

Article

Transition towards a resource efficient circular economy in Europe: Policy lessons from the EU and the Member States

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Abstract

With the introduction of the Roadmap to a Resource Efficient Europe (2011) and the more recent commitment of The Action Plan towards the Circular Economy (2015), the European Commission (EC) has expressed its fundamental interest to substantially improve the resource efficiency of the European economy and enable the transition towards the Circular Economy (CE). This policy push has meanwhile been complemented by some quite ambitious national programmes for RE and CE and institutional advances but it is not yet bound to targets or mandatory reporting.

Against this background, the objective of this paper is to give a comprehensive overview of the current policy frameworks at EU and a selection of MSs and provide insights into the elements shaping policy processes. The analytical framework relies on three essential interconnected components: the policy framework, the economic incentive system and economic side policies which are relevant in the context of RE and CE and actor constellations. The paper does this looking at the interface between EU-MSs. The analysis is based on different empirical surveys in which the policy development is observed and discussed (EEA 2011, 2016a, 2016b, EIO 2013, 2014, 2016) and a comprehensive review of legislative and policy frameworks at the EU and selected MSs, undertaken as part of the project POLFREE (Policy option for a Resource-Efficient Economy) (Domenech et al., 2014, Bahn-Walkowiak et al. 2014). The analysis reveals that policy frameworks for RE/CE are complex and fragmented as competing goals and visions reduce effectiveness of measures. The paper makes recommendations as to how EU and MS policies could improve RE in a coordinated way, but recognizes that achieving such coordination will be challenging in the current political context.

Keywords: resource efficiency; circular economy; policy frameworks; policy mixes; resource policy; system of economic incentives

1. Introduction: Motivations for a resource efficiency policy framework

Changes in the commodity markets and price volatility of resources in the last decade have significantly increased attention towards resource issues and its implications for supply security and competitiveness. Global resource extraction has dramatically grown: From 1970 to 2010, annual global extraction of materials tripled, growing from, 22 billion to 70 billion tonnes (UNEP, 2016), inter alia, driven by the rapid growth of emerging economies such as India and China (Ekins and Hughes, 2017). By categories, non-metallic minerals used mainly in the construction sector experienced the fastest growth (UNEP, 2016).

In Europe, Domestic Material Consumption (DMC)¹, which includes the four main categories of fossil energy materials/ carriers, non-metallic minerals, metal ores and biomass for EU 28 peaked in 2007 with over 8 billion tonnes and has slightly reduced since then to around 6.6 billion tonnes in 2016.

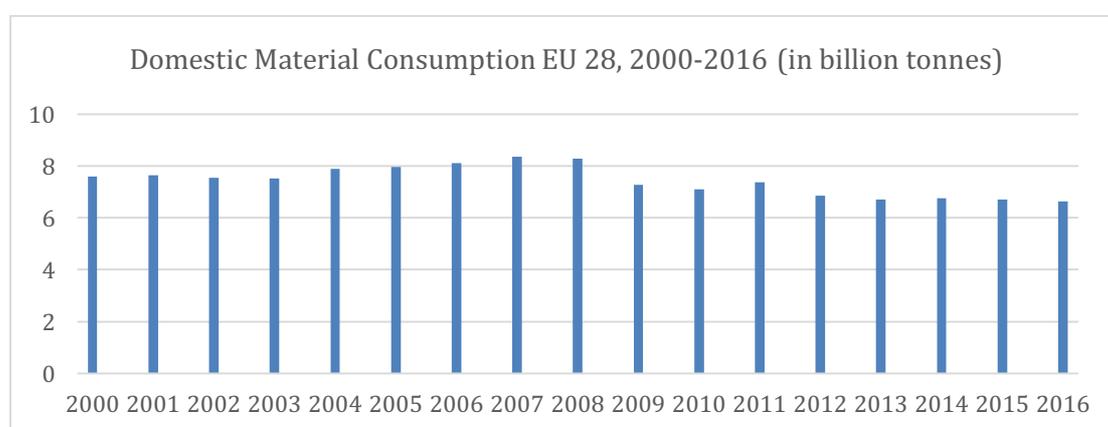


Figure 1: Evolution of Domestic Material Consumption, 2000-2016, EU(28); Source: Eurostat, 2017.

It is important to note though that per capita consumption varies greatly among MSs. While Italy, for example, is currently a modest consumer with around 7 tonnes per capita, Ireland consumes more than 3 times more with around 22 tonnes per capita and year (Eurostat, 2017b). Finland with 33.3 tonnes per capita has the largest per capita domestic consumption, as a result of the relevance of extraction industries in the country. The EU average still remains above world-average and high, with approximately 13 tonnes per capita and year (2016).

¹ DMC indicates the annual quantity of raw materials extracted from the domestic territory, plus material imports minus exports. DMC does not include upstream hidden flows (materials that are extracted or moved, but do not enter the economy) related to imports and exports of raw materials and products (Eurostat, 2017a).

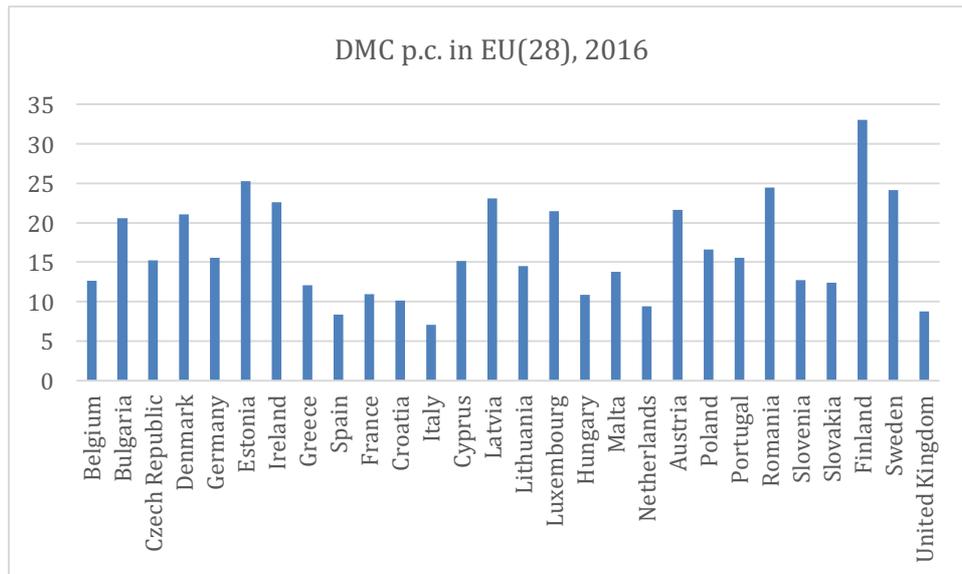


Figure 2: Domestic Material Consumption p.c. in tonnes EU(28); Source: Eurostat, 2017b.

As part of the Resource Efficiency Roadmap, a dashboard of indicators was developed to track the progress towards a more resource efficient Europe. The ‘RE scoreboard’ covers the areas of materials, land, water and CO₂, which all play a role in RE. The headline indicator is resource productivity. Resource productivity refers to the economic value extracted from resource consumption. It is calculated as the ratio between GDP and an indicator of material consumption, generally DMC². Resource productivity in Europe, measured as above, has increased by 34% between 2000-2014. This increase is mainly associated to the decrease of DMC as a consequence of the impact of the economic crisis in traditionally resource intensive sectors such as construction and manufacturing. Another factor is the growing reliance on imported fossil fuels and metals into the EU-28 which is not fully depicted by DMC figures (EEA, 2016a), as it does not capture environmental implications of upstream activities³.

Looking at the evolution of GDP and DMC, the figure 3 below seems to suggest that most EU MSs have experienced some sort of decoupling, either relative (when GDP grows faster than resource consumption) or absolute (when DMC falls even though GDP is on the increase). In fact, the EU-28 on average experienced absolute decoupling for the period 2000-2014. This though needs to be treated with caution as here the physical indicator used to calculate decoupling is DMC, which does not take into account the “hidden flows” of the imported goods, and therefore, does not include the resource use associated with the outsourcing of material intensive sectors to third countries (i.e. steel or clinker production).

