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WP 1 – Why have resources been used inefficiently?

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Resource Efficiency, webs of constraints and drivers, EU, Members states, policy mixes

1. Introduction

This report provides a synthesis of the work in WP1 that was interconnected through the shared question: Why have resources been used inefficiently? This question has been explored from different angles: from an EU policy perspective, from national policies perspective, from a business perspective and from a citizen-consumer perspective. As this report will show, there is no straightforward answer to this question, for different reasons. The key reason is that resources are so diverse. As the Polfree DoW states, our project considers resources *to comprise energy, water, land and marine area (with associated ecosystem goods and services), soil, biotic (including biodiversity) and abiotic materials, and the capacity of the air, water (fresh and marine) and land to disperse and reintegrate into natural cycles, without harm to human health, emissions of all kinds from human activity, without loss of ecosystem function*. Most activities, practices or policies directly or indirectly involve multiple resources being consumed and released back into natural ecosystems in the form of pollutant emissions or waste. Obviously, a matter so diverse will not likely have a single reason for being used inefficiently.

As the report will show, a second reason for lack of straightforward answers is that in resource use human agency matters, and for understanding practices of human agency, single factor explanations do not offer a lot of mileage. For instance, green values are not a good predictor for green behavior: values tend to interplay with many other things, such as with costs, preferences, social norms, convenience, infrastructural context, policies, etc., often dampening the impact of green values. In other words, the answer to the question of inefficient resource use is a compound or complex one.

Because of this, the analytic framework of WP1 has proposed to move beyond the notion of 'barrier' (as in 'barrier to resource efficiency') as something concrete that can individually be tackled and overcome by for example a specific policy instrument. Rather, it suggests that in most cases barriers resemble more a complex web of constraints that include individual and institutional behavioural patterns, inertia and direct and indirect interconnections between the institutional, social and individual levels. An implication of this is that the design of a far-reaching policy strategy on resource efficiency requires systemic changes operating at different levels including business models, social consumption patterns, regulation and discourses.

This report provides a synthesis of the work in WP1 - addressing the central question 'why are resources not used more efficiently'. The next four sections give highlights of the contributions of the four angles to the central question – EU and national policies, citizen-consumer and business perspectives. Section six addresses the market for primary and secondary resources. Section seven discusses the link between resource efficiency and energy efficiency with special attention to recycling and remanufacturing. The subsequent section provides some integrative conclusions and reflections on the usefulness of the notion of 'webs of constraints'. The concluding section discusses the implications for policy for resource efficiency, including both limits and possibilities. Through its reflection on barriers to, drivers of and policy lessons concerning resource efficiency, this report is a precursor to the deliberations about policy mix choices and modelling analyses (in WP2 and WP3).

2. Highlights of EU policy review

The Polfree Analytical framework (Task 1.1) provides the framework for the identification of drivers and barriers that has informed the review of EU policies (Task 1.2) and that of national policies (Task 1.3). Both tasks are highly connected since they both explore drivers and barriers derived from existing legislative and policy frameworks. However, they differ in their scope, because the analysis of the policy and legislative framework of the EU provides a level playing ground across EU27, while changes in the implementation contribute to explain significant performance divergences between member states. The interface between the supranational and national level is of key relevance to identify drivers and barriers for resource efficiency.

The review of EU policies on resource efficiency 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. On the other, 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.

Environmental policy in Europe has demonstrated an ability to maintain steady growth both with regard to coverage and to ambition of existing policies (Jordan, 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. As recognised in the 2020 strategy, resource efficiency has been identified as “the route” to an economy that is competitive, inclusive and provides a high standard of living within the limits of planetary boundaries and where resources (energy, water, air, land and soil) are sustainably managed while ecosystems are protected and restored (EC, 2011). The pre-eminence of resource efficiency in the policy agenda has been motivated by a steady increase in resource prices over the last decade and especially since 2002 (McKinsey, 2011). This has been translated into a number of important initiatives in the area of resource efficiency that have culminated into the recently released circular economy package.

The circular economy package gives answer to some of the shortcomings of the pre-existing resource efficiency agenda with a strong focus on energy and climate change. A number of recent communications from the Commission have tried to address other relevant dimensions of resource efficiency, such as materials, waste and land. The circular economy package also proposes to include a material efficiency indicator, measured as material productivity (RMC/GDP), in the upcoming review of the 2020 strategy.

At this moment, three key policy documents provide the overall vision and strategy for moving towards a resource efficiency strategy.

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

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 Europe 2020 strategy for smart, sustainable and inclusive growth outlines the overall EU development strategy for the period up to 2020. The strategy was made up by seven flagship initiatives, which aim to define a stable policy framework to coordinate actions and provide certainty for investment in order to achieve key policy targets defined in the 2020 strategy. The flagship initiative on resource efficiency has been operationalized through a number of roadmaps and communications that tackled different dimensions of resource efficiency, one of the resource efficiency roadmaps 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.

In terms of instrumentation, the Waste Framework Directives and the Eco-Design Directives are important pieces of legislation. The Waste Framework Directive requires member states to ensure that waste is recovered or disposed of without endangering human health and without using processes and methods which could harm the environment. To this end, it requires MS to impose particular obligations on all those dealing with waste at various stages, including holders and professional collectors and transporters of waste. "Establishments or undertakings" which carry out waste disposal and recovery operations must obtain a permit or register a permit exemption; their operations must be inspected periodically and they must keep records of their activities in respect of waste. The Directive requires member states to take appropriate measures to establish an integrated and adequate network of disposal installations. It also promotes environmental protection by better use of resources, by way of promoting the recovery of waste over its disposal (the "waste hierarchy"). For these purposes, member states must produce waste management plans.[1]

Within the waste framework there are 4 priority waste streams:

- Packaging Waste
- End-of-life Vehicles
- End-of-life Batteries
- Waste from Electrical and Electronic Equipment

Waste regulation is based on the polluter pay principle (PPP) and the principle of extended producer responsibility (EPR). The EPR, together with the waste hierarchy and life-cycle thinking, inform policy action in the area of waste management. An important gap in the current legislative framework identified in the analysis is the lack of end of life regulations for buildings.

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. The Directive allows for EU-wide rules on the environmental performance of these products to be made, developing minimum environmental standards for energy-using and energy-related products, preventing national legislation in these areas becoming obstacles to the intra-EU trade.

Technically, the Eco-Design Directive is based on the Methodology for the Ecodesign of Energy-using Products (MEEuP) and its successor, the Methodology for the Ecodesign of Energy-related Products (MEErP) which extends the first methodology (MEEuP) from energy-using to energy-related products. MEErP is developed to investigate eco-design requirements appropriate for the products that are covered under the Eco-Design Directive such as heating equipment, cooking equipment (i.e.

[1] From https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69353/pb13569-wfd-guidance-091001.pdf

ovens and furnaces), machine tools, refrigerating and freezing equipment, sound and imaging equipment, transformers, and ventilation systems.

Eco-design has proven a highly politically feasible instrument that is accepted by a wide range of stakeholders. Evidence 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, 2013).

The review of EU policies on resource efficiency gave a number of interesting insights regarding the issues studied[2]. In general, the analysis suggests that policy binding objectives largely concentrate on the output side of resource efficiency while the input side is either completely overlooked or addressed 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 backed up by specific policy instruments or dedicated strategies.

From the feasibility point of view, there is evidence that suggests increasing resistance from MSs to agree on quantitative targets. The process of review of the waste legislation has revealed the opposition of a number of countries to the adoption of additional targets for waste prevention, landfill or recycling at the EU level. This resistance has also been observed in other areas such as soil protection, water or air quality. The ability of the EU to negotiate at the international level, however, strengthens its capacity to enforce targets in areas regulated by international agreements, such as climate change.

There are also cross-influences of EU directives and instruments (explicitly on resource efficiency or not) operating in the various areas, some of a synergistic nature (mutually reinforcing incentives towards RE) and some of a conflicting nature. Increasing the recycling of waste, for instance, could in principle also reduce the pressure on the consumption of primary raw materials and associated CO_2 emissions (although to date no evidence has been found that increased levels of material recycling and resource productivity in the EU have led to decreased demand on primary materials). Examples of conflicting relations are easier 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 is also an important source of environmental impacts such as air pollution, land use and fragmentation and material use. While the link between transport and air pollution have been the primary focus of sustainable transport policies at the EU level, less attention have 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. The IEA (2013) in a recent report estimated that road and rail infrastructure would increase significantly to 2050 to meet the needs of growing passenger and freight travel. This would not only have consequences in terms of GHG and thus climate change but also in terms of land use and materials. Under the BAU scenario (4 degree increase), 25 million paved road lane km are required and 333000 rail track km globally. In addition, it is expected that parking space would grow somewhere between 45,000-77,000 km^2 (IEA, 2013). Although most of these developments would happen in emerging economies, a comprehensive resource efficiency policy at the EU level need to take into account

[2] The aim of Task 1.2 was to provide an overall picture of existing policy strategy and to identify policy gaps hindering progress towards more resource efficient scenarios. It was not the aim of task 1.2 to provide a detailed analysis of the effectiveness or detailed impact of each legislative instrument.

possible tradeoffs between the transport policy and climate change as well as energy, materials and land. Policies to “avoid and shift” would significantly contribute to reduce these figures but would require ambitious policies that address not only alternative transport modes but also overall reduction.

Another example of an inconsistency in EU policy over time is waste policy. After years of investing heavily in incineration (which resulted in an expensive incineration infrastructure), EU shifted to strong promotion of recycling. Indeed, the roadmap and circular economy package set as a target the limitation of incineration to non-recyclable materials. In economic terms, this means a double investment in waste management infrastructure, making it very expensive especially since payback periods of waste management infrastructure tend to be long. Landfill diversion policies have led to increasing rates of incineration of municipal solid waste (MSW) and, thus, to the construction of waste to energy plants. Investment costs of modern waste to energy plants are generally supported by long-term contracts with municipalities that guarantee a certain volume of waste for a long period of time. This may lock existing waste management practices in a certain technology path, increasing the costs of switching to recycling. Overcapacity of incineration in some Northern countries has to some degree absorbed low incineration capacity of southern and central European countries. However, increasing recycling targets may mean that recycling facilities may compete with incinerators for a number of waste streams, since generally the recyclable fractions of MSW are the ones with a higher calorific value, such as paper, cardboard or plastics. A number of studies have showed that waste send to energy plants contains a high proportion of recyclable materials (Petersen et al., 2005). Also, recycling tends to work better through high-quality eco-design rather than through waste-separation. Although an instrument of high potential, the process of setting eco-design standards has demonstrated far from simple. The standards are biased towards a few environmental impacts and member states show increasing resistance to agree on quantitative targets. Under many of the conflicts highlighted in the waste area is the ‘waste as resource’ rhetoric, which seems to be very popular among EU politicians and policymakers, but provides a partial fuzzy picture of the practical reality of ‘waste as cost’. Cost of waste management across countries varies significantly according to a number of parameters such as technologies, infrastructures, logistics and collection systems. Unit costs and benchmark costs are extremely difficult to calculate as other aspects such as optimal source separation level (SSL) of recyclable fractions. Recent studies have estimated a critical threshold of optimal recycling at SSL of 50% (Consonni et al., 2011), although modeling results need to be taken with caution, given the number of variables influencing levels of recycling.

A consistent resource efficiency policy agenda needs to acknowledge potential tradeoffs between different dimensions of resource efficiency while also navigate through the boundaries of feasibility of policy-making.

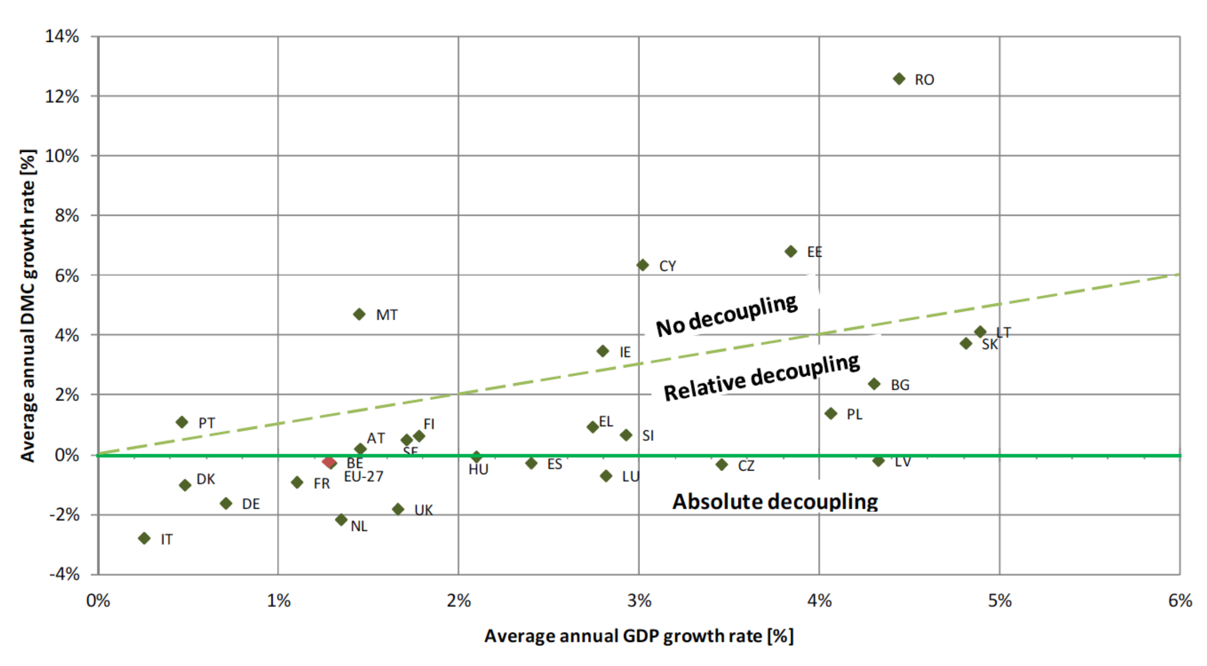
A policy strategy that relies mainly on the output side of the material and energy cycles is thus unlikely to bring the transformative change needed for a truly resource efficient economy that operates within the carrying capacity of ecosystems (or safe operating space, Rockstrom et al., 2009). Unless there are significant reductions in the input side through a substantial increase of energy efficiency and the limitation of resource use (e.g. a factor 4/10), environmental problems are unlikely to be resolved but more likely to be 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 loop 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. 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. Therefore, Section 7 will elaborate further on the trade-off of resource efficiency and energy efficiency.

