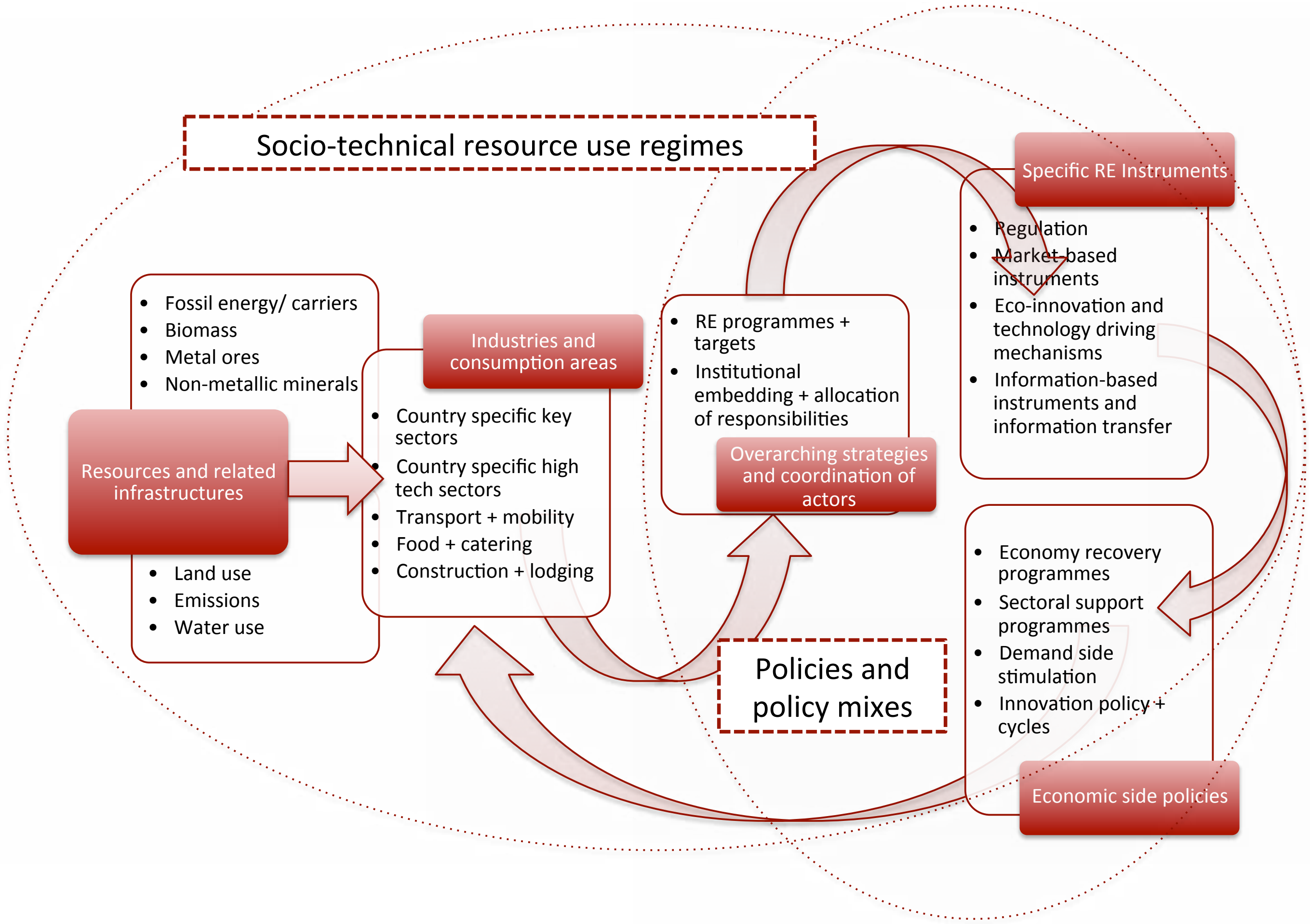

Figure 23: Socio-technical resource use regimes and policy coordination requirements

Concerted action is necessary due to increasing partial resource scarcity, high raw material dependences, overconsumption and high environmental impacts (Bringezu 2014; SERI 2012; 2009). The prospective shifts to new transport, energy, and agri-food systems in order to achieve radical resource efficiency leaps such as 95% fossil fuels or 85% minerals reduction (BIO IS 2012, Bringezu 2014; see also Deliverable 2.2 of this project) are confronted with a multitude of interacting barriers on the different transformation levels (see Chapter 3.2).