² Raw Material Consumption aims to provide a more accurate picture of the impacts of resource consumption by taking into account the “rucksacks” associated to imports, which are not considered in the DMC indicator. There are, however, still data gaps for the calculation of resource productivity using RMC. It is not provided at country level to date.

³ LCA approaches suggest that environmental burden of extraction activities and primary transformations represent a large share of the overall life-cycle impact (Mattila et al., 2010).

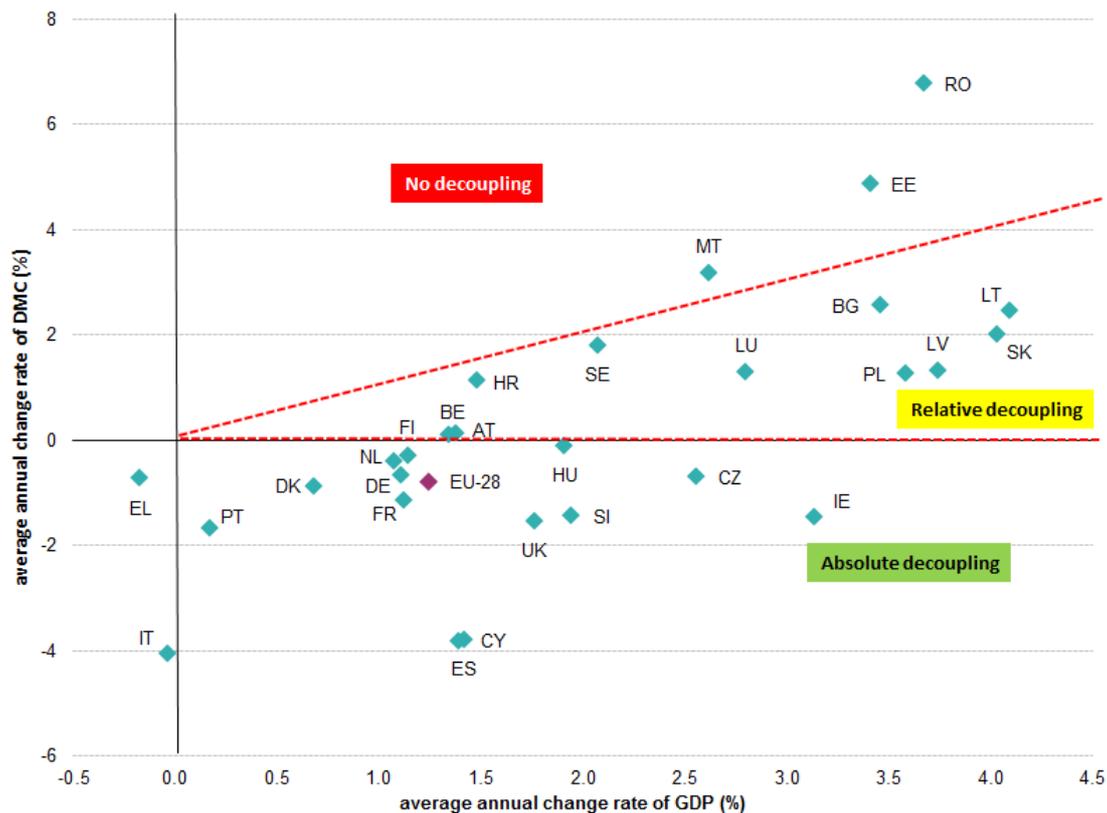


Figure 3: DMC and GDP average annual change rates in EU-28 and countries between 2000 and 2015; Source: Eurostat, 2016.

According to a recent monitoring report (European Commission, 2015a), the EU shows progress towards resource efficiency. However, in comparison to figures stressed by relevant authors concerning the necessary level of material consumption in 2050 (i.e. a reduction of resource use of up to minus 80% of the current level), the EU progress appears rather slow (Ekins et al., 2009; Dittrich et al., 2012; Bringezu, 2015).

The concept of the circular economy is though much wider. It involves a systemic change that encompasses innovation and technology systems but also policies, society, business models and finance (EC, 2015). The idea is to create a regenerative system where products, components and materials are maintained at their highest value for as long as possible and resources can be productively recovered and reintegrated in the economy or provide nutrients to natural systems (Webster, 2015). Benefits associated to new business models are indeed substantial. Meyer et al. (2011) estimated that resource efficiency improvements across different value chain could provide raw material savings in the region of 17-24% and costs savings of around €630 mill. in Europe. Based on product-based modelling, EMF (2012) suggested that boosting circular economy business models could increase EU GDP by 3.9% by 2030.

Achieving benefits is, however, not a straightforward process as resource efficient behaviours and new business models are faced by a number of dynamic and interrelated barriers that form what has been referred to as the 'web of constraints' (Kemp and Dijk, 2013). This paper aims to provide an overview of the key characteristics of the current legislative frameworks for resource efficiency at the EU and its MSs to better understand the framework conditions as well as the structure of incentives and institutional set up that define the play-level field for Resource Efficiency and CE in Europe. The analysis also aims to unveil areas of conflict and inconsistency across different policy areas and legislative levels. This is done looking at the inter-linked levels of EU-MSs. The paper has been structured as follows. Methodological notes are summarised in the next section 2. Section 3 discusses the role of

policy frameworks. Section 3.1 presents the analysis of the policy framework at the EU level, while section 3.2 presents the results of the analysis at the national level. Section 4 discusses the interface EU-MSs and identifies key challenges and provides policy recommendations. Section 5 draws a conclusion.

2. Methodological notes

2.1 Definitions

Resource efficiency is an engineering term referring to the increase of resource productivity or the reduction of resource intensity of the use metals, minerals, fuels, water, land, timber, fertile soil, clean air and biodiversity (European Commission, 2011)⁴. In the policy context it is used in a wider sense encompassing approaches and initiatives that increase energy and material efficiency and help the transition towards decoupling of resource use from economic development. A resource-efficient economy, which is understood as an economic system that is competitive, inclusive and operates within the planetary boundaries (Rockström et al., 2009), has become a vision of the EU (European Commission, 2011). The concept of the circular economy is mainly a policy concept and has been defined as an economy *“where the value of products, materials and resources is maintained (...) for as long as possible and the generation of waste is minimised”* and is seen as an essential contribution to *“a sustainable, low carbon, resource efficient and competitive economy”* (European Commission, 2015b). The CE proposes the transition from linear systems to circular systems driven by new business models that exploit circular loops and more efficient use of resources.

2.2 Analytical framework

The main aim of this paper is to provide insights into the current policy landscape for resource efficiency and the circular economy in Europe. The analysis departs from the analysis of the overarching EU policy framework shaping resource policies and then looks at a selection of policy frameworks in a representative sample of MSs. The analysis also investigates the interaction between both levels and the constellation of policies, institutions and actors that shape policy decision-making for resource efficiency and circular economy in Europe and investigates inconsistencies and conflicting goals across policy areas and levels. The analytical framework is loosely inspired by the notion of the “web of constraints” (Kemp and Dijk, 2013), to allude to the dynamic and simultaneous effects shaping the interplay between policy, policy implementation and institutional patterns that result in inefficient use of resources.

The analytical framework designed, as depicted in Figure 4, distinguishes three essential and interacting components: 1. the policy landscape for resource management constituted by relevant policies and targets, the set-up of the programmes and the legislation for resource efficiency, i.e. key programme and targets but also the sharing of legal responsibilities and competencies between institutions, as well as the coordination among them; 2. the economic incentive system which is composed of market-based instruments such as resource taxes and direct financial support but also importantly by framework conditions defined by taxation and fiscal systems and systems of innovation; 3. Relevant actor constellations and institutional set up influencing and shaping policy making in Europe. The analysis looks at two key policy levels: the EU and the MSs. The authors argue that it is essential to compare

⁴ Resource productivity = GDP/ resource use (in analogy to labour productivity) or resource intensity = resource use/GDP (as the inverse of productivity)

political and institutional structures, actor constellations and paths at the supranational and national level, including the interplay of both levels, in order to identify inertia factors and incentive structures that are potentially counteracting systemic or technological leaps.