3. Highlights of national policies for resource efficiency

National policies for resource efficiency have been studied in WP1.3. Researchers from the Wuppertal Institute carried out a screening of the existing resource policies in selected MS with special attention to policy mixes or strategies, quantitative reduction/decoupling targets or roadmaps, innovation strategies addressing resource efficiency objectives, tax and subsidy aspects in resource-intensive sectors, and waste policies and infrastructures. The focus of the analysis is on the following countries: Germany, Austria, Hungary, The Netherlands, Estonia, Finland, Poland, Spain, Sweden, and the UK[3].

The study uncovered a great variety in resource productivity across the EU. Resource productivity has been increasing in most countries between 2000 and 2009 and several countries show an absolute decoupling (See Figure 1: Italy, The Netherlands, UK, Germany, Denmark, France, Luxembourg, Belgium, Spain, Czech Republic, Hungary and Latvia).

Figure 1: Average annual growth in DMC and GDP by country (average 2000-2009)



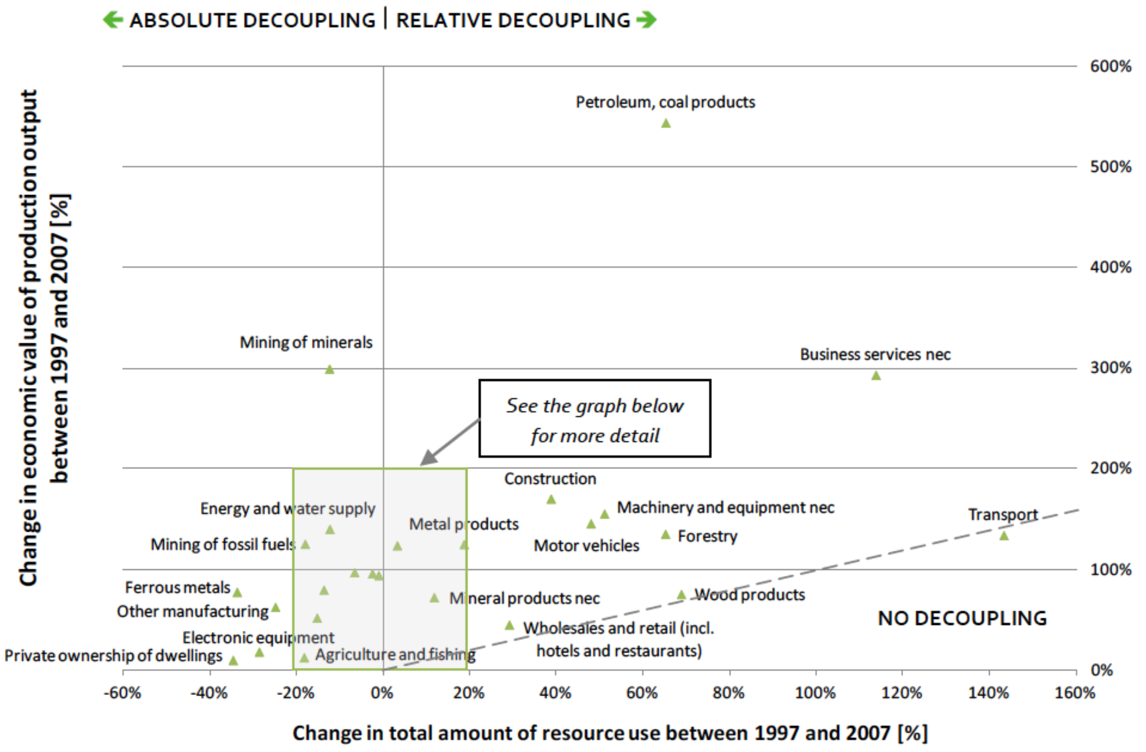
Source: BIO Intelligence 2012b (update DMC accounts), p. 29

It should be noted that one factor responsible for the decrease of domestic material consumption (DMC) is growing outsourcing of primary material extraction. In terms of sectors, the following sectors show an absolute decrease in material inputs between 1997 and 2007 (see Figure 2): mining of minerals, energy and water supply, mining of fossil fuels, ferrous metal production, electronic equipment production and other manufacturing. Material use per unit of economic output rose in only one sector:

[3] The country sample was selected on the basis of having a mix of countries, consisting of 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. For reasons of research effort, data availability and comparability across WP, it was decided to investigate all 10 countries 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 only where instructive).

transport. This means that all sectors except for transport experienced either a relative or absolute decoupling. Note that this analysis uses the indicator Raw Material Input (RMI).[4]

Figure 2: Developments of changes of material use compared with changes of economic value in sectors, 1997-2007



Source: BIO Intelligence 2013a, p. 33

There is no link between DMC per capita and the Eco-Innovation scoreboard overall index for MS.[5] Older MS have better scores for eco-innovation output but have higher average scores for environmental outcome (in terms of resource use per capita). Population density plays a role: "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" (EIO 2013, p. 25).

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,

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

[5] The overall eco-innovation index is based on 5 indices: eco-innovation input, activities, output, environmental outcomes, socio-economic outcomes. The score for eco-innovation output is based on eco-innovation related patents, academic publications related to eco-innovation and coverage of "eco-innovation" in electronic media. The score for environmental outcomes is based on countries' productivities in material consumption, energy use and water use as well as countries' intensity of GHG emissions. The score for socio-economic outcomes is based on exports of products from eco-industries (% of total exports), employment in eco-industries (% of total workforce) and turnover in eco-industries

or conversely, whether countries with a high share of service industries have a lower level of per cap consumption" (EIO 2013, p. 26).

Resource policies and frameworks differed widely in four countries that were investigated more closely. Box 1 summarizes the targets. In the Netherlands there are no targets for resource efficiency (RE) or resource productivity (RP), which is related to the Netherlands not having an integrated resource efficiency framework. Austria, Germany and Hungary all have targets for RE, RP, energy consumption and land use.

Box 1: Quantified targets of Austria, Germany, Hungary

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
Ecological farmed areas 20% by 2010

Germany
Increase of RP by factor 2 of abiotic resources (minerals) by 2020 and increase of RE of abiotic resources
Increase per capita consumption of wood/wood products from sustainable forestry to 1.3 m^3
Reduction of land use daily growth of 30 ha by 2020
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

The Netherlands
No targets for RE and RP

Source: D1.4 Note: RE stands for Resource Efficiency, RP for Resource Productivity

Environmental taxes in Europe can be classified into four main categories (EUROSTAT, 2013): energy, transport, pollution and resources. The weighted average of the revenue by environmental taxes in EU-27, however, is marginal compared to other types of taxes, such as labour tax and in 2008 it represented only about 2.4% of the Gross Domestic Product (GDP). Moreover, environmental taxes apply mainly to energy and transport sectors, traditionally taxed sectors, while pollution and resource taxes account to only 5% of environmental taxes and 0.1% of GDP (Bahn-Walkowiak et al., 2012).

In terms of environmental taxation the Netherlands ranks highest and Austria rather low. The **Netherlands** ranks 2 (10.1% of total taxation) in the category environmental taxes, and ranks 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) and water abstraction charge. With a share of 5.8% of environmental taxes in total taxation and a ranking of 22 **Germany** is behind Hungary and The Netherlands. It ranks 16 concerning the pollution/ resources category (collected from toll collection system for freight and water abstraction charges). **Austria** ranks 23 with a 5.8% quota of environmental taxes in total taxation (equal to Germany) and ranks 22 in the pollution/ resources category (through toll collection systems on motorways and tree protection charges) with a very low share of 0.1% (Eurostat 2013; OECD/EEA database; Ecorys 2011a).[6]

Resource and material input taxes have been increasingly discussed as a way to contribute to the environmental tax reform. Given the complex transnational character of the supply chain of primary raw materials, a tax on construction minerals has been proposed and introduced in a number of EU countries, as an effective way to increase efficiency of the most resource intensive sector of the economy where the EU is largely self-sufficient. A tax or levy on construction minerals is meant not only to reduce the environmental impacts linked to extraction and manufacturing of construction materials such as sand, gravel, crushed rock and limestone, but also to provide incentives to the development of secondary material markets and eco-innovation. The minerals tax is designed as a charge or levy per unit of weight, which will affect the price of the product and influence the entire supply chain. Taxes are not only effective but optimizing mechanisms, especially where there are no absolute targets that need to be achieved (such as in the climate change area). A number of practical experiences exist across Europe of minerals extraction taxes, e.g. in UK/Northern Ireland, Sweden, Denmark, Lithuania, Latvia, Bulgaria, the Czech Republic, Cyprus and Italy and Belgium on the regional level (Bahn-Walkowiak et al., 2012). However, in many cases, the tax level is so low that their effectiveness is significantly reduced. In 2008, the EEA published a report on the effectiveness of construction mineral taxes (EEA, 2008). The aggregates levy in the UK, introduced in 2002, has proved successful in reducing the consumption of primary aggregates and boosting the recycling market, however, the tax has also been highly criticised by the extractive sector that claimed important inter-regional consequences as a result of illegal tax evasion, particularly in regions that have borders with tax differentials, and miss-use of levy exemptions. The resistance to the introduction of taxes on raw materials is not dissimilar to the resistance of taxes in general, although, perhaps in this case the distribution of winners and losers needs to be examined in detail. As with any other instrument that have an effect on market conditions there is likely to generate problems of tax evasion or cross-border distortions.

An attempt at evaluating the resource policies was undertaken in Task 1.3 on the basis of the following evaluation studies: Ecorys 2011a, RPA 2014, TNS 2013, ÖkonRess 2014, IEEP 2012.[7] Figure 3 summarizes the results of the country review with regard to the dimensions: “institutional set-up” and “incentives and side policies” (as in the EU roadmap).

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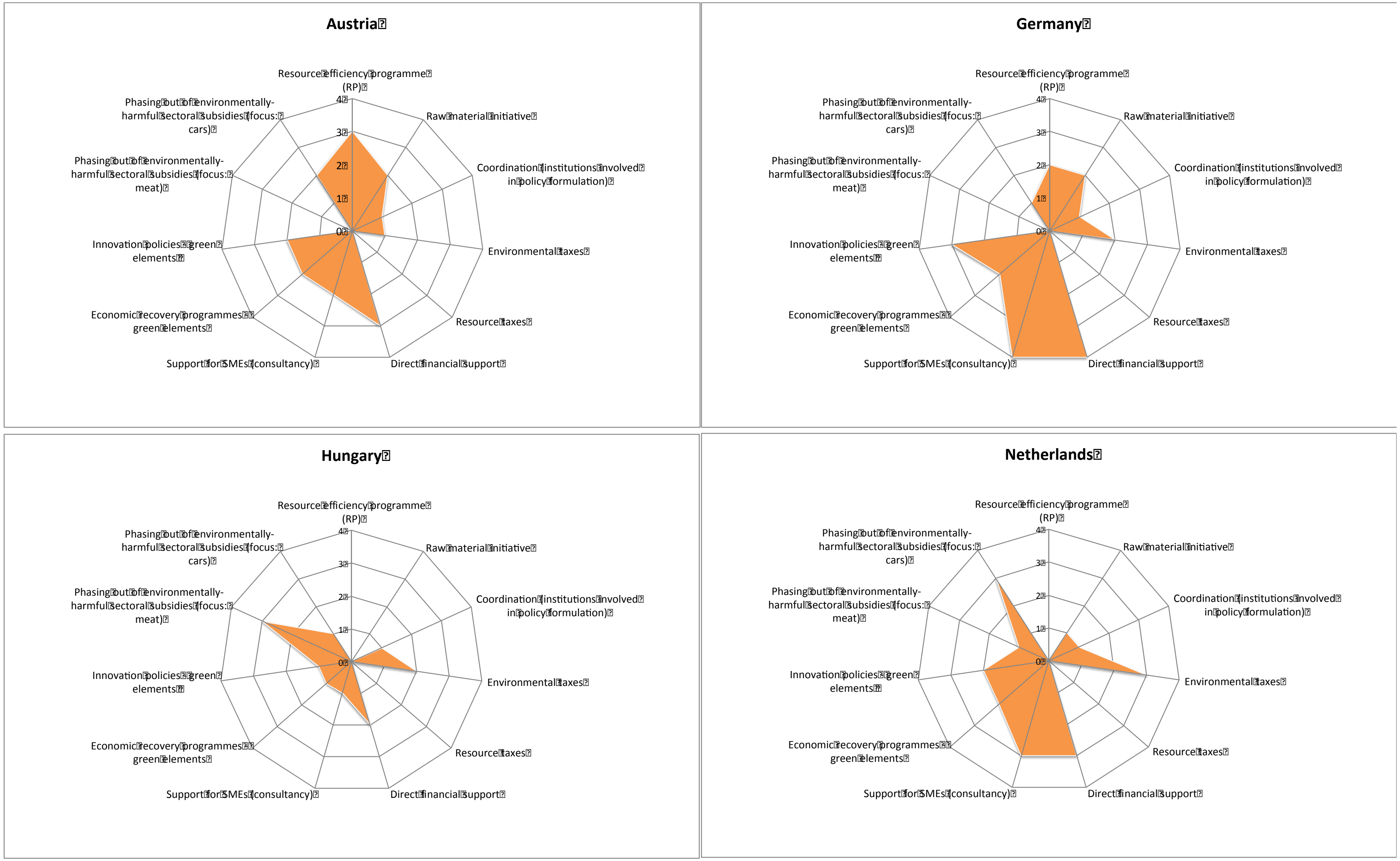
[6] The presentation as percentage of total tax revenue (and not, as usual, as percentage of the GDP) has been chosen deliberately to illustrate the order of magnitude.

[7] The countries are assessed according to their fulfilment of 11 criteria. 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 presented in so-called spider web 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.

Figure 3: Country assessment on RE Policies;

The scores range from 0 = no activities; 1 = low degree of activities; 2 = moderate degree of activities; 3 = above-average degree of activities, 4 = high degree of activities. Source: D1.4



Evaluation of the frameworks and policies revealed several weaknesses in the form of non-action, frequent use of qualitative targets, low status of targets, insufficient vertical policy coherence, insufficient horizontal policy coherence, orientation and information deficits, and strong influence of vested interests. In Europe, Germany and Austria are lead countries in terms of resource efficiency policies through the use of quantitative targets and timelines for selected indicators. Different ministries are involved in both countries but responsibilities in both countries are unclear. There is a need for more policy coordination to achieve greater policy coherence.

A summary of resource use outcomes and EIO rankings for specific years for the focal countries are given in Table 1.

Table 1: 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	23.4	16.1	13.2	11.8
Resource productivity trend	time-series (2001, 2006, 2011) PPS EUR per kg		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	Index, composite of input, activities, output, environmental outcome, socio-economic outcome (in the years 2011-2013)	ranks 4 - 6 - 9	ranks 7 - 4 - 3	ranks 16 - 21 - 23	rank 11 - 10 - 13
Eco-innovation Observatory (Socio-economic outcome)	Index for 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 downwards	121 / 95 / 93 downwards	77 / 120 / 125 upwards	92 / 123 / 142 upwards

Source: D1.4. Note: The shading indicates an above-average performance compared to the European average.