Conclusions on resource policy planning at the interface of EU and national level

Although "Environmental policy innovation as well as regression is caused primarily at the national level", as Jänicke (2005) points out, the EU has adopted a promising approach to guide and channel the break up of the strongly interconnected multi-level path dependencies in the resource intensive sectors. Against the background of a patchwork of regimes and a multitude of barriers as described above, it is proposed that the RE Roadmap is to strengthen and substantiate its approach by applying the "transforming of the economy" agenda in the key sectors singled out, which are food, buildings, and mobility - the sectors with the greatest potential environmental benefits as well as the largest inertia. "(…) [W]e asked for the main restrictive sectors in environmental protection. The answer was first the energy sector, second road traffic, third agriculture, fourth the construction sector (…). These are actually sectors that are not under hard global competition; partly even the contrary is true (agriculture, the power industry and the construction industry strongly depend on public or regulated demand)" (Jänicke 2005, p. 133). For this reason, one outcome of the Roadmap follow-up process could be to explicitly depart from a one-sided competition for the most successful economic and innovation performance (potentially resulting in a reproduction of established regimes and systems and "blue banana" [Brunet] effects) towards a more qualitative oriented competition for environmentally relieving policies and eco-innovation, including the acknowledgement and integration of more modest life-styles and economies. Support and guidance are required as there are orientation deficits and ambiguities.

The results from the empirical analysis (Chapter 3.2), a perceptible level of uncertainty and inactivity in central "transforming of the economy" fields and key sectors suggest the following conclusions:

- Strengthen the direction of march by introducing hard (measureable) incentives within the milestone approach by equipping it with more precise targets and magnitudes (comparable to the buildings context).
- Raw material and resource efficiency strategies have to be integrated at EU level as well as national levels to remove trade-offs.
- It should be differentiated between the "phasing out of EHS" and the "getting the prices right" approach, because they are two sides of the same coin but they are not the same.
- The EU should specify which EHS have to be phased out and which sectors have priorities for this purpose: the resource intensive sectors - mobility and the favouring of individual traffic, food and the favouring of resource intensive production processes and products.
- Phasing out of EHS has to be reflected at EU level, in the context of mobility (i.e. in the cohesion context), housing (as regards a clearer position towards proliferation, urban sprawl and land take) and food (i.e. in the CAP context).
- Better monitoring and transparency of the allocation of resources and a streamlining to EU RE Roadmap requirements, flanked by a renewed understanding of cohesion as aiming at a leapfrogging, not catching-up approach; adaptation of the related instruments within the application for funds processes to this end, remove trade-offs within the instrument
- Concerning internalisation ("prices") and "reorientation the burden of taxation": From vaguely "shifting towards environmental taxes" to how much should have been shifted by a certain target year, and towards a more precise specification and guidance in which way labour taxes have to be relieved
- Orienting to pioneering countries (such as Netherlands' environmental taxes of 10%) as benchmark for other countries (implicit top runner thinking in terms of a qualitative competition).
- While, by nature, scientific breakthrough cannot be prescribed, the scale of resources that are allocated to green R&D should be specified, in order to tackle the issue that green investment funds and green taxes remain pawns in national budgets.
- Further support should be given in terms of inducing a diffusion of information-based and capacity-building institutions.

Since the focus of this report was on the institutional and political level, the responsibility of the consumers was not reflected. However, consumers are also in charge. In this respect, the EU could follow the example of Japan and widen the Roadmap to an overarching strategy in order to integrate the stakeholders in their respective areas of responsibility. From today's perspective, it must be assumed that the RE Roadmap has raised little attention in the European population. With introducing more effective measures and requirements, in particular in the tax context, this is likely to change.

WP 2.3 "A new policy mix for a resource-efficient economy in Europe" will have to consider all those aspects described in the previous sections. Improving European policies and guidance calls for a prioritising of barriers and shortcomings that have to be overcome. A driver-barrier based approach could help in search of suitable combinations of framework conditions, eco-innovation policies and sector-oriented or target-group oriented measures and instruments. The implication for WP2.3 is that it has to address a variety of actors that exert influence on those barriers: civil servants from different public administrations, managers from different businesses and company divisions, peer groups in society. In order not to lose track, resource policy however will have to focus on desired outcomes, while keeping an eye on up-stream and down-stream changes. In addition, it will have to be aligned with other policies such as energy or transport policy. To conclude, research will have to focus on certain priority areas as well as on coherency with other policies.