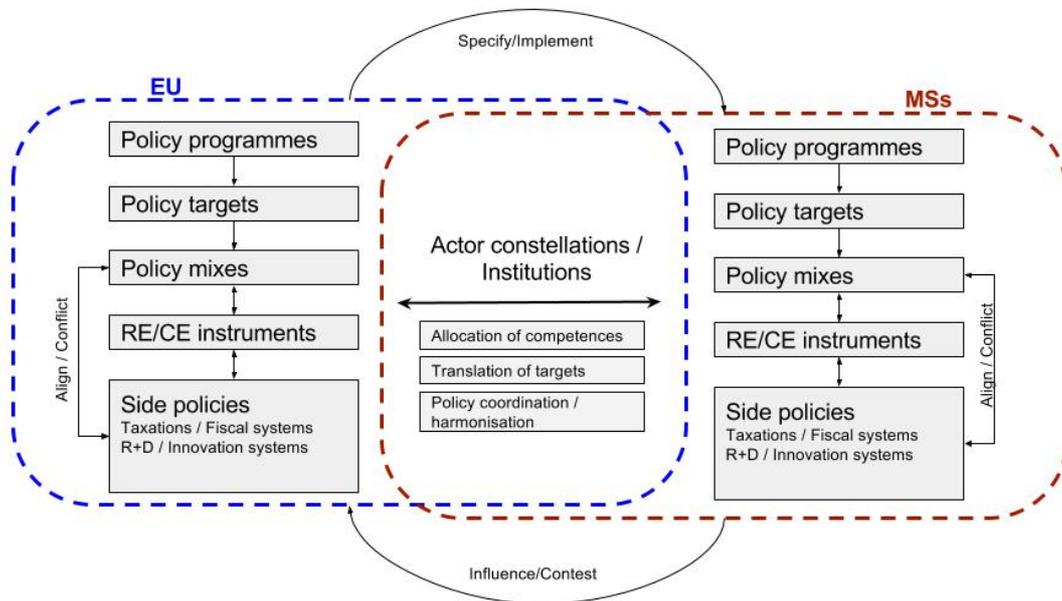


Figure 4: Analytical Framework; Source: Authors' elaboration.

2.3 Data sources

The analysis is based on a comprehensive review of policy documents and empirical surveys in which the policy development is observed and discussed (EEA 2011, 2016a, 2016b, EIO 2013, 2014, 2016). Programmes, policy documents, legislative proposal, Directives, targets and a comprehensive review of EU and selected MSs institutional set up has been undertaken. The work builds on the review undertaken as part of the project POLFREE (Policy option for a Resource-Efficient Economy) (Domemech et al., 2014, Bahn-Walkowiak et al. 2014).

3. The transition to a resource efficient circular economy: overview of policy frameworks

Previous analyses have shown that economic development and resource use depends on a complex interplay between formal and informal institutions (North, 1990), environmental and economic policies (Bleischwitz et al., 2011; Ekins and Speck, 2011) and systems of innovation (Kemp, 2012; EIO, 2013). In the case of Europe, this complex system is also shaped by the distribution of competencies between European supranational level and the national MSs level and the systems of negotiation and actor constellations at both levels and the interplay between them.

3.1. EU policy landscape

This section provides an overview of the policy framework in Europe, identifying overarching policies, targets and key instruments. It also points at potential conflicts between policy areas and discusses the role of EU in shaping incentive structures.

3.1.1 EU policy framework for Resource efficiency: legal basis and key programmes

The protection of the environment is one key priority of EU law. Specific reference to the protection of the environment was first introduced in the European Community treaties by the Single European Act (1986), articles 130r and 130t and refined in the Treaty of Maastricht (1992) and Amsterdam (1997) (Massai, 2012). The treaty of Lisbon (TEU and TFEU) refers to sustainable development as one of the objectives of the EU (art 3(3) TEU) along with other principles such as economic growth and price stability. Also, art 3(5) TEU refers to the role to be played by the EU in achieving a “sustainable development of the earth”. Furthermore, a specific reference to sustainable development is included in the general provision on the Union’s External Action (art 21(2)d and f TEU), guiding the foreign policy and external action of the EU.

The TFEU also indicates the guiding principles of EU environmental protection policy and its objectives, and it includes a principle to ensure the “*prudent and rational utilization of resources*”, which provides legal basis for the action of the EU in the area of sustainable resource use and the circular economy. In fact, while progress in other areas has been more fragmented and subjected to political cycles, environmental policy has demonstrated an ability to maintain steady growth both with regard to coverage and ambition of existing policies (Jordan et al., 2005). The policy focus on resource efficiency in the last years has been the necessary bridge to embed environmental concerns into the core of the development strategy of the EU. The pre-eminence of resource efficiency in the policy agenda was initially motivated by a steady increase in resource prices in the period 2002-2011, but has since then been associated with wider issues such as supply security and competitiveness.

The review of EU policies on resource efficiency though shows a somewhat ambiguous picture. On the one hand, the EU has today one of the most advanced policy frameworks of the world in terms of environmental protection and specific action has been detailed for resource efficiency with the ‘Resource Efficiency Roadmap’ and the ‘the Circular Economy Action Plan’. On the other hand, the resource efficiency agenda has also fallen in the “joint-decision trap” (Scharpf, 1988), favouring status quo and incremental policy over more radical, innovative policy approaches.

At this moment, the overarching vision and strategy for moving towards a resource efficient circular economy is provided in the following key policy strategy documents:

- The Europe 2020 strategy for smart, sustainable and inclusive growth
- The flagship initiative on resource efficiency and the resource efficiency roadmap
- The circular economy package

All these initiatives have come to complement areas of traditional special interest of the EU environmental policy such as waste management and energy efficiency.

The flagship initiative on resource efficiency has been operationalized through a number of roadmaps and communications that tackled different dimensions of resource efficiency (see table 1).

Table 1: EU policy instruments and main purposes/ targets

ROADMAP/POLICY INSTRUMENT	MAIN PURPOSE/ TARGET
Low-carbon economy 2050 roadmap	Possible pathways to reduce GHG emissions by 80-95% 1990 levels by 2050 Improve energy security and promote sustainable

	growth and jobs.
Roadmap for a resource-efficient Europe	Increase resource productivity and decouple economic growth from resource use and environmental impact
Energy roadmap 2050	Pathways towards a low-carbon and resource efficient energy system
European Transport plan	Increase mobility and further integrate transport networks while reducing GHG emissions associated with transport

The resource efficiency roadmap provides orientation in terms of policy strategy to transform Europe’s economy into a resource efficient economy by 2050, defining milestones for 2020 to track the progress towards the 2050 vision and defining responsibilities for the EC and MSs (see table 2 below). Within the policy target of ‘transforming the economy’ the areas of sustainable production, consumption, taxation, innovation and research and ‘waste as a resource’ are tackled. These areas are meant to pave the way for the transformation required by the Circular Economy Action plan.