Correlating the policy packages in the four countries and the respective resource use outcomes is complex and does not allow us to draw clear conclusions regarding preferable political and institutional factors. All countries have taken action and implemented policies, but to a varying degree and with varying success. Economic and geological individualities lead to country-specific political preferences and a path-dependent concentration on the respective competitive key sectors that have yet not been broken up. Thus, indirect or direct subsidies for resource-intensive sectors such as mobility and nutrition are common. Irrespective of different development stages of resource efficiency agendas, a lack of coherence of policies and national objectives are apparent, e.g. a division of strategies and responsibilities for resource efficiency action plans and other raw material initiatives with partial goal conflicts or poor coordination. Although support programmes and financial incentives for industries are effectively implemented and successful in individual areas, the overall picture is fragmented and rather inconsistent. Green stimulus programmes generally tend to be more aligned to short-term economic objectives and mainly focus on energy efficiency and transport measures. The prevailing reluctance with regard to economic instruments leaves large potentials untapped, for instance through a shift from labour to resource taxation. The current level of transposition of the 2020 milestones calls for greater specification of targets and prioritization of sectors as regards resource efficiency measures.

Special attention is given to waste. Ten countries were assessed regarding the dimensions: targets, policy instruments for waste management, technical infrastructure and outcomes.

Following this, countries were 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. Annex 1 presents Figures that summarise the results. In addition to incineration capacity shown in Annex 1, Table 2 shows this in relation to MSW generation.

Table 2: 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

Source: D1.4.

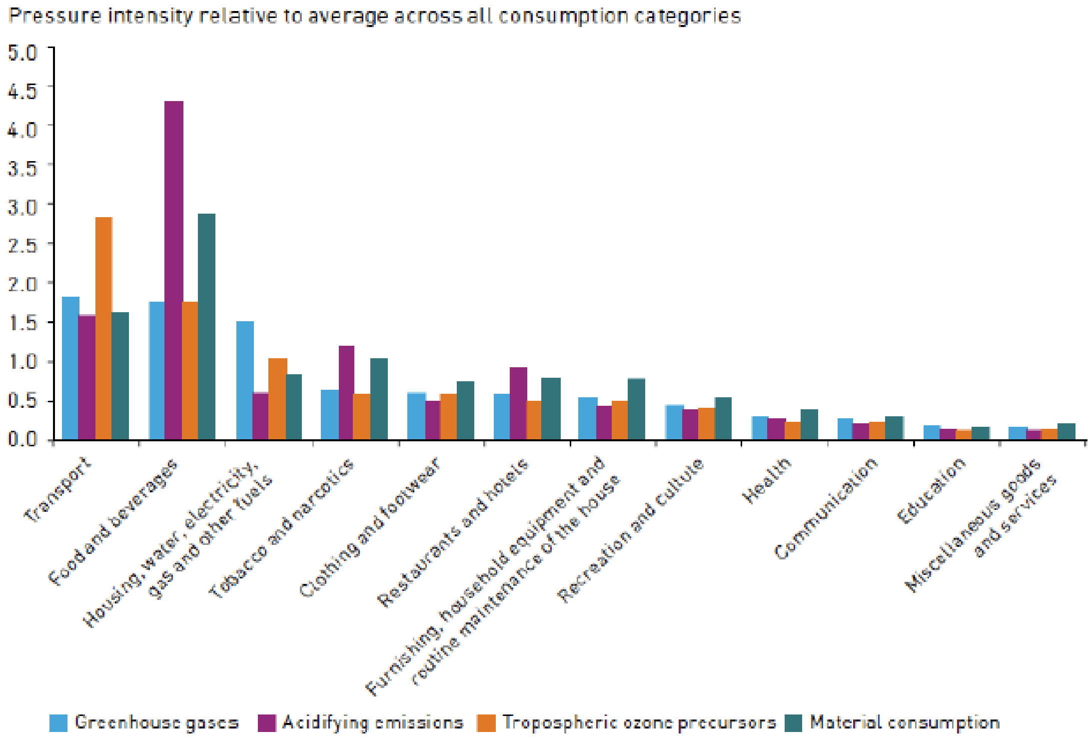
The assessment shows that all ten countries have established waste management plans and waste prevention programmes and the EU targets are transposed in the national regulatory framework. The recycling levels however differ enormously and waste prevention and reuse have a minor role to date. Especially the issue of waste incineration capacities highlights that policy approaches can lead to unwanted effects and inappropriate treatment choices. If they do not consider every step of the waste hierarchy against the background of resource efficiency and life-cycle thinking in the respective context, they are either 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).

Although waste management is one of the areas where significant progress has been achieved in the last years, the cross-country comparison still shows important incongruences in the application of the waste hierarchy and the pre-eminence of treatment solutions that do not contribute to resource optimisation. The recent focus on landfill diversion has, in some cases, entailed promoting incineration and waste to energy solutions, which in occasions compete with recycling for the same type of high calorific value waste streams, putting pressure on long-term investments in incineration infrastructure. It may be too early to evaluate the effectiveness of waste prevention plans but their effectiveness is likely to depend on the policy mix deployed to reduce waste at source and move waste up the waste hierarchy. Very important differences across countries have been identified as well with regards to recycling. Although the waste framework directive introduces the principle of high quality recycling, its interpretation varies considerably between countries. Collection and recycling targets do not account for the efficiency of the recycling process and the quality of the recyclates obtained from it. Hence, we conclude there is a lack of policies that steer waste onto routes that save most natural and economic resources and a lack of targets that focus on material quality rather than weight. Policies to counteract this could include targets (1) on recycling efficiencies or quality of the recyclates, (2) policies to integrate eco-design principles in product design to favour reuse, reparability and dissembling or (3) tax incentives to steer consumption towards more environmentally friendly products/ materials, such as VAT differentials. Policies should be catered to the location-specific context and aspects such as recycling infrastructure, actor constellations and institutional set up.

4. Highlights of the citizen-consumer perspective

In this section we present findings from the study of household behavior for three areas of consumption: mobility, food and heating. The three areas have been chosen for being the most resource-intensive areas of consumption (see Figure 4).

Figure 4: Environmental pressure per euro spent on private consumption in nine EU member states



Note: * Austria, Czech Republic, Denmark, Germany, France, Italy, the Netherlands, Portugal and Sweden.

(Source: EEA, 2010b)

Household behavior has been studied in POLFREE with the help of four theoretical frameworks (Max-Neef's scheme of needs and satisfiers, Bamberg's stage model of self-regulated behavioural change, Social practice theory, and the Nature-Society relation framework). The use of the four frameworks helped to obtain a more comprehensive, systemic and interdisciplinary perspective of individual behaviour. Each of the frameworks helped to reveal particular aspects relevant for people's behavior, such as people's needs as perceived by them, their knowledge and attention to ways (strategies) to satisfy their needs, and influencing aspects from the external context such as the embeddedness of individual behaviour into certain systems of provision.

The findings show that individual (domestic) consumption practices are not just the outcome of personal attitudes, values and individual decisions but the result of people's participation in social (collective) practices and settings as well. The survey allowed for the generalization of findings to larger groups of people and the evaluation of whether the results gathered through the qualitative methods implemented (interviews and the focus group) are valid on a macro scale level as well and hence added to the scientific rigour of this study and the reliability of findings.

Below we give summary findings from the survey for each of the three consumption domains.

Food

Regarding barriers to more resource-efficient food consumption, a number of observations were made:

- Around 42% of the respondents in the survey indicated that they had considered eating less meat and fish. This suggests that there is an interest to eat less meat and fish. The percentage of people expressing an interest in reducing fish and meat consumption is highest in Austria (49%) and lowest in the Netherlands (38%) (in Hungary it is 41%).
- Generally, younger age groups indicated less resource-efficient behavioural patterns.
- Younger age groups and Hungarian respondents showed the highest preference of processed convenience food.
- Hungarians frequently purchase their meat or fish at the butcher or fishmonger, much more that Austrian and Dutch respondents who very strongly opt for buying meat or fish at the supermarket along with other groceries
- Dutch respondents reported strikingly low knowledge about the region of origin of food products they buy and little attention to the total transporting distance of meat or fish they buy.
- The consumption of seasonal fruit and vegetables seems to be high, in general, and highest among female and older respondents.
- There are diverging views exist as to what constitutes a healthy diet. While many respondents, women in particular, reasoned they would like to reduce their meat consumption based on health considerations, others, particularly men and Dutch respondents answered they have not yet reduced their meat consumption because “it is healthy to eat meat”.
- A very strong and consistent value pattern was found with respect to meat consumption reduction: people who (strongly) agreed to feel a (spiritual) connection with nature were (by far) the most likely to have considered eating less meat.

Mobility

Regarding barriers to more resource-efficient personal mobility, the following observations were made:

- 49% of the respondents said they would like to use their car less (40% in the Netherlands, 51% in Austria and 58% in Hungary)
- The main reasons for why people would like to use their car less are to ‘save money’ (61%), ‘get more exercise’ (53%) and ‘protect the environment’ (39%).
- Respondents with a higher education level are more likely to indicate ‘save money’ as a reason.
- A share of 28% of all respondents indicated that they have reduced their use of the car already to a minimum (ranging between 16% in Hungary and 38% in the Netherlands).
- “Public transportation not being a good alternative” is said to be an important reason for why it is difficult for people to reduce car use (mentioned by 64% of the respondents). Here we discovered something odd, which is that it was mentioned more as a factor in countries with good public transport (Austria and the Netherlands). A possible explanation is that people who are accustomed to a high level of convenience (of individual car mobility) have come to appreciate public transport less.
- The most reported reason for not owning a car is that it is cheaper (56%) but a significant share also simply does not have a driving licence (43%). Care for environment’ is a reason for not owning a car for only 15% of the respondents.

- People with a household income below €10,000 per year are 13 times less likely to own a vehicle than households with an income above €30,000 and people between €10 and €20,000 of income are still more than three times less likely.
- Austrians are almost twice more likely to own a new vehicle than the Dutch and the Dutch tend to own smaller vehicles than Austrians and Hungarians.
- There is a clear connection between people's knowledge of energy labels of cars and the existence of tax-exemption schemes linked to energy labels.
- People aged 65 or older are more likely to own a new vehicle than all other ages.
- Higher income groups are more likely to own larger vehicles.

Heating

Regarding barriers to more resource-efficient heating of houses, the following observations were made:

- 36.7% of the people in Hungary said that they or another household member had looked into getting a newer heating systems (in Austria and the Netherlands 23.5% and 13.3% had done so). As much as 61.6% of the respondents in Hungary said that in the past 5 years "our household or our landlord/landlady has considered improving the insulation of our building (e.g. roof, wall or loft insulation, double- or triple glazing)". The percentage of people in Austria and the Netherlands who had also considered this are much lower but still reasonably high (at 23.5% in Austria and 13.3% in NL).
- People who are higher educated and better paid are more likely to consider investments in energy improvement of their homes. Curiously, income could not be identified as determining factor in people's investment plans.
- Across countries, investment costs are seen as the main obstacle to improving building insulation. In Hungary, people also view investment cost as the biggest hindrance to getting a new heating system.
- Hungarians and Austrians are less likely to regulate the thermostat down when airing a room or leaving the home.
- Men report less frequently to regulate the thermostat when airing the room or leaving the house than women and lower income groups more frequently than higher.
- People who feel comfortable at lower room temperatures are also more likely to turn down the heating when not needing it. As Dutch people feel comfortable with lower indoor temperature, this explains to some extent why the Dutch are also more likely to turn down the heating occasionally.

Product sharing and communal living

Product sharing and communal living in which space is being shared reduces the need for materials. Whether it actually leads to lower consumption of materials is something that requires further study. According to Wimmer (2013), people who are engaged in co-housing have a lower ecological footprint and live more sustainably in terms of food consumption, they are more interested in extending product lifetimes, and in making thermal improvements to their home, considerations which led us to investigate the degree to which people are engaged in the sharing of product and space, and the degree to which they are interested in this.

Regarding barriers to more resource-efficient material possessions, the following observations were made:

- In Austria and Hungary the majority of the people were interested in "living in a community with people I get on with" (68.7% and 57%). In the Netherlands the share of people interested in a communal way is far lower: 25%.
- People who live together share products and space but there are notable differences in what they share. Tools and machinery ranks highest and living space and a car rank lowest.

- In Hungary 2.9% of the people who interact regularly with their neighbours and are like a community are engaged in sharing living space, 5% share a car, 57.6% share tools and machinery and 13% share everyday tasks. In the Netherlands, the shares are: 2.5%, 7%, 50.8% and 8.5%.
- 24.9% of the people in Austria who are *interested* to live in a more communal way were willing to share their car. 12.6% say they are willing to share living space. In Hungary 19.3% of the people interested in a more communal way of life say they are willing to share their car and 17.1 express an interest in sharing living space. In the Netherlands the percentages are 35.6% and 21.1%.[8]
- The main reasons given for not living in a communal way are that people prefer their own private space (39%) and that they consider it difficult to find the right people (36.8%).
- People who currently share living space, i.e. younger age groups and people following a study or vocational training are also more willing to share living space in the future. People living in very large cities (above 1 million inhabitants) were significantly more likely to indicate wanting to live in sharing communities in the future.

Discussion of the findings

Overall the findings show that there is a considerable interest in more resource efficient practices. Up to 49% of the respondents said they would like to use their car less and 42% of the respondents in the survey have considered to eat less meat and fish. In Hungary as much as 61.6% of the respondents said that in the past 5 years they or their landlord/lady have considered improving the insulation of their building. There also appears to be a great interest in living in a more communal way in Austria and Hungary and when doing so to share products (especially tools). Reducing resource use is not the primary motivating factor for this. Most often stated motivating factors to use the car less are: to ‘save money’ (61%), ‘get more exercise’ (53%) and ‘protect the environment’ (39%). Motivating factors to eat less meat are: health, animal welfare and climate change. Interestingly, the primary motivating factor for Hungarians is health, for Austrians it is animal welfare and for Dutch people it is climate change. We find that *resource use is only implicitly considered* through costs, climate change and the environment in general.

A good deal of the respondents (in fact just the majority) indicated *not* to be interested in using a car less or to eat less meat and to thermally improve their home. Those people can be expected to be against coercive policies designed towards those ends, a topic to which we will come back to.