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6. ANNEX

Table 32: Direct material productivity and total resource productivity of selected countries

	GDP (EUR PPS/cap/year) 2011	DMI (t/cap 2011)	Direct material productivity GDP / DMI (EUR PPS/kg) 2011	Total resource productivity GDP / TMR (EUR PPS/kg)
AT	32,300	29.1	1.11	0.37 (2008)
DE	30,800	21.3	1.45	0.39 (2011)
EE	17,400	44.0	0.40	n/a
ES	24,300	14.1	1.78	n/a
EU27	25,200	15.8	1.59	n/a
FI	29,000	45.8	0.63	0.28 (2012)
HU	16,900	13.5	1.25	n/a
NL	32,500	31.6	1.03	0.26 (2007)
PL	16,400	22.8	0.72	n/a
SE	31,400	31.6	0.99	0.41 (2007)
UK	26,400	12.3	2.14	0.96 (2011)

Source: Eurostat

Table 33: Average Domestic Material Consumption per capita, by material categories - EU28 (12 years, 2000-2011); Source: Eurostat

	Biomass	Metal Ores	Non metallic minerals	Energy carriers	Total
Ireland	9.9	1.8	25.4	3.9	41.0
Finland	6.5	1.9	21.7	5.3	35.5
Cyprus	4.0	0.8	17.4	3.1	25.2
Denmark	6.7	0.2	12.3	5.8	25.0
Austria	4.9	0.9	14.4	3.2	23.4
Luxembourg	4.6	1.3	11.4	5.3	22.6
Estonia	2.5	0.0	7.8	10.5	20.9
Sweden	5.9	3.5	9.1	2.1	20.7
Portugal	2.8	0.3	13.6	2.0	18.8
Slovenia	2.6	0.4	11.2	4.4	18.5
Czech Republic	2.4	0.5	8.0	7.0	17.8
Spain	3.3	0.6	10.8	2.9	17.6
Belgium	4.5	0.7	8.4	4.0	17.6
Latvia	9.9	0.0	6.3	1.2	17.5
Romania	2.9	0.3	10.9	2.7	16.8
Bulgaria	2.3	3.7	5.4	5.0	16.3
Germany	3.0	0.4	7.4	5.3	16.1
Poland	4.4	0.9	5.8	4.3	15.4
Greece	2.7	0.7	3.5	8.0	14.9
Italy	2.7	0.4	7.6	3.0	13.7
France	3.8	0.3	7.1	2.3	13.4
Hungary	3.5	0.2	6.4	3.0	13.2
Slovakia	3.4	0.5	5.7	3.1	12.6

Croatia	3.0	0.2	7.3	1.9	12.4
Netherlands	3.0	0.4	3.5	4.9	11.8
United Kingdom	3.3	0.3	4.4	3.7	11.7
Lithuania	4.5	0.0	5.4	1.6	11.5
Malta	1.5	0.3	1.0	1.4	4.1