Table 2: “Transforming the economy” areas, milestones and responsibilities

AREA	MILESTONES	RESPONSIBILITIES	
TRANSFORMING THE ECONOMY	By 2020	Commission	Member States
Sustainable consumption	Appropriate price signals and products and services environmental information. Minimum performance standards for products and services	GPP Common method for environmental footprint Expand the scope of eco-design directive to include non-energy related products	Incentivise companies to measure and benchmark resource efficiency Help companies to make best use of waste Support SMEs Revise REACH candidate list
Sustainable production	Market and policy incentives to reward efficiency. Companies can measure and benchmark lifecycle resource efficiency		
EHS and taxation	<ul style="list-style-type: none"> Phase out EHS Shift taxation from labour to environmental taxation 	<ul style="list-style-type: none"> Phasing out EHS and monitor via European Semester country specific recommendations Exchange of best practices on phasing out EHS Indicators on the use of taxes on pollution and resources 	<ul style="list-style-type: none"> Identify most significant EHS Prepare plans and timetables for phasing out EHS Shift taxation from labour to environmental impacts Review fiscal policies to promote resource efficiency
Innovation and research	<ul style="list-style-type: none"> Scientific breakthroughs and sustained innovation efforts in the understanding, management of 	<ul style="list-style-type: none"> Innovation partnerships for meeting resource efficiency goals Joint technology initiatives or PPP to 	<ul style="list-style-type: none"> Focus of public research funding on resource efficiency

	resources and the reduce, reuse, recycle and substitution	promote resource efficiency <ul style="list-style-type: none"> • Tackle barriers to eco-innovation • Research funding on key resource efficiency areas through Horizon 2020 	
Waste as a resource	<ul style="list-style-type: none"> • Waste pc is in absolute decline • Recycling and reuse of waste streams • Full implementation of waste legislation • Eradication of illegal waste shipments • Energy recovery only to non-recyclable materials • Landfilling is phased out • High quality recycling 	<ul style="list-style-type: none"> • Stimulate secondary materials markets through economic incentives and end-of-waste criteria • Review existing prevention, reuse, recycling and landfill diversion targets (residual waste close to zero) • EPR schemes to ensure minimum recycled content, durability and reusability criteria • EU budget to give priority to activities higher in the waste hierarchy • Exchange of best-practice on collection and treatment of waste 	<ul style="list-style-type: none"> • Minimum targets in waste prevention and management strategies

Milestones under ‘Waste as a resource’ and ‘taxation’ in Table 2 are closely interlined with the policy process to the CE, which would be identified in the next section. They set the basis for the necessary departure from the linear economy and existing economic structures towards enabling the emergence of enabling CE policy approaches. Although there is some evidence that progress towards those milestones have been done at the EU level (Domenech et al., 2014), MSs progress has been more fragmented and less well monitored (Bahn-walkiak et al., 2014).

3.1.2 The EU policy framework for the Circular economy

The circular economy package (European Commission, 2015b) is the other key pillar of the strategies on resource efficiency that also originated from the Flagship Initiative. Its journey has in itself been illustrative of the complex policy landscape of the EU and its interactions with MSs and lobby groups in the policy-making process. The European Commission, under its former President Barroso, adopted a Circular Economy package in July 2014. The communication entitled "Towards a circular economy: a zero waste programme for Europe" established a common and coherent EU framework to promote the circular economy. The earmarks of this 2014 circular economy package were:

- boosting recycling and preventing the loss of valuable materials;
- creating jobs and economic growth;

- showing how new business models, eco-design and industrial symbiosis can move us towards zero-waste;
- reducing greenhouse emissions and environmental impacts.

The package proposed an overall headline target for material productivity measured as GDP relative to Raw Material consumption of 30% increase by 2030 and the setting of more stringent targets for recycling of waste, including a 70% recycling target for municipal waste, a 80% recycling rate for packaging waste by 2030, landfill bans for recyclable materials by 2025 and the objective to virtually eliminate landfill by 2030.

The withdrawal of the package though was one of the first decisions of the new Commission led by Jean-Claude Juncker and with Frans Timmermans as First Vice-President. The new Commission alleged that the withdrawal was motivated by the heavy focus of the package on waste and did not appropriately reflect differences in the production structure across MSs. The withdrawal sparked a wave of support for the circular economy among forward thinking companies that believed that the circular economy was the only way forward for European manufacturing sector. This led the commission to rethink the package and commit to a more ambitious and country-specific package by the end of 2015. The new package preparation was coordinated by First Vice-President Frans Timmermans with other DG's including growth, jobs and competitiveness, Environment, Maritime affairs and fisheries and Internal market, industry, entrepreneurship and SMEs. The new package "Closing the Loop – An EU Action Plan for the Circular Economy" has a stronger focus on eco-innovation and aims to cover the whole process from design to disposal and recovery/recycling. The new package includes among other key measures the review of the eco-design directive to include measures to support the reparability, durability and recyclability in product requirements, testing programmes under Horizon 2020 to tackle planned obsolescence, requirements for dismantling, reusing and recycling of electric products, actions to promote green procurement, quality standards for secondary products, action towards including individual responsibility under Extended Producer Responsibility schemes and targeted measures for a number of priority streams such as plastics, food, critical raw materials, building and demolition, biomass and bio-products.

The package is accompanied by legislative proposal, indeed the only legislative action directly included in the package, to review waste directives that include provisions such as 65% EU recycling target for municipal waste by 2030, a 75% recycling of packaging waste by 2030, a landfill cap to 10% of total waste by 2030 and harmonization of definitions and calculation methods.

3.1.3 Key Instruments

In terms of instrumentation, the Waste Framework Directives and the Eco-Design Directives are important pieces of legislation. Waste regulation combines in its foundation the polluter pays principle (PPP), the principle of extended producer responsibility (EPR), the waste hierarchy and life-cycle thinking to inform policy action in the area of waste management and beyond (i.e. waste prevention). The newly proposed targets in the circular economy package contribute to the shift from waste to 'waste as a resource' by boosting resource efficiency and maintaining products and materials and products longer in the productive cycle. However, as will be discussed later, large differences persist among MSs and the evidence of 'high quality recycling' is still weak (Domenech et al., 2014).

The Eco-Design Directive lays down an EU-wide legal framework for improving the environmental performance of energy-using and energy-related products through eco-design. Eco-design has proven a highly effective instrument, with wide acceptance across a range of stakeholders including producers and consumers. Evidence also suggests that the Directive has contributed not only to improve environmental performance of products but has also yielded positive effects on competitiveness of EU industry (Dalhammar et al., 2014). Including additional requirements to ensure the reparability, durability and recyclability of

products can promote the embedding of circularity principles in the product design phase. However, the instrument has also been criticised for its limited coverage (Bundgaard et al., 2017) and long process of development of guidelines by product category.

3.1.4 Relevant side policies: synergies and conflicts

Policy strategies directed towards resource efficiency and the circular economy are part of a complex landscape of policies and instruments that serve a variety of purposes such as growth, wellbeing, competitiveness and free internal market. Sitting underneath these explicit policy objectives and co-existing with them there is a myriad of power structures and lobby players that pursue specific interests that influence the policy making process. The analysis of EU regulation has revealed a number of cross-influences of EU directives and instruments (explicitly on resource efficiency or not) operating in areas as varied as agriculture and food, transport or infrastructures. While some of these policies operate in a synergistic nature (mutually reinforcing incentives towards RE), others pursue conflicting goals. Figure 4 describes some of these synergistic (in green) as well as conflicting (in red) interactions. For example, GHG reduction positively correlates to renewable share, but increasing renewable may have a negative impact on resource use and water availability and indirectly on land use.

Increasing the recycling of waste, for instance, could in principle also reduce the pressure on the consumption of primary raw materials and associated CO₂ emissions in Europe and upstream in exporting countries. There is though little understanding whether increasing levels of material recycling have contributed to substitute demand for primary resources in Europe or elsewhere (Fellner et al., 2017).

Examples of conflicting relations are not difficult to find. For instance, EU Transport policy is a key element in achieving the internal market and thus ensuring the free movement of people and goods, however, transport has also important resource implications as a source of environmental impacts such as air pollution, land use and land fragmentation and material use. While the link between transport and air pollution has been the primary focus of sustainable transport policies at the EU level, less attention has been given to the material and land use implications of transport policy. Little evidence and data exists regarding the direct and indirect use of land by transport infrastructures in the EU and even less so on the materials required to maintain and increase the transport stock. For example, a large amount of EU cohesion funds (around 12%) was used in large road-based transport infrastructure projects that aim at increasing convergence between MSs, but led to increased use of non-renewable resources for infrastructures and CO₂ emissions in the long term (Usubiaga et al., 2011).