Reasons (stated by respondents) for not having followed up on considerations to eat less meat are (in the order of descending importance): enjoying the taste of meat, health, difficulties to change habits, other household members liking meat. While Dutch respondents were more likely to argue that they liked meat, Austrians and Hungarians were more likely to indicate that other members of their household like meat. Further, Dutch respondents were the most likely to state that it is healthy to eat meat, while Hungarians were more likely to mention difficulties with changing habits.

In general terms the findings suggest that people mostly act towards RE when this serves their own interest. Broadly half of the respondents does not consider reducing resource use,

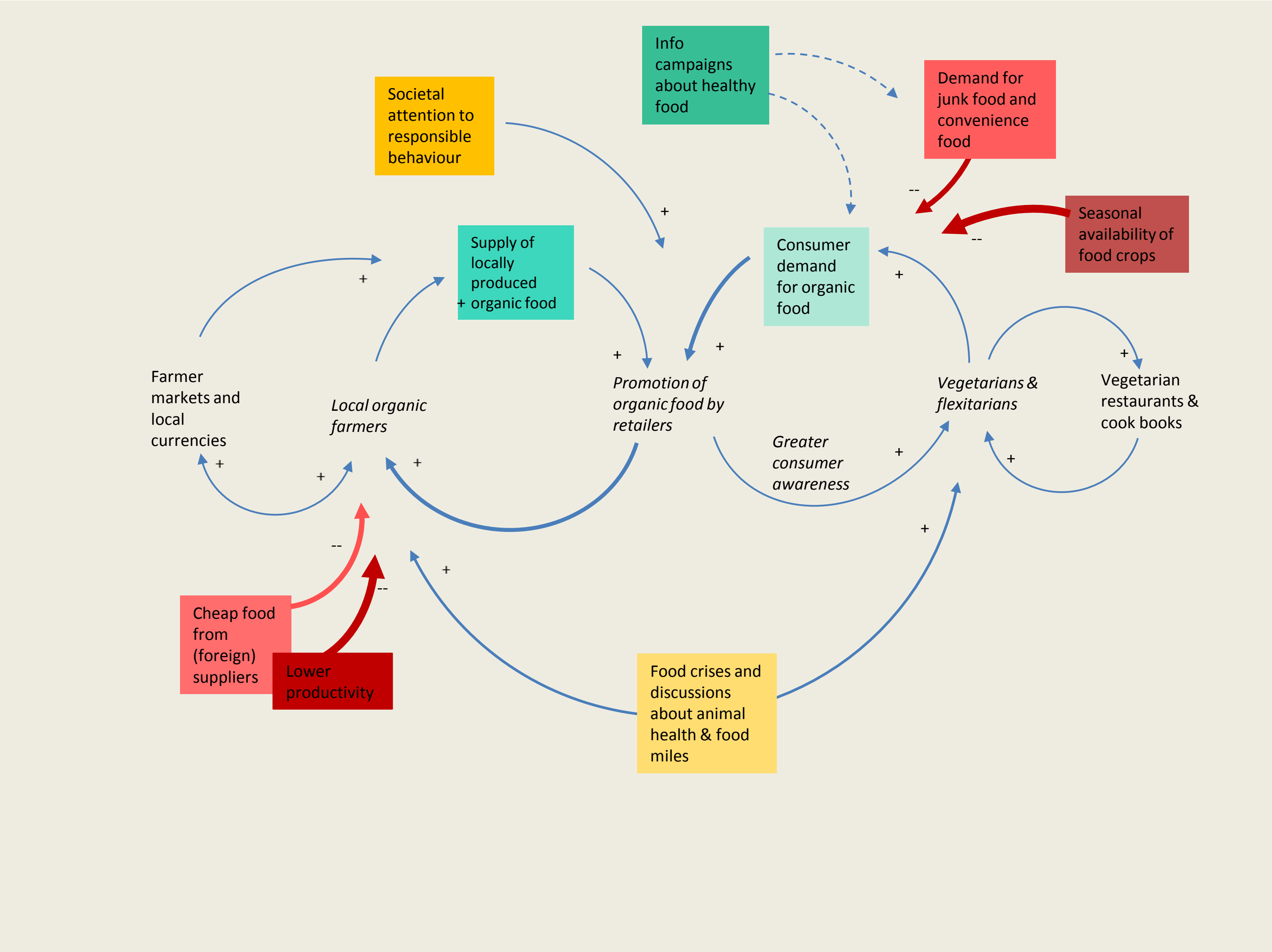
[8] The stated willingness to share products and space is far lower than the revealed willingness to share products and space. 35.6% of the Dutch people interested in living in a more communal way said they were willing to share their car with others, but only 7% of the people who were practicing a communal life shared their car. For Austria the figures are respectively 24.9 and 6.8% and for Hungary 19.3% and 5%. The difference between stated preferences and revealed preferences is highest in the Netherlands.

because they like what they do; the other half does consider (or is willing) to reduce, mostly because it can serve their interest (own cost savings typically 3 or 4 times more important than decreasing environmental impact). Apparently, policies for RE cannot count on the green values of people, but policies need to create a context (such as infrastructure, pricing, etc.) in which it is in the interest of citizen-consumers to reduce. This point is important for the policy discussion and is picked up again in Section 9 (regarding policy interventions for heating at home).

Motivating/enabling factors and demotivating/hampering factors come into play with one another via feedback loops. In the below diagram (Figure 5) we have depicted causal loops for the case of locally produced organic food. Supply and demand are shown to be interlinked: an increase in local supply will have a positive influence on demand in terms of what people buy, and vice versa an increase in demand for local organic food will lead to an increase in supply. Increases in demand stem from health concerns and food crises but also people being subjected to organic food offers (in restaurants, retail shops and farmer markets).

If it was not for balancing developments we would get an ever increasing supply and demand. Important balancing developments working against the supply and demand for locally produced, organic food are: non-organic food being cheaper, the seasonal nature of local food and the demand for junk food and convenience food. The last factor does not have to be a constraining factor because junk food and convenience food could be based on local, organic produce. When the balancing developments are stronger than the positive stimuli, we get a negative spiral of decreasing demand and supply.

Figure 5: Causal relations for locally produced organic food



Interconnected practices

One of the insights of practice theory is that practices of people are often interconnected. To investigate this further, we undertook a correlation analysis for food consumption and food buying practices. In Table 3 the results of a correlation analysis of practices are presented.

Table 3: Correlation coefficient matrix for food consumption and buying practices

	Q32 Regional Food	Q33 Seasonal Food	Q34 Throwing Away	Q35 Planning Meals	Q36 Processed Food	Q37 Vegetarian	Q38 Meat/Fish per Week	Q40 Organic Meat/Fish	Q41 Meat/Fish Distance
Q32	-								
Q33	0.283**	-							
Q34	-0.047	-0.119**	-						
Q35	-0.012	-0.088**	0.107**	-					
Q36	-0.115	-0.214**	0.251**	0.155**	-				
Q37	-0.023	-0.066*	0.022	-0.009	0.071*	-			
Q38	0.055	0.016	-0.052	0.011	-0.062*	-	-		
Q40	-0.059	-0.184**	-0.030	-0.025	0.095**	-	-0.154**	-	
Q41	-0.205**	-0.230**	0.059*	0.078**	0.097**	-	-0.183**	0.305**	-

Source: Wieser (2014). Note: A * (**) indicates that the coefficient is different from zero at a 5% (1%) level of significance; light grey areas indicate correlation coefficients between 0.1 and 0.3, dark grey areas correlation coefficients above 0.3

The strongest correlations are between food practices. Taking food travelling distance into account is negatively correlated with the buying of regional food ($r=.283$, $p<.01$), as expected. There is a relatively strong association between buying regional food and seasonal produce which suggests that people who buy regional food are also likely to buy seasonal fruit and vegetables. Again this is as expected. The analysis further suggests that vegetarians are slightly more likely to buy seasonal food ($r=-.066$, $p<.05$) and less likely to buy processed food ($r=.071$, $p<.05$). People who plan their meals throw less of their food away ($r=.107$, $p<.01$). Finally, the significant positive correlations between buying processed food and buying seasonal produce, amount of food thrown away and planning meals are worth noting. In particular, the practice of buying processed food is especially strongly correlated with throwing away food ($r=.251$, $p<0.01$). This may reflect buying too big (pre-packaged) portions and/or unwillingness to consume left-overs another day. They probably take a more instrumental view on food being the deeper root cause behind throwing away food. People who take the distance that meat or fish has travelled into account consume less meat ($r=-.183$, $p<.01$). This suggests that big meat eaters are less environmentally conscious or alternatively that they value local produce less than those who eat less meat.

A deeper analysis is being undertaken for 15 people (that were not part of the survey) on the basis of interviews. The results are given in Table 4.

Table 4: Elements Associated with Sustainable Food Purchasing Practices and their Carriers

	Regional	Seasonal	Processed	Meat/fish	Organic
Product-related Elements					
Tasty	+	+	+/-	+/-	+
Quality	+		-		+
Natural	+	+	-	+	+
Healthy	+	+	-	+/-	+
Chemical-free	+		-		+
Fresh	+		-		
Nutritious				+	
Other Motivations					
Traditional	+			+	
Diversity	-	+/-		+	
Self-made	+				
Support local farmers	+				+
Save money		+/-		-	-
Convenience			+	+	
Laziness			+		
Easier to prepare			+		
Skepticism/fear			-		+
Animal welfare				-	+
Environmental score		+	-		+
Personal/Household Characteristics*					
Women	+	+		-	
Age	+	+/-	-	+/-	
Education			-	+/-	
Income		+		+	+
Housewifes/-husbands					-
Single household			+		
Planning meals		+	-		

*Based on the survey

Source: Wieser et al. (2014), based on joint work with Julia Backhaus.

In the interviews, people were asked to indicate positive product attributes for five types of food: regional, seasonal, processed, meat/fish and organic. The answers reflect their perceptions and understandings. The results show clear differences in the attribute associations. Regional and organic food score positive on all product quality attributes except for nutrition (which surprisingly is associated with meat/fish): tastiness, quality, being natural, organic, healthy, chemical free, fresh and nutritious. No single practice scores positively on all positively valued aspects, which means that choices involve trade-offs. Regional and seasonal food consumption are perceived to be in conflict with a diet that is rich in variety. The price is the most dominant problem for people who want to buy organic food. Processed food or ready-made meals are considered to be tasty (by some), convenient and easy to prepare. Meat and fish are considered as tasty, natural, nutritious, traditional and convenient and associated with a high variety of dishes (in comparison to a meat- or fish-free diet). The different drawbacks associated with each sustainable food purchasing practice suggest that different strategies are necessary to bring pro-environmental changes about. There are two factors, however, which affect all sustainable food purchasing practices: people distrust green claims and indicate a lack of knowledge. When trust in the methods and practices of the system of food provision is lacking, citizen-consumers are less willing to compromise variety, convenience or other aspects which speak against the consumption of sustainable products. Also the required knowledge and competences differ considerably from practice to practice. In particular the environmental consequences of food consumption are highly complex and therefore difficult to know (Lea & Worsley, 2008). Much of the differences between sustainable food practices can be traced back to different primary sources of information: Whereas information on organic and regional food is mainly drawn from product labels, 'informal' sources like parents or friends are more important with regard to seasonal food, processed food and meat/fish.

Are green people consistent in terms of green behaviour?

Is green behaviour consistently practiced? Within the food domain people behaviour is relatively consistent but across domains we observe inconsistencies (see Table 5). Waste separation is not significantly correlated with sustainable food practices, trying to save fuel while driving and energy-efficient houses. The use of second hand clothing is negatively correlated with car use distance and uncorrelated with other green behaviour (probably for cost-saving reasons). Turning down the heat while airing the room is significantly positively correlated with driving in a fuel-efficient way but unrelated to waste separation and to eating organic food. It is significantly negatively correlated with eating seasonal food. The reasons for non-consistency of green behaviour across domains is that choices in the different domains depend on a wide range of considerations (such as the fun of driving in the case of cars, health considerations in the case of food and the high investment costs of thermal insulation).

Table 5: Correlations between different practice domains

	Q19 Waste Sep.	Q21 Cleaning Waste	Q22 Second-h. Clothes	Q23 Other Second-h.	Q33 Seasonal Food	Q40 Organic Meat/Fish	Q68 Car Use Distance	Q74 Save Fuel Driving	Q91 Energy Efficien.	Q113 Turning Down
Q19	-	0.344**	-0.037	-0.013	**-0.018**	**0.100**	0.074	0.197*	0.205**	**0.101**
Q21	0.344**	-	-0.084	**-0.145**	-0.041	**-0.029**	0.076	0.099	0.153	0.111
Q22	-0.002	0.013	-	0.471**	**-0.114**	-0.012	**-0.246****	**-0.026**	-0.014	0.130
Q23	0.000	-0.028	0.481**	-	**-0.120**	**-0.061**	-0.004	0.113	0.010	0.015
Q33	-0.180**	-0.111**	0.023	0.045	-	**-0.012**	-0.075	-0.194*	-0.049	-0.148
Q40	0.209**	0.173**	-0.042	0.068*	-0.184**	-	-0.064	0.039	0.094	**-0.138**
Q68	-0.023	0.039	0.077*	0.044	-0.058	-0.035	-	0.066	0.009	0.027
Q74	0.172**	0.133**	0.085**	0.092**	-0.120**	0.039	-0.008	-	0.071	0.159*
Q91	0.139**	0.076**	-0.038	0.015	-0.066*	0.163**	-0.071*	0.076*	-	-0.021
Q113	-0.006	0.091**	0.070*	0.091**	-0.093**	-0.002	0.049	0.180**	-0.012	-

Source: D1.6.

People's needs according to Max-Neef

In the survey no attempt is made to identify people's real needs. People preferences are studied in three ways: 1) by asking questions about their behaviour and their motivations for such behaviour, 2) through questions about their willingness to engage in more resource-efficient behaviour such as using the car less, driving more efficiently, and buying food with less food miles, and 3) the stated reasons for why did not engage in specific types of more resource efficient behaviour. When it comes to preferences of people, economists place a much greater trust in revealed preferences (through behaviour) than in stated preferences. When people own a car and drive one, they can be assumed to have a preference for the use of cars. When they eat meat it can be assumed that they like eating meat. What is kept out of consideration here is that people’s choices also depend on external circumstances: the availability and convenience of transport alternatives in the case of automobility and the food that is available in a nearby shop or that is being prepared for the entire family. Revealed preferences are therefore not a perfect indicator for people’s preferences. As for the stated preferences (e.g. a scoring of the statement ‘I would like to use my car less’), we think that they reflect genuine interests of people rather than weak preferences for something they don’t do. Such a view is contested in the literature, where some people claim that people's behaviour does not necessarily reflect their real needs.