Source: Eurostat

Table 34: Assessment scheme for resource policy

			Austria	Germany	Hungary	Netherlands
Geological and economic framework conditions	Natural assets		oil, coal, lignite, timber, iron ore, copper, zinc, antimony, magnesite, tungsten, graphite, salt, hydropower	coal, lignite, natural gas, iron ore, copper, nickel, uranium, potash, salt, construction materials, timber, arable land	bauxite, coal, natural gas, fertile soils, arable land	natural gas, petroleum, peat, limestone, salt, sand and gravel, arable land
	Raw material dependence	fossils, metals	fossil 47%, metals 40%	fossil 35%, metals 27%	fossil 43%, metals 31%	fossil 41%, metals 35%
	Key sectors (top five)	according to value added to economy	construction, machinery, vehicles and parts, food, metals, chemicals, lumber and wood processing, paper and paperboard, communications equipment, tourism	motor vehicles, machinery, chemicals, computer and electronic products, electrical equipment, pharmaceuticals, metals, transport equipment, foodstuffs, textiles, rubber and plastic products	mining, metallurgy, construction materials, processed foods, textiles, chemicals (especially pharmaceuticals), motor vehicles	agriculture-related industries, metal and engineering products, electronic machinery and equipment, chemicals, petroleum, construction, microelectronics, fishing
	Infrastructures	Rank (out of 148) & Score (1-7)	rank 8, score 6.3	rank 9, score 6.2	rank 51, score 4.8	rank 10, score 6.2
	Economic performance	GDP per capita in PPS	33,300	31,300	16,700	32,800
	Economic performance	GDP per capita in PPS (EU28 = 100)	130	123	67	128
Institutional set-up	Resource efficiency programme (RP)	no 0 / stand-alone programme 1 / qualtitative targets 2 / quantitative targets 3 / backed by measures 4	3	2	0	0
	Raw material initiative	no 0 / stand-alone programme 1 / qualtitative targets 2 / quantitative targets 3 / backed by measures 4	2	2	0	1
	Coordination (institutions involved in policy formulation)	more than three 0 / three 1 / two institutions 2 / one institution 3 / integrated management 4	1	1	1	1
Incentives + side(effect) policies	Environmental taxes	no 0 / yes 1 / valuable effects 2 / considered successful 3 / more than one resource group 4	1	2	2	3
	Resource taxes	no 0 / yes 1 / valuable effects 2 / considered successful 3 / more than one resource group 4	0	0	0	0
	Direct financial support	no 0 / yes 1 / valuable effects 2 / considered successful 3 / more than one resource group 4	3	4	2	3
	Support for SMEs (consultancy)	no 0 / yes 1 / valuable effects 2 / considered successful 3 / more than one level 4	2	4	1	3
	Economic recovery programmes - green elements	no 0 / yes 1 / valuable effects 2 / considered successful 3 / more than one level 4	2	2	1	2
	Innovation policies - green elements	no 0 / yes 1 / valuable effects 2 / considered successful 3 / more than one level 4	2	3	1	2
	Phasing out of environmentally-harmful sectoral subsidies (focus: meat)	0 = no activities; 1 = low degree of activities; 2 = moderate degree of activities; 3 = above-average degree of activities, 4 = high degree of activities	0	0	3	1
	Phasing out of environmentally-harmful sectoral subsidies (focus: cars)	0 = no activities; 1 = low degree of activities; 2 = moderate degree of activities; 3 = above-average degree of activities, 4 = high degree of activities	2	1	1	3
Outcomes	Resource use	per capita tonnes average (DMC) (2000-2011); EU = 18t	23.4	16.1	13.2	11.8
	Resource productivity trend	time-series (2001, 2006, 2011) PPS EUR per kg DMC	1.18 / 1.26 / 1.59 = increasing	1.55 / 1.76 / 1.93 = increasing	0.43 / 0.58 / 1.00 = increasing	2.24 / 2.99 / 3.12 = increasing
	Decoupling	Average annual growth rates in DMC and GDP (2000-2009)	absolute	relative	absolute	absolute
	Eco-innovation Observatory (2011-2013)	Index, composite of input, activities, output, environmental outcome, socio-economic outcome (2013)	ranks 4 - 6 - 9	ranks 7 - 4 - 3	ranks 16 - 21 - 23	rank 11 - 10 - 13
	Eco-innovation Observatory (2011-2013)	Socio-economic outcome = Exports of products from eco-industries (% of total exports), Employment in eco-industries (% of total workforce), Turnover in eco-industries (2011-2013)	138 / 112 / 102 downwards	121 / 95 / 93 downwards	77 / 120 / 125 upwards	92 / 123 / 142 upwards
	Resource intensive sectors	ranked along Raw Material Input (RMI) contribution (2007)	construction sector, agriculture, transport	construction, energy and water supply, manufacture of petroleum and coal products, mining of fossil fuels	construction, agriculture and fishing, manufacture of petroleum and coal products	manufacture of petroleum and coal products, construction, manufacture of food products and beveeages

Table 35: Assessment scheme for waste policies

Pillar	Dimension	Indicator	Scoring
Institutional set-up and incentives / programmes	Targets	MSW Recycling target	1 if more ambitious than EU target / 0 if EU target
		ELV target	1 if more ambitious than EU target / 0 if EU target
	Regulatory framework	Existence of waste prevention programme (WPP) in accordance with Art. 29 WFD	
		Number of waste management plans or concepts / Levels of target setting national/regional/local	
		Specific law for biogenic waste	
	Agencies and competences	Existence of agency for environmental issues including waste issues	
		Actor close to the market for implementing packaging decree	
	Policy instruments for waste management	Economic recovery programmes	1 if existent / 0 if not existent
		Waste charge systems	1 if exist 3 instruments / 0.5 if exist 2 instruments / 0 if exist 1 instrument

		EPR on ELV	1 if existent / 0 if not existent
		WPP instruments	1 if more than 50 % regulative and economic instruments / 0.5 if more than 25 % regulative and economic instruments / 0 if less than 25 % regulative and economic instruments
Technical set-up	Technical infrastructures	Incineration capacity per capita	1 if above 0,8 Quintile / 0,75 if above 0,6 Quintile / 0,5 if above 0,4 Quintile / 0,25 if above 0,2 Quintile / 0 if no MSW incineration capacity
		Access separate biowaste collection	1 if 100 % / 0.5 if partly implemented / 0 if not implemented
		ELV treated per ATF	1 if above 0,8 Quintile / 0,75 if above 0,6 Quintile / 0,5 if above 0,4 Quintile / 0,25 if above 0,2 Quintile / 0 if no ELV facility
	Outcomes	MSW Recycling rate	1 if above the EU targets / 0 if less than EU target
		MSW landfilling rate	1 if 0% / 0.5 if less than EU target 2009 / 0 if above EU target 2009