Policies to 'avoid and shift' would significantly contribute to reduce the impact of transport but would require ambitious policies that address not only alternative transport modes and fuels but also the politically less attractive issue of overall reduction.

actors and what is considered feasible and viable and what is not. Two key areas defining framework conditions are fiscal and taxation systems and innovation and R&D systems.

R&D activities have been recognised a core element of the policy shift towards a more resource efficient, circular economy (EC, 2015). The Europe 2020 strategy sets the target to increase combined public and private investment in R&D to 3% of GDP by 2020. Progress to this target though has been negatively affected by the crisis and it seems unlikely that the target will be achieved. In 2014 it was 2.03% and has experienced limited progress since then. Forecasts predict that it will rise to 2.1% by 2020. The Europe 2020 also provides guidelines for R&D investment, identifying key strategic areas. The eco-innovation scoreboard assesses and compares eco-innovation performance across MSs. One of the key policy instruments designed to steer R&D activity has been the 'innovation union' flagship initiative, and the EU Eco-Innovation Action Plan derived from it. The plan addresses the bottlenecks, challenges and opportunities of achieving environmental objectives through innovation.

Taxation is another of the key areas to help transform incentive systems to work towards rather than against resource efficiency. Green Tax reforms in Europe have been extensively studied (see, for example, (Ekins and Speck, 2011). Most modelling exercises (Ekins et al., 2011; Ekins et al., 2012; EEA, 2016a) suggest that green tax reforms could deliver positive impacts. The EEA study calculated that applying ETR to achieve the 20% target of GHG reduction would help to create more than 1 million jobs with minor costs (0.04% of GDP). However, progress in this area at the EU level is faced with substantial obstacles. EU has very limited competences in the area of taxation. Taxation lies generally within the competence of national MSs (see section 3.2). The EU can only act where taxes pose a barrier to the internal market, under Art. 113 TFEU and, even then, it has to act unanimously.

The limited impact of the Energy Tax Directive (Directive 2003/96/ EC) is illustrative of these hurdles. The original of the Directive was to restructure and widen the scope of the EU's minimum rate tax system for energy products (previously limited to mineral oils), to all energy products including coal, natural gas and electricity. It also seeks to reduce distortions of competition that originate from divergent tax rates in MSs on energy products and promote energy efficiency and reduction of emissions. Under the framework of the Directive, Member States are free to set their own national rates above a minimum, which '*should reflect the competitive position of the different energy products and electricity*'. The Directive states that '*[i]t would be advisable in this connection to base the calculation of these minimum levels as far as possible on the energy content of the products. However, this method should not be applied to motor fuels.*' However, in reality, rates are based on historical values in Member States, rather than relative energy content, and motor fuels are explicitly excluded from this approach. In addition, over one hundred derogations were available which allowed Member States to apply reduced rates or exemptions for specific policy purposes, although most of these expired at the end of 2006. The directive, however, under Article 17 of the ETD, also leaves freedom to MSs to apply up to full tax exemptions for energy products used for a number of purposes, such as heating and agriculture or those regulated by special agreements, such as voluntary agreements or tradable permits. Other specific processes and sectors, including international aviation and shipping, and energy products used for combined heat and power (CHP) generation are exempted. The limited practical impact of the Directive led the Commission to propose a revision that better aligns with the current energy and climate change targets. As it stands now, for example, there exists no incentive for the use of renewables in place of fossil fuels, for both electricity and transport. Fuels used to generate electricity are exempt, and electricity consumption is taxed at a flat minimum rate – although other instruments such as the EU-ETS provide such incentive. A perverse incentive exists in

transport, as biodiesel is taxed at the same rate as diesel, despite lower energy content by volume. The proposal was seeking to differentiate the energy content and CO₂ emissions in the calculation of the minimum rates. However, following unsuccessful negotiations between the Council and the MSs, the Commission finally withdraw the proposal in 2015. As it stands, the directive is unable to contribute to the objectives of energy efficiency, reducing energy consumption or shift to cleaner fuels.

Another key element of the policy framework with an impact on resource use is raw materials policies. While the traditional realm of resource efficiency and environmental policies has been the demand and output side, raw material policies rather focus on the supply side and connect with the international dimension of resource extraction and consumption. In a largely globalised world, commodity markets are highly volatile, distorted by national framework conditions and purchasing power providing important limitations to the real impact of a EU policy on resource efficiency focused solely on the internal market. EU Raw Material Initiative was published in 2008 and reviewed in 2011 as an attempt to address the input side of resource policies. It is based on three key pillars: 1) 'fair and sustainable supply of raw materials from global markets'; 2) sustainable supply of raw materials within the EU; 3) Resource efficiency and supply of 'secondary raw materials' through recycling (EC, 2008). Commission actions for the first pillar have focused on action at the international level to guarantee security of supply (through 'Raw Materials Diplomacy'), enhance transparency of financial payments in the mining sector and trade agreements with strategic partners. The second pillar has been pursued through actions to promote best practices, research and innovation and development of benchmarks. Finally, the third pillar is directly linked to the resource efficiency and CE agenda.

3.1.5 Conclusion

The analysis thus shows a complex policy landscape. While resource efficiency and the circular economy have grown in policy relevance, existing institutional structures and limitations in the legislative power of the EU provide an overall picture with competing targets and aspirations across different areas. A consistent resource efficiency policy agenda needs to acknowledge potential trade-offs between different dimensions of resource efficiency while also navigate through the boundaries of feasibility of policy-making in a context of weakened EU institutions.

The analysis also reveals that most policy efforts have concentrated on the demand side of resource efficiency with a view to increase resource efficiency and boost secondary market materials. Raw material policies are more complex and interlinked with trade and development policies and highly depended on the international dimension. The strategy has developed targeted measures that tackle investment and innovation in extractive industries in the EU, bilateral and multilateral trade agreements with third countries and anti-dumping instruments, but further coordinated action maybe needed to make progress towards the three pillars of the strategy.

Against this background, MSs have a major role in setting the right policy and economic incentives to progress towards resource efficiency. The next section reviews national policy frameworks for resource efficiency, and provides an overall picture of the national strategies, programmes and instruments in place for a selection of MSs.

3.2 National policy frameworks

Against the background of the guidelines developed and elaborated in the RE Roadmap (as displayed in table 2), the following section will provide a brief overview of the development at the national level and partly refer to country examples.

3.2.1 Programmes, targets and institutions

The terms resource efficiency and circular economy have also increasingly been taken up at the national level. The milestones set by the Roadmap to a resource efficient Europe (European Commission, 2011), the development of a resource efficiency scoreboard (European Commission, 2016) and the objectives of the circular economy package (European Commission, 2015b), have contributed to set clear impulses for MSs to embed resource objectives in various national programmes, strategies and instruments. In fact, some national policies precede EU policies.

Although the EU does not have a binding overarching target for resource efficiency, nine countries have adopted targets for a national and economy-wide resource productivity so far: Austria, Estonia, France, Germany, Hungary, Latvia, Poland, Portugal and Slovenia.⁵ Most of these targets are based on gross domestic product in relation to domestic material consumption (GDP/DMC), the EU's lead resource productivity indicator (EEA, 2016a). However, absolute reduction targets do not exist to date while some consumption limits have been implemented at sectoral/ raw material level, e.g. in Sweden and Estonia (Bahn-Walkowiak and Steger, 2015). However, the majority of the goals described in sustainability strategies or environmental programmes for resource efficiency are rather qualitative, i.e. without timelines and figures to be achieved.

From a barriers perspective, resource targets serve the society and economy by removing orientation and information deficits and they can initiate or at least prepare for a change in behaviour. Due to their controllability and higher liability, quantitative targets are mostly considered 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 and Steger, 2015).

Only three countries have a dedicated strategy for resource efficiency so far (Austria, Germany and Finland), although most countries address resource efficiency issues in one or several other strategies and action plans (EEA, 2016a). From today's perspective, the relatively specified strategies of Germany and Austria are regarded as pioneering, with Austria being the only country indicating figures and timelines and Germany seizing the roadmap ideas in terms of the sectoral approach. Unclear ministerial and often overlapping responsibilities in many countries, however, require greater efforts in terms of the horizontal and vertical policy coherence (EEA, 2016a).