A different attempt to study people’s preferences is made by researchers from SERI who inquired into the needs identified by Max-Neef (1992). Max Neef does not talk about preferences but about needs of which he says that they are universal, non-hierarchical and key to a person’s well-being and the well-being of communities. The needs identified by Max-Neef (1992) are: subsistence, protection, affection, understanding, participation, idleness, creation, identify, freedom and spirituality. What the researchers did was ask people to indicate the needs which are most important to them. The exercise was done for a small group of people in Austria and in Hungary. Results for Austria are given in Table 6, showing that the needs for subsistence and affection are stated most often, followed by the need for understanding, identify and freedom. Interestingly, they hardly found a difference between green and non-green people (but this may not mean much as the sample is very small). In the interviews, people were also asked to state the motivations for certain types of behavior with the help of a laddering approach to identify “real” needs. Laddering means to ask "why" or "what are motives or reasons" for a certain behaviour again and again until the level of "real" needs (in terms of the scheme of Max-Neef) is reached.

The laddering approach constituted a real challenge, as people found it difficult to assess and rank the set of needs identified by Max-Neef independent from activities such shopping, eating, cooking, driving a car etc. Needs which were said to be important sometimes were inconsistent with behavior and no clear difference was being found in terms of the needs of green and non-green people.

Table 6: Needs chosen as currently most important for the interviewees in Austria

Needs	A4	A1	A2	A5	A6	A3	Totals
	fem, 30	male, 26	fem, 50	male, 51	fem, 30	male, 58	
1 Subsistence…	X	X	X	X	X	X	--
2 Protection…	X	X		X	X		4
3 Affection…	X	X	X	X	X	X	6
4 Understanding…	X	X	X			X	4
5 Participation…	X						1
6 Idleness…					X		1
7 Creation…	X		X			X	3
8 Identity…		X	X		X	X	4
9 Freedom…		X	X	X		X	4
10 Spirituality…				X	X		2

Source: D1.6

The above analysis does not disprove the scheme of needs altogether but it is clear that something important is left out of consideration: the product offerings, life circumstances, people's desire for convenience, prices and costs and the systems of provision which co-determine the convenience and inconvenience of behaviours, to name but a few important matters.

The link between materialistic lifestyles and happiness

Happiness is generally believed to be fostered by material consumption. In economic theory, more consumption of a good makes you happier by definition. There is a good deal of evidence that suggests a negative relation between happiness and materialist values. What this research shows is that people who are highly focused on materialistic values have lower personal well-being and psychological health than those who believe that materialistic values are relatively unimportant (Kasser, 2002). It is also found that people for whom materialistic aims are central to their values have shorter, more conflicting relationships with friends and lovers. As a conclusion it is being said that "people believe in materialism because society is so materialistic, and society is so materialistic because many people believe that materialistic pursuits are a path to happiness (Kasser, 2002). Our research design did not allow us to study the link between happiness and material possession. We did include a few questions about people's wish to work less and have less money available for material consumption.

Reducing material consumption is generally viewed as a sacrifice, overlooking that you also gain something: more free time when working less, less stress from work with less anxiety about consumption choices. In the survey we asked people about their interest to work less. Almost 30% of the respondents who answered the question, said they would like to work less.[9] About 10% said they wanted to work more and 62% indicated that they were content with the number of hours they worked. Working less appears a desirable option for more

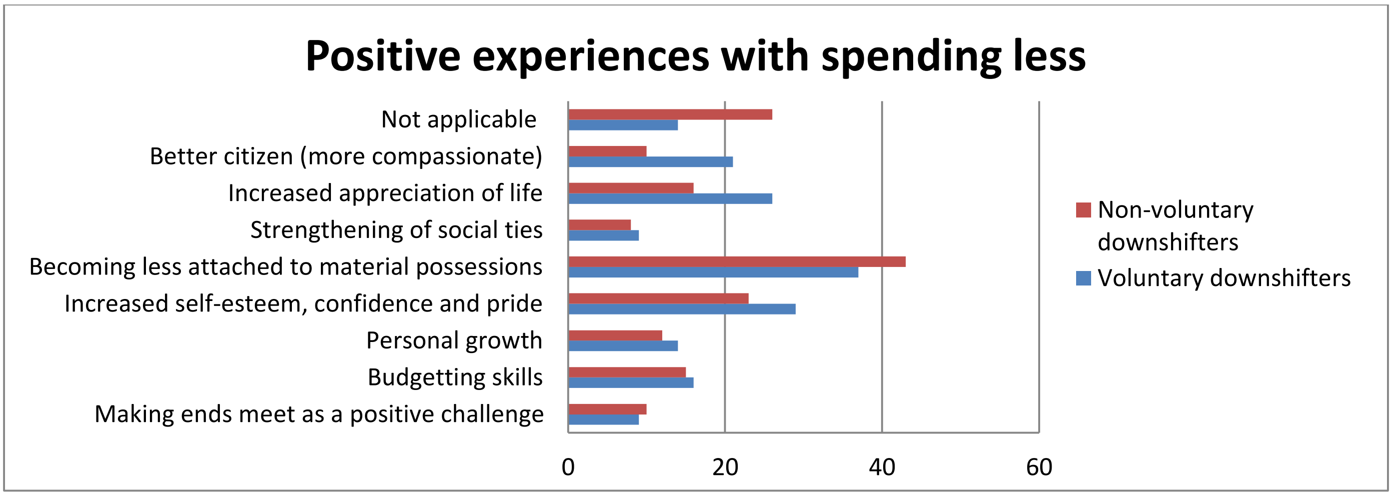
[9] We should note here that a large proportion of the respondents (47.1%) did not answer this question.

than 30% of the people who work. For them, the work-life balance is not right in that they prefer to have more free time. How much income they are willing to forgo is not clear from our survey as we did not ask this explicitly. The question we asked was: If you were working fewer hours per week, could you live well with earning less money? To this question 70% said no, 30% said yes. When asked with how much less salary per month they could still live well, 45% indicated that could not live well when their income dropped with 100 euro or more. Up to 47% said they still could live well when earning between 100 and 500 euro less.

The wellbeing effects of reduced material consumption

Reductions in income and less material consumption are the opposite of what the European Commission wants to achieve, but it is interesting to look at the changes in wellbeing that people experienced when experiencing a voluntary and non-voluntary significant reduction in spending (which for the non-voluntary downshifters is related to reductions in earning). Scheurs (2010) from ICIS studied the effects of reductions in spending of more than 25% for a sample of 741 people living in the Netherlands.[10] The results are given in Figure 6 and 7.

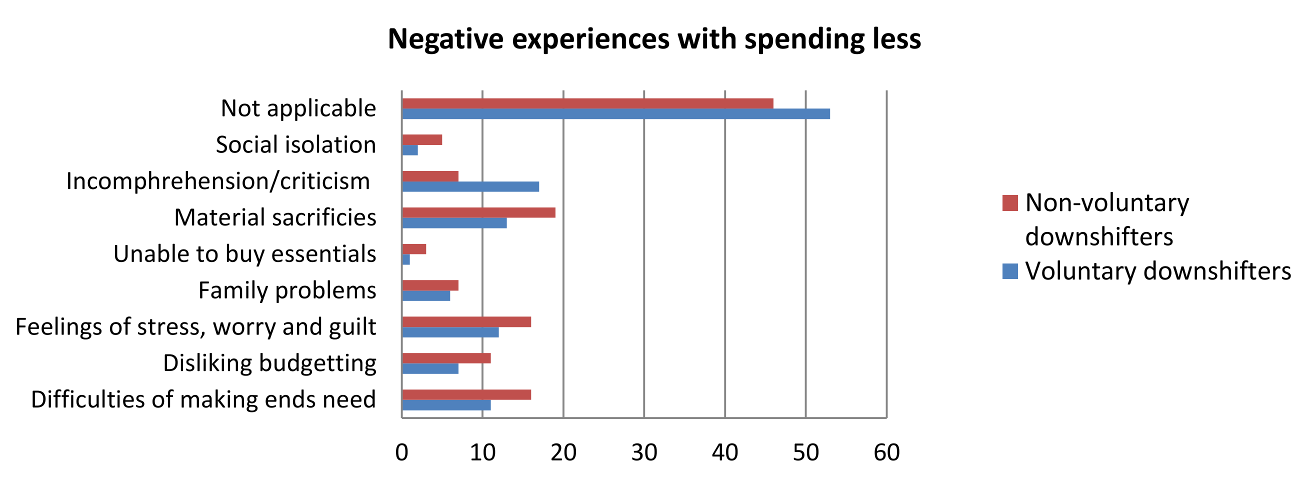
Figure 6: Self-reported positive experiences of downshifters in the Netherlands



Source: Own graphs based on data from Schreurs (2010)

[10] The sample consists of 461 voluntary downshifters, 280 involuntary downshifters and 265 non-downshifters.

Figure 7: Self-reported negative experiences of downshifters in the Netherlands



Source: Own graphs based on data from Schreurs (2010)

The results show that people experience both positive and negative experiences with spending less. The most frequently mentioned positive experiences are: becoming less attached to material possessions, increased self-esteem, confidence and pride, and becoming a better citizen (more compassionate with greater engagement with issues of poverty, pollution and global concerns). Up to 26% of the downshifters reported an increased quality of life, consisting of such things as less fatigue, less stress, improved health, more free time and having a more adventurous life because of new activities (Schreurs, 2010, p. 109).

Voluntary downshifters experience more positive experiences than downshifters as expected but the differences are smaller than expected. Positive downshifters experience an increased appreciation of life more than non-voluntary downshifters. Interestingly, the non-voluntary downshifters stated that they become less attached to material possessions more frequently than voluntary downshifters. A possible explanation for this is that voluntary downshifters were already less attached to material possessions. Against the positive experiences, there are a number of negative experiences. These include of material sacrifices, feelings of stress, worry and guilt (towards once children), difficulties of making ends meet, criticisms from their social environment (especially towards the voluntary downshifters), family problems, social isolation and not being able to buy essentials. Budgeting as a way to monitor and control one's expenditures was mentioned by some as a negative and by others as a positive experience. The positive experience consisted of being able to budget one's expenditures, giving people a sense of control and achievement. Less than 4% of the people said that they were unable buy essentials, which is remarkable. Interestingly, voluntary downshifters reported increased expenditures on charitable donations (22%), food (14%) and holidays (12%). Non-voluntary downshifters reported an increase in debt repayments (62%) and in savings (64%) (Schreurs, 2010, p. 105). Overall, positive experiences are reported more frequently than negative experiences. The picture that emerges from the study is that reduced spending does have lots of benefits. The negative effects appear less negative than anticipated. Generally, non-voluntary downshifters report more negative effects than voluntary downshifters. Voluntary downshifters experience more negative effects from the social environment. The primary motivation for downshifting is to improve their quality of life or their financial situation but one of the positive effects is an increased concern for the environment. In terms of the greenness of their behavior, the study found that downshifters were significantly more economical with energy than non-downshifters ($p < .01$) (Schreurs et al., 2012, p. 105).

The results for the Netherlands are in line with results for the US, where 87% of voluntary downshifters (simplifiers) report being happier compare to before they downshifted (Alexander and Ussher, 2012). The macro-economic effects of downshifting beg further analysis. According to Burch (2012, p. 22) "any major transition towards a culture of mindful sufficiency would have momentous economic implications, but not necessarily catastrophic or destructive ones". His viewed is echoed by Charlebois (2014, p. 70) who states that "a large increase in the number of voluntary simplifiers in the US would not halt or harm economic progress; rather, it would lead to more locally focused economies, changes in demand towards ethical and organic products, and an improved overall relationship between people and earth. This inherent value to voluntary simplicity brings endless intangible benefits". Whatever what may think of this, it appears worthwhile to consider the virtues of downshifting against the toll of material consumption.

Reductions in working time that are accompanied with income reductions can be expected to lead to lower resource consumption. According to a study of CEPS, the impact on climate change of reducing work hours over the rest of the century by an annual average of 0.5 percent, would "eliminate about one-quarter to one-half of the global warming that is not already locked in (i.e. warming that would be caused by 1990 levels of greenhouse gas concentrations already in the atmosphere)" (Rosnick, 2013, p. 3). The study notes that the pursuit of reduced work hours is associated with an absolute reduction in the living standards of low income earners, especially the working poor whose incomes fall below a given poverty line.

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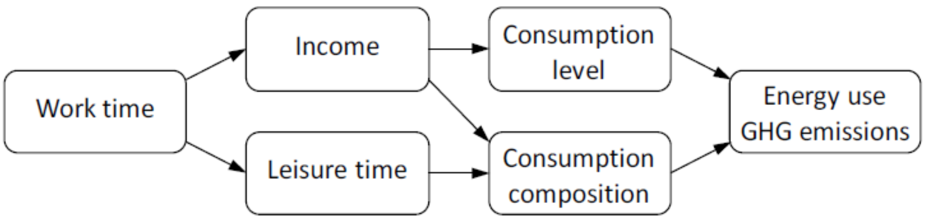
Figure 8: Model of links between working time, consumption, energy use and greenhouse gas emissions



Source: Nässén and Larsson (2014)

It is being found that a decrease in working time by 1 percent reduces energy use and greenhouse gas emissions by 0.7 percent and 0.8 percent respectively. The findings are based on the energy intensity and GHG intensity of average and marginal time use in Sweden, given in Table 7.

Table 7: Average and marginal time use, together with energy intensities and CO2-eq intensities of time activities in Sweden

	Time use		Energy intensity	GHG intensity
	Average	Marginal		
	Minutes/hour	Minutes/hour	MJ/cap/h	$kgCO_2$-eq/cap/h
Work (energy-intensity: home heating etc. while at work)	15.1	-60.0	8.9	0.41
Domestic work	5.5	11.8 ***	34.3	0.72
Child care	1.2	2.5 ***	10.2	0.42
Sleep, eating, hygiene	24.6	18.1 ***	11.5	0.48
Sports, outdoor and participatory activities	1.4	2.1 *	19.4	0.98
Entertainment, culture	0.2	1.3 ***	54.8	2.57
Socializing	2.4	6.5 ***	24.1	1.16
TV, radio, reading	5.0	8.3 ***	19.4	0.54
Hobbies	1.1	5.8 ***	43.0	1.95
Travel	3.4	3.5 ***	91.9	5.10

Significance levels: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$ (two-tailed test)

Source: Nässén and Larsson (2014)

The 0.7 percent reduction in energy use for a 1 percent reduction in working time is in line with estimates for other European countries from other studies (0.84 percent in the Netherlands, 0.86 in Denmark and 0.91 in Spain). Estimates for other countries are: 0.57 percent in the US, 0.64 in Japan and 1.0 in Brazil. The partly offsetting effect of households having more time available for leisure activities is found to be less than a tenth of the income effect.

Final remarks on household behaviour

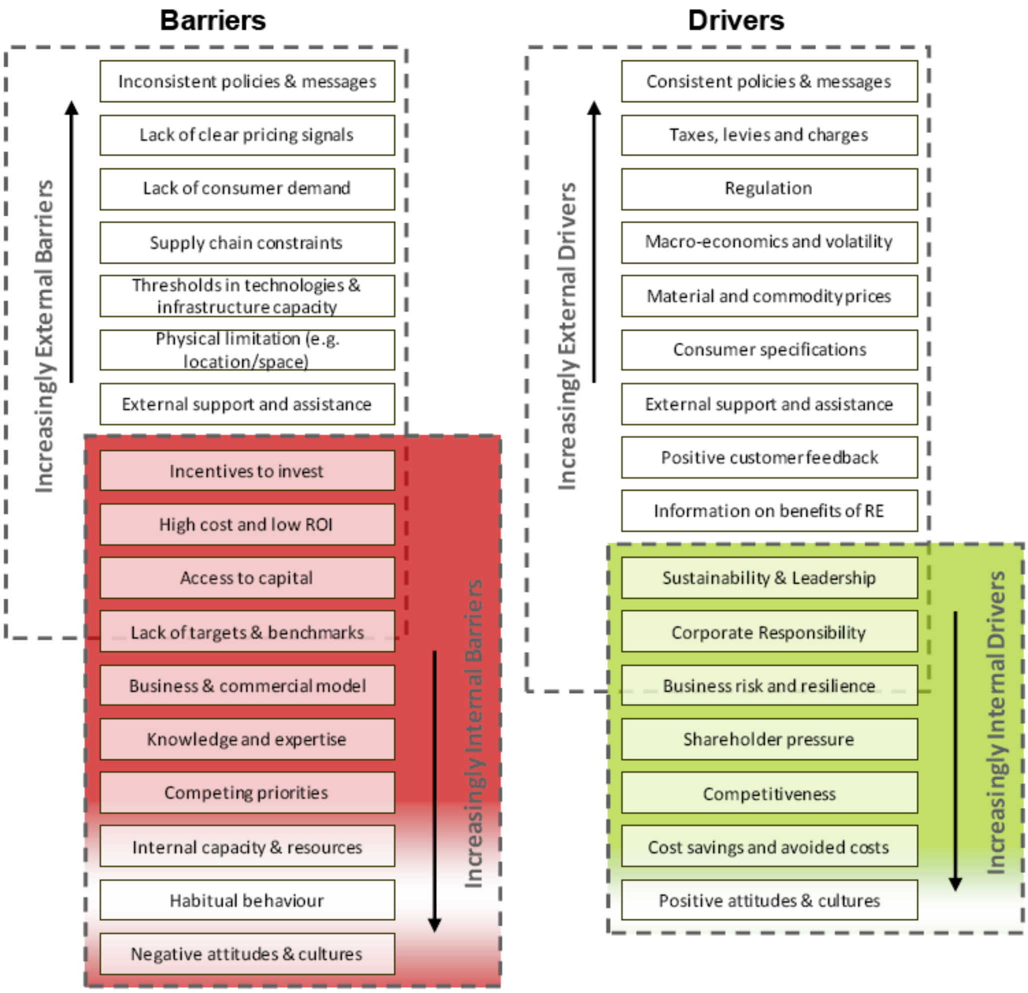
Overall the studies into behavior showed that resource consumption patterns are influenced by numerous factors that are strongly interlinked. Individual (domestic) consumption practices are not just the outcome of personal attitudes, values and individual decisions but the result of people's participation in social (collective) practices and settings as well, such as the availability of products, services and infrastructures (and people's awareness and appreciation of those) and social norms. The webs of constraints could not be determined in all cases, but there is clear evidence that people experience different barriers to living more resource efficiently. An unexpected finding is that many people expressed an interest in product sharing and in more resource efficient behaviour (such as eating less meat and driving less. Reducing resource use is not the primary motivating factor for this. We find that *resource use is only implicitly considered* through costs, health issues, climate change and the environment in general.

5. Highlights of business barriers study

Businesses have proven to be both part of the problem of resource inefficiencies as part of the solution. Therefore Task 1.5 focused on why firms use resources inefficiently and why some firms are implementing 'resource efficiency measures' (REM). A REM is defined more or less the same as eco-innovation, thus as *the production application or exploitation of a good, service, production process, organizational structure, or management or business method that is novel to the firm or user and which results, throughout its life cycle, in a reduction of environmental risk, pollution and the negative impacts of resources use (including energy use) compared to relevant alternative*s (Kemp & Pearson 2008).

The drivers and barriers to achieve process and product RE improvements have been analyzed in earlier FP7 research (e.g. in Bio Intelligence 2013). Many low-cost/no-cost measures and opportunities can provide substantial benefits and are relatively simple to implement. Inefficiencies are being squeezed from commercial supply chains and businesses are undertaking internal examinations of production process efficiencies. For instance the potential gross benefits from the quick wins are estimated between 10% and 17% of turnover on average (Bio Intelligence 2013). Figure 9 provides an overview of business barriers and drivers that this study found, both ordered on an internal/ external axis.

Figure 9: Barriers and driver for implementing resource efficiency measures at firm level



The Eurobarometer (2011) survey identified a number of changes within European companies regarding the implementation of eco-innovations in order to become less material intensive (n=5,222). The results of this survey show that especially the share of material costs in the total costs is important: the higher this ratio, the more companies are committed to modify their business models (to decrease material use). When material cost are more than 50% of the total cost, up to 32% of the companies reported they have changed their business model as a response to material cost reduction measures; when this ratio is below 10%, only 17% of the firms have. In other words, for firms cost reduction is a significant driver for REM.

When material cost is not a big issue, resource inefficiencies often remain and for many firms sustainability policy is not more than meeting environmental regulation. For example, 51% of European SMEs state that they comply with environmental legislation but do not wish to go beyond these requirements (Eurobarometer 2013).

Environmental regulation and taxes that have been introduced in the last decades have led to significant ecological improvements, and therefore many see this as the way forward and plead for more far stretching ecological tax reforms (e.g. Von Weiszäcker 2009).

At the same time, what a sustainable business model is remains an understudied topic (Shaltegger, el. al., 2012), and many questions of how businesses can become more resource efficient –and why many don't - have remained unanswered.

Based on an analysis of 150 recent 'resource efficiency measures' (REMs), the Polfree Task 1.5 and 2.4 sought to explain why these REMs were introduced, assuming that in these cases the barriers to resource efficiency were overcome[11]. It distinguishes three groups of REMs, depending on whether it is focused on the firm's operations, the product, or the whole life cycle, see Table 8. Operations-focused measures impact on the supply side component of business models, product-focused measures interrelate more with the customer side. Life-cycle measures have an impact on both supply and demand components, and in particular to the core element of value proposition because they typically imply radical product and system re-design.

[11] Polfree report D2.4 evaluates descriptions of cases (on resource efficiency related to business model changes) that were found in several reports, studies, and other sources. The description of a case ranged from a few paragraphs to full articles. It is debatable whether such a content analysis is the most effective way to identify firm barriers and motivations to resource efficiency measures, but it should give a first impression.

Table 8: Three categories of resource efficiency measures

Category of BM	Eco-innovation or Strategy	Example of Resource efficiency measure (REM)	Additional references
Life cycle-focused	Industrial ecology	Industrial symbiosis	(Chertow, 2000)
		Remanufacturing	(Savaskan, Bhattacharya, & Van Wassenhove, 2004)
	Radical re-design	Circular economy	(Ellen MacArthur Foundation, 2013)
		Cradle to Cradle (C2C)	(Braungart , McDonough , & Bollinger, 2007)
		Green chemistry	(Anastas & Breen, 1997)
Operations-focused	Process integrated measures	Pollution control	(3M & UNEP, 1982)
		Cleaner production	(UNIDO, 2009)
		Eco-efficiency	(WBCSD, 2000)
	Management measures	Green Supply Chain Management	(Sarkis, Zhu, & Lai, 2011)
		Energy efficiency management (in production)	(Bunse, Vodicka, Schönslebe, Brulhart, & Ernst, 2011)
		Environmental management systems	BS7750, ISO14001
Product-focused	*Goods-focused*	Green products	(Miller, 2009)
		Greener products	
	Service-focused	Green services	(Halme, Anttonen, Kuisma, Kontoniemi, & Heino, 2007)
		Service substitutes	(Tan, Matzen, McAloone, & Evans, 2010)
	Product-service systems	Product related services	(Tukker & Tischner, 2006)
		Advice/ consultancy	
		Product lease	
		Product renting or sharing	
		Product pooling	
		Pay-per-service unit	
		Activity management	
		Functional result	

Source: D2.4

The study finds most RE potential for businesses in three measures: green (business) services, cradle-to-cradle and industrial symbiosis, because more than the other measures, these ones impact both business competitiveness[12] and resource efficiency[13], often across the value chain (Dias Lopez et al., 2014).

A key example of a green business service is an energy service company. In recent years there has been an increased interest in energy service projects throughout Europe. An energy service company or energy savings company (acronym: ESCO or ESCo) is a commercial or non-profit business providing a broad range of energy solutions including retrofitting, energy conservation[14], energy infrastructure outsourcing, power generation and energy supply, and risk management. An Energy Performance Contract (EPC) is a partnership between a customer and the ESCO that allows the customer to improve the demand-side energy efficiency of their facilities without any up-front capital costs or special loans. Customers of ESCOs are often looking to upgrade their building systems that are either outdated and need to be replaced, or for campus and district energy plant upgrades.

In terms of organizational structure, an ESCO is typically a specifically composed consortium of a few firms, a new legal entity, which takes over the ownership of a range of applicable equipment, configured in such a way as to reduce the energy cost of a building. The building occupants, or landlord, then benefit from the energy savings and pay a fee to the ESCO in

[12] Although the authors acknowledge they had hardly any information on the business value of REMs in terms of impact on return on investment, cost savings etc.

[13] Although the authors acknowledge the case studies often lacked data on the precise environmental gains.

[14] Mostly in in lighting, heating (including ventilation and air conditioning) and building energy management.

return. At all times, the saving is guaranteed to exceed the fee. The ESCO starts by performing an analysis of the property, designs an energy efficient solution, installs the required elements, and maintains the system to ensure energy savings during the payback period. The savings in energy costs are often used to pay back the capital investment of the project over a five- to twenty-year period, or reinvested into the building to allow for capital upgrades that may otherwise be unfeasible. If the project does not provide returns on the investment, the ESCO is often responsible to pay the difference.

An example of an ESCO in the UK is RE:FIT which offered energy saving to public buildings of Transport for London (TfL), the transport organization of London, between 2003 and 2011. It involved a 16% carbon reduction for its complex and fragmented building mix across 22 buildings. By replacing lighting and controls upgraded building energy management controls, amongst others, RE:FIT reduced TFL's gas consumption by about 15% and electricity use by 20%, whilst realizing energy savings of £500k per annum.

EPC's offered by ESCO's are an example of how web-of-constraints towards energy efficiency in buildings can develop into webs-of-drivers, because ESCOs concert a number of changes at the same time, addressing a number of barriers at the same time. First of all by marketing and offering their services, ESCOs overcome lack of awareness of most building owners. Energy efficiency tends to remain the invisible solution for most landlords and by bringing the knowledge and experience of how an EPC can be successful, ESCO's shift focus on demand-side measures (while traditionally the focus is on supply side measures). Secondly, EPC's overcome the barrier of upfront investment cost and associated risks. The ESCO takes care of the upfront investments and the client doesn't need to bother their own personnel with complex technical issues. The issue of split-incentive between landlord and tenant is a significant barrier in the housing sector, and EPC's can overcome them. Finally, ESCO's trigger a shift from subsidy-thinking into business-thinking. Landlords and citizens in general still tend to associate energy-efficiency investment with (waiting for) government subsidies, which would make the EU 2020 strategy a very expensive and long, top-down process. ESCO's activate bottom-up business-thinking towards energy efficiency.

Countries with a longer history of public private partnerships tend to be leading in setting up ESCOs (such as the UK) or countries with a longer history in energy savings, such as Germany. But other countries without such traditions are quickly following. In the Netherlands an ESCo (a daughter company of large construction firm Structon) took over the technical management of the nine swimming pools of the city government of Rotterdam in 2011. The ten-year contract entails a reduction of energy cost of 4.5 million euro, following from energy reductions of 43% of gas, 24% of electricity and 9% less water. After this first ESCo-initiative in the Netherlands, more firms developed this service as a spin-off of their traditional business (especially large construction companies), and by 2014 at least 33 larger and smaller EPC's have been set up.

There are also barriers that hinder the further emergence of the ESCO-initiatives. At the client side the main one is perceived insecurity or inconvenience of losing control of the energy infrastructure for a long time (typically 10 years). This leads some firms to decide to manage the savings operation themselves. According to one branch organization for ESCOs this is mostly a 'fear for the unknown'. A key barrier for more projects at the side of the ESCO is the difficulty to get funding. Typically a new project needs new third-party financing, often from a finance institution, and not from internal funds of the ESCO or of the customer. Therefore banks need to have sufficient confidence in the new ESCO-project before providing loans. During the financial crisis of the last years, banks have been more hesitant to do so.

The Energy Performance of Buildings Directive 2010/31/EU (EPBD) is currently the main legislative instrument to reduce the energy consumption of buildings. Most of the requirements under this Directive are able to contribute to the increase of the ESCO market through promoting an energy efficient building stock and related public measures.

The second ‘resource efficiency measure’ of great potential is Cradle-to-cradle (C2C) design. C2C actually moves beyond the notion of resource efficiency and draws on a resource-effectiveness paradigm. The proponents of the concepts argue that resource efficiency is too linear, trying to minimize the volume, the velocity and the toxicity of the material flow from raw materials to product disposal, but not to transform its linearity and single usability stream (Braungart et al., 2007). They criticize RE because even if some materials could be recycled, it only happens as an "end-of-pipe" solution, thus as an adaptive measure that occurs only at the end of a process stream and at the point of discharging byproducts into the environment; since these materials are not designed to be recycled, the actual recycling degree is very limited and it often results in a downgrade or degradation of the material quality. Resource-effectiveness at the other side has a lot more emphasis on the transformational potential of a properly designed material flow. Embedding the assumptions of recyclability and of perpetual reuse of resources in the initial development of the product rather than at the end, it allows the generation of a cyclical metabolism (Braungart et al., 2007), which enables materials to maintain their value over multiple uses and accumulate intelligence over time (Braungart et al., 2007). This means that the quality of the resources is not sacrificed for the purpose of the final product, but that the final product still holds within itself the sufficient purity of materials and the capacity to be transformed in another product multiple times after the first utilization, preserving healthy characteristics and not being downgraded in quality but indeed upcycled in other products, ready to be used for other purposes (McDonough & Braungart, 2013).