There is nevertheless evidence of a growing tendency to establish organizations in many countries, such as efficiency agencies, but they are very heterogeneous at European scale and usually focus narrowly on their area of jurisdiction, or a single sector or a resource type (EEA, 2011; EEA 2016b).

While such national strategies and their institutional embedding reduce orientation and information deficits, a division of strategies into rather economically driven and rather ecologically driven policies has emerged at European level and was partly reproduced in some countries, such as Austria, Germany, Finland (Bahn-Walkowiak and Steger, 2015; Bringezu et al., 2016) which bears the risk of conflicts of interests between competing societal goals. This is also reflected in diverging responsibilities between economic and

⁵ Examples of specific goals aiming at increasing resource productivity/ resource efficiency are: Austria stipulates an increase of resource productivity by factor 4 (2012) and factor 10 (2050), resource efficiency increase of 50% and decrease of 20% resource use (2020). Germany strives for a doubling of raw material productivity (1994-2020) while Hungary aims at minus 80% material intensity by 2050.

environmental ministries for resource efficiency and raw material access. Securing access to raw materials and addressing availability problems as well as exploiting the business opportunities of eco-innovation in an efficiency transition does entail further conflicting goals and interests, not only at a strategic level but also at business level (Bleischwitz et al., 2012; Bastein et al., 2014).

3.2.2 Economic incentive systems and further relevant policies

Different instruments can be combined to shift towards resource efficient, more circular economies. Economic incentive systems play a crucial role here by embedding resource efficiency in the decision-making of economic actors. In this vein, 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 simultaneously achieving economic objectives and increasing resource efficiency (EIO, 2016; COWI, 2011) by being a fusion point of innovation and environmental policies. Incentive instruments and programmes are widely established, and yet mainly focused, in the field of energy. Policies aiming to influence resource use, e.g. market-based instruments, innovation and technology driving instruments, and informational instruments, show a broad range of more than 127 different environmental protection and resource efficiency policies across the EU32 for SMEs, often tailor-made for national needs (Ecorys, 2011). The recent EEA report (EEA, 2016a) even reports 166 examples specified as good policy practices for resource efficiency.

The examination of European countries concerning direct financial incentives and support programmes for resource efficiency in businesses shows many parallels, both in terms of the measures implemented and the effects associated – but there is no single instrument that is applied in all European MS. Rather, different combinations of resource efficiency innovation and technology driving market incentive programs and information transfer in the form of targeted counselling prove to be quite effective (Hirschnitz-Garbers et al., 2015). This is particularly well documented in the field of energy efficiency measures in the building sector. While support programmes and financial incentives reduce information deficits and cognitive barriers and encourage learning processes with relatively good diffusion results in Europe, the overall picture is inconsistent and regionally fragmented.

Concerning market-incentives, it turns out that environmental taxes (e.g., Netherlands 8.9%, Hungary 6.8%, Germany 5%, Austria 5.5% with Serbia, Slovenia and Croatia leading with more than 10%) are altogether not very high and the contribution of pollution/resource taxes to the overall tax revenues is in fact negligible. It is mainly zero or below a 1% threshold of the overall tax revenue of European MS. In the general statistics, 76% of the environmental tax revenues stem from energy, 20% from transport, 4% from resources and they altogether come up to 6% of the total European tax revenue, which relates to 2.5% of the European GDP (Eurostat, 2016).

From an environmental perspective, taxes are a step towards reflecting the full external and social costs of resource extraction and use (Wilts et al. 2015) but from an economic perspective, taxes are always assessed as second-best policies due to their inherent impreciseness (Söderholm, 2011). Despite a long-standing debate on green tax reforms and the fact that the environmental effectiveness of eco-taxes is widely recognised among scientists and policymakers and an active promotion by many of the most influential international organisations such as the OECD, the UN, and also the EU for many years, a large-scale implementation of resource taxes has not taken place. Some authors argue that this mainly depends on the perceived high conflict potential of potentially regressive tax effects policy makers avoid with regard to their voters (Tews et al., 2003). In fact, resource taxes are confronted with a bundle of structural barriers: the market power of key sectors, the lack of information and cognitive barriers on various levels (industries, consumers, politics), split incentives in value chains, between companies, and different resources. Environmental taxes and charges are therefore overwhelmingly implemented on a very selective basis; they

cannot be considered sending a clear-cut signals to economic actors and consumers to date. In some countries, specific resources such as construction minerals are addressed by rather low tax rates (Withana et al., 2014). Hence, potentials are not exploited; the tax shifting aim (i.e. major shift from taxation of labour towards environmental taxation) (European Commission, 2011, p. 11) is not tackled seriously.

3.2.3 Green R&D, eco-innovation, and phasing out environmentally harmful subsidies

The green R&D (Research & Development) budgets are comparatively low within total government R&D budgets in the European MS (e.g., Austria 4%, Germany 7.1%, Hungary 3.8%, Netherlands 2.8% of total R&D) although some countries show larger magnitudes such as Estonia 13.9% and Finland 12.5%. The green R&D expenditures of businesses are unknown, i.e. there is no indicator as yet (Bahn-Walkowiak et al., 2014). Green elements in recovery programmes have a range of 13-56% with a striking clustering of expenditures for transport and energy efficient buildings (Pollitt, 2011).

Eco-innovation efforts and outputs still 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 pathways are determined like this. The last Sectoral Innovation Watch report is from 2008 (Europe Innova 2008) and 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 drastically being reflected in the budgeting for eco-innovation in recovery, R&D efforts and innovation policies, pointing to a fundamental “mislabelling of sustainability as purely environmental” (Sustainable Development Commission UK, 2011).

Another significant debate in the context of resource efficiency focuses on the reduction of subsidies contributing to pollution (Wilts et al., 2015). Subsidies are often associated with environmental disadvantages; many of them are “resource-relevant” (Münch and Jacob, 2014). A useful definition widely used draws on the OECD term environmentally harmful subsidies 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 indicates that the definition refers to “action” only. But “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 et al., 2012).

In contrast to the rather fragmented picture of environmental taxation, there is a remarkable inter EU homogeneity of subsidies in resource-intensive sectors, for example in the transport sector (according to Roadmap transport is a key sector and the only sector without any decoupling signs), such as commuter compensations, company cars privileges, no road pricing, tax cuts for agricultural vehicles, unfavourable taxation of competing modes of transport, etc. And there is altogether a low activity in the phasing out of national environmentally harmful subsidies; the countries inspected show rudimentary or even no activities (Bahn-Walkowiak et al., 2014).

Summarising the above, the following figure shows governance patterns of resource efficiency policies with respect to Roadmap requirements of four example countries. Countries are assessed according to their fulfilment of the criteria indicated below ranging from 0 for no activities to 4 for high degree of activities. The results of the investigation of the three main fields institutional set-up (raw material initiatives, resource efficiency programme, coordination of programmes), incentives (environmental taxes, resource taxes, direct financial support, support for SMEs via consultancy) and side policies (green elements in economic recovery programmes, green elements in innovation policies, activities for the phase out of

environmentally harmful subsidies (EHS) in the areas meat and cars) are represented in so-called spider 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 for a comparative overview of the different policy areas and their characteristics which will be briefly described in the next section.