At the same time, however, in practice, there are some implications that limit the level of eco-effectiveness that C2C products could achieve on the market. First, even though marketed products and the end of their life cycle are technically recyclable, it might not be practical to do so because they are not collected in high volumes or may be expensive to implement a recycling infrastructure that would enable this (Bjorn & Hauschild, 2012). Moreover, in order to effectively upcycle the materials into a new product, completeness of information and data on the substances of the component manufactured along the whole value chain need to be clear and reliable to the designer of the new product, and often this is not the case. Obtaining effective closed-loop cycles implies that the company could monitor all the materials' supply chain, the manufacturing and production facilities, which is often a too intensive overhaul for businesses (Bjorn & Hauschild, 2012).

The third ‘resource efficiency measure’ of great potential is industrial symbiosis. A pioneering initiative on industrial symbiosis is the National Industrial Symbiosis Programme (NISP). It has been recognised for fostering eco-innovation by connecting businesses to create resource efficiency opportunities, creating and sharing knowledge through the network. NISP is an EU Environmental Technologies Action Programme (ETAP) and OECD Eco-Innovation Exemplar. OECD recently declared industrial symbiosis ‘a la NISP’ to be “an excellent example of systemic innovation vital for future green growth.” This innovation takes the form of new products, new processes and technologies, and in some cases new business models. A study of selected case studies from the early days of NISP UK by the University of Birmingham, 70% of synergies involved innovation of some sort: 50% involved the transfer of best practice to new markets, and 20% involved new research and development. Innovative firms that see resource efficiency as a value creator (or a business opportunity) come in all sizes –some incumbents fit this bill, although they are often hamstrung by their incumbent status, vested in the status quo.

The three most promising 'resource efficiency measures' (REMs) that were discussed -- green services, cradle-to-cradle and industrial symbiosis-- imply that firms should explore the potential of green services (through performance contracts) for their business, as well as that of cradle-to-cradle certification and/or industrial symbiosis consultancy. An ESCO can perform an analysis on the energy savings potential for the business, and provide an offer for an energy performance contract (EPC). From an RE-perspective, such performance contracts may be extended to include material savings (to become 'Resource Savings Companies', RSCOs, which to our knowledge don't exist to date), but most likely there will only be business opportunity for this in case material prices would rise. Cradle-to-cradle certification should be considered because through their implementation resource effectiveness and competitive improvements can go hand-in-hand (although more study in needed in this direction). A study on four C2C-certified firms in the paper and pulp industry did find that these firms have experienced competitive advantages of the certification (mostly through better performance in (green) niche markets, and less through cost savings [Pierano, 2014]). The analysis performed during such a certification-process may also open up RE synergies with other industries (industrial symbiosis). RE policies should especially seek to stimulate firms in taking these three measures. We will pick up these policy implications at the end of this section.

Why are some firms introducing REMs, while others are not? Regarding the motivation for introducing the REMs studied, the analysis of 150 cases concludes that there can be various reasons. On the supply side costs may be reduced and supply may be (more) secured, on the demand side new customer niches (either through products or services) may be tapped or a new forms of customer intimacy may be reached. But beside these obvious benefits, companies may also be active in this field to be seen as a reliable employer, which is attractive for new employees as well as for current employees, which may feel themselves more motivated.

These findings are quite consistent with a literature review by Bohnsak (2013) who finds three key motivations for firms to invest in sustainable innovation: first-mover advantage, corporate social responsibility (CSR), and policy pre-emption. First, some firms tend to innovate to gain a first-mover advantage (Lieberman & Montgomery, 1988). By being the first to launch a sustainable product, the innovator may yield technological leadership that might allow an eventual increase in its market share (Van den Hoed, 2007). A key example is Toyota that gained a first-mover advantage with its introduction of the hybrid Prius (Porter & Kramer, 2006). Further, creating exclusive access to scarce resources may create an advantage. Car manufacturers, for example, can secure rare metals for its production of batteries through backward integration. A first-mover advantage can also create switching costs for consumers, for instance if EV manufacturers create industry standards with regard to recharging infrastructure.

A second motivation that Bohnsak (2013) identified is that it is part of the corporate social responsibility activities of the firm. Different concepts and perceptions have emerged around the notion of CSR (Bassen, Jastram, & Meyer, 2005; Carroll, 1999; Kolk, 2010). Broadly the literature may be separated into two streams. One line of literature, known as the 'beyond compliance' perspective, would suggest that socially responsible firms invest in sustainable technologies to contribute to society and enhance quality of life (WBCSD, 2000). Another body of literature would argue that engaging in CSR and investing in sustainable technologies leads to a competitive advantage (Porter & Van der Linde, 1995), a better reputation (Rindova et al., 2005), or increased access to markets (Ambec & Lanoie, 2008). Thus, sustainable technology investments may be part of firms' aspiration to contribute to society and 'doing well while doing good' while at the same time using such innovation as a strategic move to enhance competitiveness[15].

A third motivation for firms can be to anticipate potential government policy (Nidumolu, Prahalad, & Rangaswami, 2009) and pre-empt more stringent future regulations (Van den Hoed, 2005). Sceptics have argued, for example, that the commitments car manufacturers made to fuel cell technologies were merely 'window-dressing' to prevent more stringent regulation (Van den Hoed, 2005). Consequently, Van den Hoed (2005: 271) suggests a more nuanced perspective, arguing that investments were "balancing the pressures from external stakeholders (regulators, consumers, competitors) and internal barriers for innovation in uncertain technologies." Thus, pre-emptive behaviour—and government incentives (Diamond, 2009)—could stimulate firms to engage in sustainable technologies.

The Eurobarometer survey *SMEs, Resource Efficiency and Green Markets* (2012) finds that mainstream businesses (i.e., the majority) see resource efficiency primarily as a cost measure, route to revenue diversification, and to some extent risk mitigation. Leaders, on the other hand, seek business opportunity by their nature, and resource efficiency is one driver that provides this. Only a minority (23% of SMEs and 36% of large companies (250+ employees)) of the companies taking action on resource efficiency are motivated by competitive advantage and new business opportunities.

How can policy help to overcome business barriers? Resource efficiency policies should especially seek to stimulate firms in exploring resource performance contracts (green services), adopt cradle-to-cradle certification and explore industrial symbiosis potential. Energy (or in the future possibly: resource-) performance contracts may be stimulated in various ways, e.g. through a general energy tax (which improves the business case for an ESCO). Taxing other resources would be a way to stimulate RSCOs, a possible material equivalent of ESCOs. Although there are no examples of these in practice at the moment, the finding that firms' commitment to RE measures correlates with share of material cost (p.36) supports this idea. Further study is required on this topic. Another way to stimulate energy performance contracts is Energy Savings Obligations (ESO). Sometimes referred to as 'White Certificates', these are an example of a stick-type policy instrument that forces energy companies to realise energy savings at the level of the end-user (Al-Saleh and Mahroum 2014). They represent documented and often tradable obligations that a certain reduction in energy consumption has to be attained. Such policy schemes have motivated energy companies to develop business models that realise mandated energy savings (IEA-RETD, 2013). In France, this was carried out through partnerships with electricians and installers to offer new energy-saving services to customers. In Italy, a large part of the obligation was outsourced to Energy Service Companies (ESCOs). In other words, ESO schemes played a role in stimulating the demand for - and growth of - the ESCO market (Boot, 2009).

Cradle-to-cradle certification may be stimulated in public procurement, similar as how biological products are stimulated. More study is necessary to understand whether and how cradle-to-cradle certification can be a basis for regulation, in the sense of making C2C-certification compulsory for some types of manufacturing operations. Finally, industrial symbiosis initiatives may be stimulated through the (financial) support of network organizations to build up knowledge & competences for resource platform services aimed at resource efficiency and closing material loops. They should develop overviews on what companies' material and waste input and outputs are, and advice businesses on improving

[15] The relationship between corporate social/environmental performance (CSP) and corporate financial performance (CFP) is somewhat contested. Some assumes that the current evidence is too fractured or too variable to draw any generalizable conclusions. Orlitzky et al (2003) conduct a meta-analysis of 52 studies and suggest that corporate social responsibility and, to a lesser extent, environmental responsibility is likely to pay off.

resource productivity whilst improving competitiveness. Such initiatives would benefit from flanking policies regarding mandatory corporate reporting on material input/output and waste, as well as mandatory recycling levels.

6. The markets for commodities and secondary materials

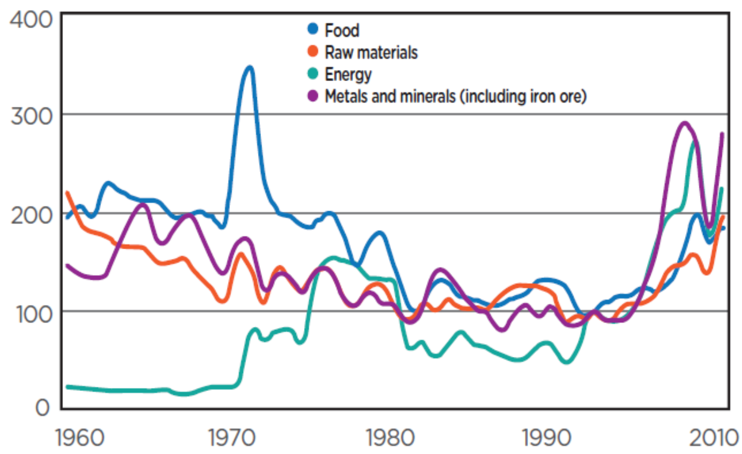
The issue of market development for recyclables has received increasing attention over the last years. The rise in the prices for virgin raw materials since 2002 could be seen as an opportunity for recycled materials to compete with virgin raw materials for prime uses. However, the situation is far more complex than this and a number of barriers operate both at the supply and demand side, limiting the penetration of recyclates. The recent publication of the circular economy package and the legislative proposal to increase recycling targets has been accompanied by measures to promote the market for secondary materials, with a special focus on the construction sector, the most material intensive sector of the EU economy. Moving waste up the waste hierarchy and providing more diverse, higher value outlets for recyclates is a prerequisite for the successful implementation of the "circular economy" concept. Increasing recycling requires a parallel increase in the markets for recycled materials that absorb the supply and progressively displaces primary raw materials. In POLFREE we did not undertake an investigation of our own of the primary and secondary markets for individual commodities, but within D1.1 we briefly examined the markets for glass and plastic.

The markets for commodities and secondary materials are special markets in that price developments are subject to cycles of boom and bust. Especially commodity markets are characterized by great price volatility (see Figure 10). The price volatility for commodities stems from the following factors:

- Mine production cannot adapt quickly to meet demand (e.g. it takes 9 to 25 years to develop a large copper project).
- High tech metals are often by-products of mining and processing major industrial metals, such as copper, zinc and aluminum, which means that their availability is largely determined by the availability of the main product (European Commission, 2010).
- Price setting behavior of oligopolistic suppliers and price manipulation by financial speculators.

The price increases for commodities in the last years received much attention and helped to establish a view of commodities being scarce and an expectation that prices will increase further, although there is great uncertainty with regards to the price behavior of different commodities. Scarcity models for commodities are extremely difficult to develop and are not as well developed as their climate change counterparts. Scarcity of material, combined with an increased global demand fueled by the emergence of new industrial economies has led to important price increases. An aggregated index price developed by ECORYS (2012) shows that on average real prices increased by over 300% between 1998 and 2011, doubling between 1998-2000. After 2000 prices have still increased by almost 6% per year in real terms (ECORYS, 2012). Resource price volatility has also increased in the last 10 years, but there are significant differences between resource groups (ECORYS, 2012). Future trends seem to point to a continuous increase in prices of commodities driven by population growth and increasing demand from emerging economies. Some estimations point to a 13% increase in metal prices for the period 2010-2020, while price increases can even be higher for other resources (i.e. 53% price increase for iron ore or 20% for graphite and fluorspar) (ECORYS, 2012). These trends together with the dependency of Europe on critical metals and minerals, some with self-sufficiency ratio close to zero, point to the supply risk of Europe for a number of critical raw materials. The raw materials initiative and the strategy to tackle the challenges in commodity markets have been first attempts to set up a strategy on raw materials where markets for secondary materials play a crucial role in not only addressing environmental concerns linked to overexploitation of resources and increasing resource efficiency but also in ensuring supply security, competitiveness and eco-innovation.

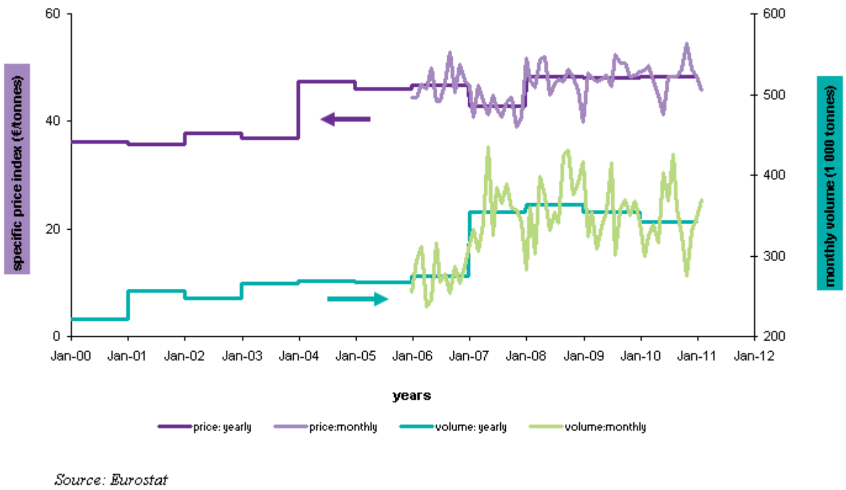
Figure 10: Commodity price indices



Source: UNEP, 2014, based on World Bank Commodity Price Data, 2011.