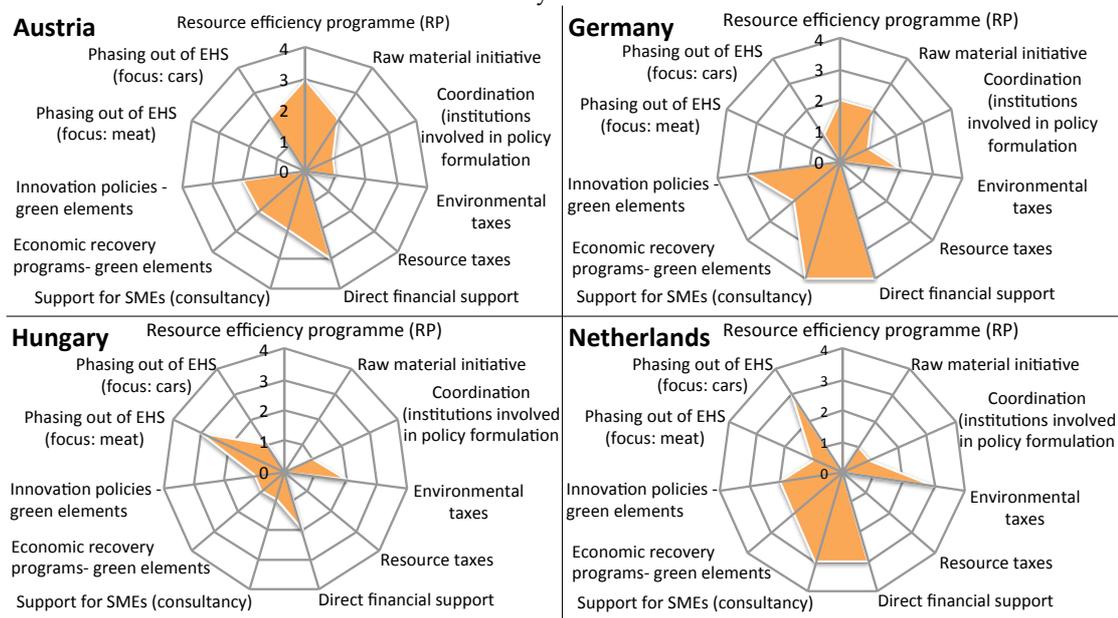


Figure 5: Policy frameworks of resource efficiency policies with respect to Roadmap requirements of four example countries; Source: (Bahn-Walkowiak et al., 2014)

In terms of resource efficiency agendas/ action plans, Austria and Germany are leading but have a focus in the field of financial incentives and support programmes for industry. At the same time, aspects like the phasing out of EHS or shifting labour taxation to resource taxation are weakly or not at all pronounced, as both countries raise no resource taxes apart from energy taxes and water charges. Other focal points lie in the field of innovation policy, which is good to very good pronounced. There are also no resource taxes in Hungary and Netherlands, but the Netherlands are leading in the context of other environmental taxes. With view to eco-innovation and green components of innovation policies, activities are mentionable 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, for example, tax deductions for commuters. Hungary stands out for introducing a raised standard value added tax rate on meat. There are no such activities to be noted in Austria and Germany. The Netherlands shows absolute decoupling and the lowest per-capita resource consumption of the country sample but it has hardly launched any activities on the institutional side such as the development of resource efficiency action plans or the corresponding advisory institutions. 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 (2000-2015). This suggests that Hungary (still) has more frugal production and consumption patterns.

The resource efficiency agenda of the Roadmap took steps towards a more input oriented approach by introducing the lead indicator of resource productivity and envisioning that “Economic growth and wellbeing is decoupled from resource inputs and come primarily from increases in the value of products and associated services” (European Commission, 2011). Meanwhile, many countries refer to the EU lead indicator without having an adequate

indicator at the national scale implemented. It is worth to note that most countries do not relate to a potential reduction of material input. By and large, most countries refer to resource policies as an efficiency issue, not an issue of reducing the absolute input. In contrast to this, the circular economy and the closing of the loops will require significant extensions of value chains and life cycles.

However, as regards waste, the main regulation at national and European scale aims to apply the waste hierarchy although there are no targets for the prevention or the reuse of waste in the European regulations including the newly released Circular Economy Package. Most countries have a focus on the recycling of materials, some on the recovery of energy from waste, very few on the exploitation of secondary resources. Present waste management is still clearly output oriented (EEA 2016a; Bahn-Walkowiak et al. 2014; EEA 2011).

Summarizing the above, the MS analysis reveals a clear movement towards establishing programmes and institutions but depicts large untapped potentials as regards eco-innovation, related investments, environmental taxation, and phasing out of environmentally harmful subsidies in resource-intensive sectors. The different institutional set-ups in the countries as well as the diversity in policy choices and preferences further shows a lack of ambitious goals and points to a general uncertainty what a focused and targeted transformation to a substantially improved resource management could mean. The role of the national key sectors (which are often resource intensive sectors) and their quantitative and qualitative contribution to path dependencies is widely not transparent and unexplored.

4. The EU-MSs interface of RE: processes, gaps and actor constellations

Building on analysis above describing overall policy framework for RE and CE at the EU and MSs level, this section provides some insights on the interface between EU and MSs to understand how EU-MSs interaction shape policy processes for RE and CE in Europe. It also adds some reflections on the overall framework conditions for RE in Europe pointing to policy recommendations.

4.1 policy processes and actor constellations

The rapid ascension of the resource efficiency agenda in EU policy has run in parallel with the development of national strategies. As it occurs in other areas of EU policy making, regulatory policy making at the EU has a *“reciprocal, two-level character”* (Lieberink and Andersen, 2005). On the one hand, policy making is highly influenced by MSs and, on the other hand, the EU policy framework has a direct influence in the national policy-making processes, because of its legal capacity to impose targets and regulations at the national level. The interface between EU and national policy making has been the object of substantial academic interest (see, for example, (Weale, 1996; Selin and VanDeveer, 2015) although there is limited research that specifically addresses how the EU-national level interface and dynamics have influenced and played a role in the definition of the resource efficiency agenda. In line with the notion of the web of constraints, policy making is a complex process where policy priorities and policy instruments are negotiated with a number of different actors that hold different and sometime conflicting sets of values, interests and practices. This contributes to explain the political difficulties to advance in the resource efficiency agenda when trade-offs are to be made. Also concerns have been raised recently about the capacity of the EU to lead the resource efficiency circular economy transition in a context of weakened institutions and rise of Eurosceptic fractions in the parliament (Ekins et al., 2015).

An example of a win-win policy that could significantly contribute to increase resource efficiency such as the removal of environmental harmful subsidies can be extremely difficult to implement in practice, given power distribution and lobbying of relevant national actors. Complexities of the policy making process at the EU level is also revealed in the recent review of waste policy. Environmental regulation is subjected to the ordinary legislative process. The process increases the opportunity to input the legislative process by EU institutions, namely the Council, the Committee and the Parliament but also increases the chances of opportunistic behaviour and veto players. Negotiation of the legislation can drastically affect the scope and ambition of a piece of regulation. In the environmental area, negotiations have been traditionally led by environmental leading countries but the enlargement of the Union has increased dynamics of leader-laggard, leading to not always optimal solutions. Liefferink and Andersen (2005) propose a classification of strategies that leading MSs may adopt to try to influence environmental policy. This classification categorises strategies according to two variables: whether the MSs act as a direct or indirect pusher, and whether its forerunner role is purposeful or incremental. For example, countries with a long tradition of environmental regulation such as Denmark or Germany, may try to exert a push towards more stringent environmental regulation and try to align with other countries or commission experts to push EU regulatory standards. Although it could be said that the EU has generally contributed to more stringent environmental standards across Europe, it may, in some cases, have restricted the adoption of more ambitious policies when these were perceived as having a negative effect on the functioning of the internal market, such as in adopting higher taxes for fuels (Liefferink and Andersen, 2005).

The negotiation of the circular economy package is also illustrative of this complex policy-making landscape. The initial withdrawal of the package was supported by the conservative lobby of Business Europe under the premise that waste regulation would have a negative impact on business competitiveness. This traditional vision overlooked potential opportunities linked to increasing the efficiency with which resources are used and the circularity of materials, especially in an import dependent region such as Europe. The lack of support to the package by some MSs such as Germany or Denmark, which generally see themselves at the forefront of environmental policy making in the EU, for its excessive focus on waste, was more unexpected and reveals the complexity of EU led processes in an era marked by weakened institutions. Despite this difficult beginning, the new package may have emerged stronger as it has pervaded the boundaries of traditional environmental policy making to include growth, entrepreneurship and internal market but it leaves questions open with regard to its compatibility and inevitable connection to the RE Roadmap.

As to the interaction of the EU and MS level, one common trait is the focus of RE policy agenda on the output side, with little consideration of input targets and measures to prevent and reduce consumption of resources in the first place. Addressing the input side even by non-binding targets has proven difficult at both levels, limiting the scope of RE and its effectiveness in the long term.

4.2 Framework conditions for RE/CE in Europe

The overview of EU and MSs policy framework for RE and CE have shown a somewhat fragmented picture. Although policy programmes towards RE and CE have been introduced at the EU and in a number of MSs, conflicting target and objectives evidence a lack of integration between RE/ CE policies and other relevant economic policies such as trade, transport or taxation. Progress towards RE is not always well monitored and the interface between EU-MSs shows a complex interaction among national actors and EU institutions.

A key feature are fiscal and tax systems, where the EU competences are limited and where attempts to introduce changes have been strongly contested by MSs⁶. Taxation systems of the MSs have continued to set incentives for natural resource wastage and shortage of employment (EEA, 2016b; von Weizsäcker et al., 2014). The overall share of public revenues generated by resource taxes in Europe is extremely low. Only 4% of the overall environmental taxes are collected from pollution and resources (EEA, 2016b) and very different among the European MS states. They create weak incentives for consumers and businesses to save resources aside the volatile behaviour of commodity markets.⁷

Aside from general framework conditions, policy frameworks also importantly influence other areas of policy such as innovation, manufacturing, infrastructures or housing with direct and indirect effects on resource consumption (Bahn-Walkowiak et al., 2014). An example of this are the conflicts highlighted in section 3.1.3 with regards to transport policy, where attempts to strengthening internal market may have a negative impact on resource efficiency.

The analysis also has revealed that foreign resource policies are crucial for the security dimension of raw materials, exploration activities and access to raw materials and while these mainly lie at the level of the national state, pointing to a potential role for the EU to work on a harmonised framework conditions to address the international dimension of raw material policy (Bringezu et al., 2016; Bleischwitz et al., 2012).

5. Conclusions

The review of policies in Europe on resource efficiency gave a number of interesting insights. The EU Roadmap has evolved and induced a strong dynamic in the resource efficiency policy area in recent years through setting aspirational objectives and encouraging innovation and learning effects, without leading to direct reduction effects so far. Resource efficiency has acquired policy pre-eminence through its inclusion as one of the key pillars of the Europe 2020 strategy, though its impact on national policy frameworks is still inconsistent and, in many cases, weak. The practical effects on resource efficiency are highly dependent on the choice of national instruments and priorities with regard to resource-intensive sectors, with lie mostly outside the legislative competence areas of the EU. A much more consistent and coordinated use of existing structures, institutions and potentials and an integration of more modest life-styles and economies is required. In general, the analysis suggests that policy binding objectives still largely concentrate on the output side of resource flows (i.e. emissions, waste) while the input side is more challenging for its connection to other areas such as Trade and Development. Action in this area has been articulated through The Raw Material Initiative, although its policy process is less straightforward articulated through aspirational, non-mandatory targets, scattered across policy documents. Absolute decoupling of resource use from economic growth is part of the vision drawn by the EU resource efficiency roadmap but has not been addressed directly by specific policy instruments or dedicated strategies at the EU level. At the national level, only a limited group has set targets for a national and economy-wide resource productivity so far and few countries have a dedicated resource efficiency or circular economy strategy.

⁶ An example of this is in the area of energy taxes. In 2011 the EC prepared a proposal to modernise energy taxation and better align it with environmental and energy goals. The key feature of the proposal was to have a tax that would split into two components to better reflect CO₂ emissions and energy content. The proposal was voted by the parliament in 2012, but MSs opposed the changes leading to its withdrawn by the Commission in 2015.

⁷ In fact, the policy interest in the circular economy was partly motivated by the steep increase in prices of resources in the first decade of the XXI century, but this motivation has become more fragile now that prices of commodity prices have returned to low levels. Aspects such as security supply, EU import dependency, volatility and specific groups of critical raw materials though have contributed to keep momentum of the shift towards circular models.

The vision of the EU roadmap has pervaded national laws and activities contributing to advance large steps forward but was recently challenged by the introduction of the CE package that does not directly continue the Roadmap's milestone approach in the areas beyond the waste issues. While the roadmap is a comprehensive visioning exercise that tackles all key areas, the circular economy package is limited in its scope and weak in terms of instrumentation (no hard-binding objectives apart from those on waste; measures very much rely on adaptation of existing instruments, e.g. eco design, rather than other economic instruments). Significant advances in resource efficiency have to be based on a successful interplay and interaction of several factors in the political realm such as congruent strategies and targets, coherent institutional arrangements and policy systems and distinct and consistent incentive systems and relevant side policies which are credible and aspirational for actors and stakeholders (Rogge and Reichardt, 2015; Wilts et al., 2015).

The restraint in the area of taxation is striking. It is obvious that taxes are used as elements for competition, so that national states flee the risk of competitive disadvantages through higher taxation on resources. But a policy strategy that relies mainly on the output side of the material and energy cycles is unlikely to bring the transformative change needed for a truly resource efficient economy that operates within the carrying capacity of ecosystems (or safe operating space, Rockström et al., 2009). Unless there are significant reductions in the input side through a substantial increase of energy and resource efficiency and the limitation of resource use (e.g. a factor 4 or factor 10), environmental problems are unlikely to be resolved but aggravated due to cumulative effects and ecosystem thresholds. Progress in recycling and reuse of materials are certainly in the right direction to increase the circularity of the system and work towards closing the loops of production and consumption processes by providing alternative sources of resources to maintain the actual physical stock of societies, but these measures are clearly insufficient if they just supplement rather than substitute primary material consumption. An example of this is illustrated by the building sector where continuous efficiency improvement and recycling have not led to significant reduction of material demand. It is also generally true that increasing circularity would not only yield benefits in material recovery but also in energy savings as reprocessed materials are expected to require less energy than primary materials. However, energy implications of recycling need to be carefully considered to understand the energy implications of increasing circularity.

The analysis of the EU policy framework and national policies on resource efficiency has revealed a complex policy picture made up of policy strategies, targets and instruments that do not always align across different dimensions of resource efficiency or sectors of activity. The web of constraints metaphor proposed moves beyond this perspective and takes an integrative view that accounts for the constraints acting on policy choices and policy processes. Policy choices in the EU are subject to specific mechanisms and political influences. The negotiation of policies at the EU level has been largely influenced by the post-Nice procedural and voting changes and the dynamics of leaders-laggards in the environmental arena (Lieverink and Andersen, 2005; Jordan et al., 2005). The enlargement of the EU to Central and Eastern European countries with weak environmental frameworks has strengthened the leader-laggard dynamics and increased national divergences in the adoption and implementation of the common EU legislative frameworks, which has also had an effect on resource efficiency and the circular economy, where large differences still persist not only in terms of performance but also in terms of the prevailing policy frameworks. Some may argue that the widening of the gap between best performing and worst performing MS could indeed provide incentives for slow movers or worst performing MS to significantly improve their national strategies while providing leaders with some pioneer advantages. In this sense, a web of constraints may develop into a 'web-of-drivers' if some changes occur simultaneously and a window of opportunity opens for the introduction of far-reaching

policies. However, one may also argue that the different resource management approaches in the countries as well as the diversity in policy choices reveals a lack of orientation and uncertainty in the general transformation to a resource efficient and circular economy. Indeed, the web of constraints is strongly shaped by different interactively linked governance regimes, not at least with regard to taxation, infrastructural and innovation pathways. Large challenges lie in a more coherent guidance at European level and the coordination of stakeholder and industrial interests at national level. Europe could take the lead (as was done with EU Roadmap) but needs to be more specific and stable about the directions and areas of action.

It seems advisable to much better interlock circular economy and resource efficiency policies and clarify their mutual relationship in order to avoid the risk of a dilution of the concepts and encouragement of a path of least resistance strategy as long as there is no clear target orientation and definitions of the way to goal attainment as such.

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