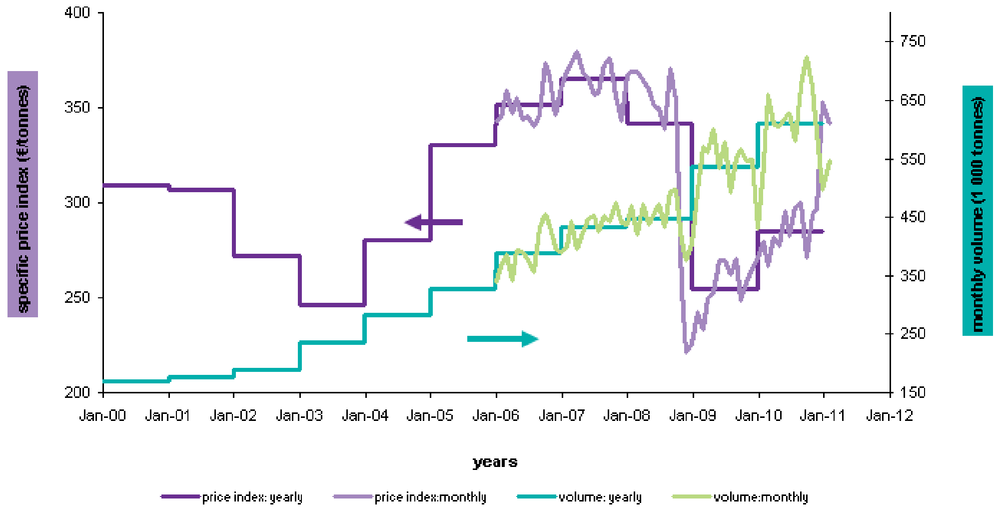
Similarly to what have happened in the primary raw materials markets, markets for secondary raw materials have experienced a significant amount of price volatility as we can see in Figures 10 and 11. The price volatility is highest for plastics. Since 2004 the price for plastic waste increased to levels above 350 €/tonnes, but there has been a 40% price drop between October 2008 and January 2009. Since then, the price recovered to 300 €/tonnes by the end of 2010. In the case of glass, with a well-established secondary market, prices have remained above 40 euro a tonne since 2004.

Figure 11: Price indicator and trade volume for glass waste in EU-27



Source: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Recycling_%E2%80%93_secondary_material_price_indicator)

Figure 12: Price indicator and trade volume for plastic waste in EU27



Source: Eurostat

(source:http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Recycling_%E2%80%93_secondary_material_price_indicator)

The differences in prices and traded volumes show that the markets for glass and plastic waste are very much different. Glass is a heavy and low-cost material and most trade takes place in-between neighbouring countries. Recycling is generally better established, technologies are well developed and issues of separation and material contamination are less of an issue given the characteristics of the material. Markets for paper waste and plastics waste are more international. In both cases issues of material contamination can be relevant and separate collection systems could contribute to enhance the quality of recyclates. The price of plastic waste depends on the supply and demand of plastic waste material but also on crude oil prices. The secondary market for metal scrap has also grown significantly, linked to the increase of the prices of metal ores and demand from emerging economies. This is a well-established market in the EU with most of the metal scrap being absorbed by the internal market. As a mature market, it operates effectively even under increase price volatility. The main barrier to further development may arise from the costs associated to collection.

Markets for recycled material are strongly connected with markets for virgin materials and depends on the costs of collection and separation, recycling technologies, waste management policies and the way in which products are designed. Landfilling tariffs and bans together with end-of-life regulations have contributed to give waste some positive economic value, thus facilitating energy recovery, material recycling and re-use of product components. However, issues have also been raised regarding the volumes of collected waste from dedicated systems (separate collections) exceeding the processing capacity of the recycling industry in the EU (EESC, 2011). This is aggravated by the fact that controlling illegal shipments of waste is highly complex and may not only reduce the environmental controls of waste but also its further reutilisation as a secondary material. The quality of the recyclates is also important in ensuring that recycled materials substitute primary materials in prime uses. By the quality of recyclates, it is important to consider both their grade (e.g. polymer type) but also their composition (i.e. how polluted the material is with other recyclable or not recyclable fractions) (DEFRA, 2013).

Recyclers require both a steady stream of waste and a steady demand (two conditions which are difficult to manage). Incineration overcapacity and low costs for landfilling can undermine waste management systems (such as recycling). Incineration facilities may compete with recyclers for the same type of high calorific waste streams such as plastics and paper. High investment cost of incineration facilities create in some cases a situation of lock-in where shifting from one system to another may create additional costs. As highlighted in this quote, competition between incineration and recycling facilities could lead to artificially low incineration prices: "Overcapacity makes it harder for local authorities to source third party waste to 'top up' their incinerator if they were to reduce their own 'residual' waste arisings. This, in turn, leads to excess capacity that results in artificially low gate fees that discourage reduction, re-use, recycling, composting and anaerobic digestion". (http://ukwin.org.uk/2012/08/28/2011-sita-discussion-of-european-incineration-overcapacity/).

As discussed above, secondary markets are subjected to some of the dynamics that operate on commodity markets but are faced by a number of additional barriers. These barriers operate both at the supply side and at the demand side. On the supply side, secondary materials markets are subjected to price competition from primary materials. Although in principle secondary materials can provide important savings in energy and materials, which could in theory translate to competitive prices, this is partly compromised by the lack of internalisation of environmental costs linked to extraction, mining and processing. Primary materials located in low –middle income but resource rich countries, may maintain artificially low prices, discouraging recycling, unless prescribed by legislation. As noted above, landfill or incineration over-capacity contributes to create artificially low gate fees in absence of landfill/ incineration taxes. This may discourage recycling over other waste treatment options. High quality recycling also requires outlets for the materials they produce and therefore it is dependent on well-developed markets for recyclates.

Barriers on the demand side also exist and play an equally important role. In fact, in most cases supply and demand barriers are closely interlinked. For example, lack of high quality recyclates may have a detrimental effect on the demand of recyclates compared to primary materials. The lack of standardisation of recycled products or slow progress in the development of certification schemes has a negative impact on the adoption of recycled materials in prime uses. The development of markets for recyclates is thus closely connected to the adoption of high quality recycling standards across the recycling industry.

From the point of view of policy, a number of initiatives have been undertaken at the EU level to promote the supply and demand of secondary materials. These measures vary from regulation to voluntary and informative instruments. The current EU legislative framework on waste is a complex and ambitious legislative package. It has set increasingly stringent targets on recycling, affecting policies across the EU (28). The waste framework Directive and a number of Directives on priority waste streams set collection and recycling targets for a number of priority waste streams. This, however, has not always been accompanied by measures than ensure: a) high levels of quality recycling and b) mature enough secondary materials markets capable of absorbing the surplus of recycled materials. A review of this framework has been undertaken as part of Task 1.2. One of the conclusions of the review connected to this is that although targets on collection and recycling have contributed to increase recycling levels, the lack of targets on the actual performance and outputs of the recycling process[16], has in many cases led to the downgrading of resources through low quality recycling. Moreover, end of life and the introduction of dedicated systems for the collection of priority waste streams, has not fully taken into consideration actual processing capacity or the efficiencies of the process, in terms of quality standards for processing facilities.

[16] Only the Directives on batteries and accumulators sets performance targets of the recycling process.

From the pull-out side, the introduction of clearer guidelines on GPP and measures to introduce legal requirements on recycled content for a number of product categories could help to increase the demand of secondary materials and thus foster secondary materials markets. Differentiated VAT schemes depending on whether a product uses primary or recycled materials could also increase the demand and promote high quality recycling. Recent legal changes such as the introduction of end of waste criteria could reduce administrative barriers to waste reutilisation and foster innovative ways to recirculate materials such as industrial symbiosis. Also, informative instruments could play a role in increasing the demand of secondary materials. Measures such as the European Declaration of Paper Recycling have proved successful in promoting more paper mills consuming increasing values of secondary materials.

A much-discussed topic has been the introduction of taxes or levies on primary raw materials to promote the market for secondary materials. A number of practical experiences exist at the national level of the introduction of a construction minerals levy or charge. The UK Sweden, Italy of the Czech Republic have successfully taxed construction minerals leading expansions of secondary materials markets. For example, the UK aggregates levy has contributed to increase recycling rate of aggregates to 25% and boosted the market of recycled aggregates.

Although it is out of the scope of POLFREE to provide a comprehensive examination of the dynamics that operate in primary and secondary materials markets, this brief analysis gives an overview of the web of constraints that operate both at the supply and demand side and that explain inefficient uses not only of primary resources, but also of secondary materials, even when dedicated systems exist for their collection and treatment. Market dynamics in secondary markets are closely linked to primary materials markets, partly through issues of competition among treatment options and processing capacities.

7. Resource efficiency and energy efficiency

This section explores the topic of resource efficiency versus energy efficiency. Does resource efficiency produce energy efficiency benefits and will there be resource efficiency benefits from working on energy efficiency? As we did not have a dedicated task to this question, we don't have much to say on this empirically. But since they constitute important questions, the relationship between resource efficiency and energy efficiency is explored for the case of recycling.

Recycling as a resource efficiency strategy will lead to lower energy consumption when the energy required to produce the virgin commodity is greater than the energy required to recover a recyclate. The energy required to recover a recyclate depend on the energy involved in collecting and transporting the recyclate and the energy needed for processing the recylate, which depends on the properties of the concerned materials. In general, there is a loss of quality in respect to specific properties and characteristics, which will affect the energy balance negatively and which can mean that materials may have to be cascaded down a usage hierarchy if the affected properties are ones that really matter. For example, the purity of copper gradually reduces with recycling and this affects the conductivity, which might be important in some applications. Once vulcanised, rubber can never be fully de-vulcanised because the cross-bonds formed by sulphur compounds are not easily broken.

The energy consequences from the use of virgin material and recycling are strongly related to supply chain geographies and logistics between virgin materials and recyclates. Virgin materials usually have concentrated sources upstream in the supply chain, whether these are mines, wells, agricultural regions or whatever. Mass commodities based upon processing bulk materials are typically produced using relatively homogeneous base materials (minerals, crops, etc.). The processes involved are homogeneous too and the transport arrangements are relatively simple and straightforward because the base materials are locally concentrated. This is not the same for recyclates, where the materials of interest tend to be embedded in end-of-life products of very different kinds and to be found in associations with a wide range of different materials, sometimes as composites that can be hard to separate. Equally in materials recycling the source of the materials of interest can be very dispersed and the quantities and qualities of materials can be very variable in time and space. As the supply of recyclable material for the production of recyclates is a lot less sure than the supply of virgin materials this tends to create need for stockpiles of recyclates to be built up. This has a land cost and is potentially very unsightly.

So whereas it is relatively easy to come up with energy cost comparisons for some recyclates, such as steel, aluminium and glass, it is more difficult for most others. Even for glass (which is a relatively simple mass commodity) there are complications because, for example, wine is exported in bottles and the empty bottles end up in countries different from the countries where wine is produced. The fact that bottles for different wines are coloured differently adds to the complexity, because glass 'broke' or 'cullet' has different secondary uses depending on its colour: clear, green, brown, etc. The solution of not breaking bottles but rather washing them for re-use is a good one so long as the distances involved are small. This was used as the solution locally for water, milk, soft drinks and beers quite routinely until the 1970s and it works so long as dairies, breweries and such like facilities are also local and small scale. It doesn't work quite so well when you start dealing with large centralised production facilities for beverages, since the transport distances and energy costs for re-using the bottles increase as the beverage companies consolidate and seek economies of scale in production. So scale economies in production are traded off against extra energy and materials costs in distribution of the product. This has implications for the viability of reuse of glass packaging and tends to lead instead to glass bottles being thrown away (in absence of recycling legislation) or broken up for 'broke', which is more easily transported long distances but incurs energy costs for melting and reforming etc. The reforming needs to take place near to sources of demand for glass containers or in centralised locations relative to the sources of demand. So siting of facilities is also a factor in the trade-offs between energy efficiency and resource efficiency when resource efficiency is won through re-use or recycling.

The overall conclusion is that recycling has a high energy cost and should not be the preferred strategy for improving resource efficiency in every case, but rather a second, third or even fourth level strategy after the others, such as maximising product usage intensity (service units obtained from product-embedded resources), maximising product longevity, reduction of materials used in the product, product redesign, product remanufacturing, component reuse, and product repair.

In general, general statements about resource efficiency and energy efficiency are not warranted but require specific analysis, in which also rebound effects and aspects of use are being considered. This constitutes an important avenue for further research. Each resource efficiency strategy has to be judged on individual merits with reference to specific materials and contextual factors and it will not always offer such clear-cut environmental gains as some other strategies. How products are designed today and how logistics of production and distribution are arranged does not favour recycling. It has long been argued by experts who have backgrounds in materials recovery and recycling that the starting point should be to design products for component and material disassembling and recoverability.

The energy saving consequences from remanufactured products have been studied for 25 products by Gutowski et al. (2011) with the help of life cycle energy analysis in eight different product categories (furniture, clothing, computers, electric motors, tires, appliances, engines, and toner cartridges). For the 25 cases investigated, the authors found that in 8 cases remanufacturing clearly saved energy and in 6 it did not. In 11 cases the results were too close to call. The use phase energy is found to be a critical phase: "small changes in use phase efficiency can overwhelm the claimed savings from materials production and manufacturing (…). For those products with no, or an unchanging, use phase energy requirement, remanufacturing can save energy" (Gutowski et al., (2011, p. 4540). The powering up of products (such as shovels, leaf blowers and power tools) is mentioned as a negative product development from the point of view of energy use. Product architecture, labour costs and inventory storage costs may work against remanufacturing. Consumer acceptance is also a negative factor (Hazen, et al., 2012).

The applicability of the resource efficiency concept to manufacturing differs per sector. An indicator of the applicability of re-use, remanufacturing, cascaded use, recycling and recovery is given in Table 9.[17]

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[17] An explanation of the different concepts is given below:

Reuse – redeploying a product without the need for refurbishment – e.g. second hand motor vehicles.

Remanufacturing – returning a product to the Original Equipment Manufacturer (OEM) performance specification and giving a warranty close to that of a newly manufactured equivalent – e.g. Caterpillar has a successful engine remanufacturing business.

Cascaded use - using a product for a lower value purpose – e.g. turning used clothes into pillow stuffing. This can occur within the operations of a customer, for example where computers are redeployed within a company for less demanding applications.

Recycling – extracting a product's raw materials and using them for new products – e.g. aluminium and steel are widely recycled.

Recovery – using a product's materials for a basic, low value purpose such as road base or combustion to produce heat.

Table 9: Applicability of Resource Efficiency Concepts to Manufacturing Sub-Sectors

Sub-Sector	Reuse	Remanu-facturing	Cascaded Use	Recycling	Recovery
Food, beverage and tobacco					✓
Textiles, wearing apparel and leather products	✓	✓	✓	✓	✓
Wood, paper products and printing	✓	✓	✓	✓	✓
Coke and refined petroleum products					
Chemicals and chemical products		✓	✓	✓	
Basic pharmaceutical products and preparations					
Rubber, plastic and other non-metallic mineral products		✓	✓	✓	✓
Basic metals and metal products			✓	✓	
Electrical, electronic and optical products	✓	✓	✓	✓	
Machinery and equipment n. e. c.	✓	✓	✓	✓	
Transport equipment[143]	✓	✓	✓	✓	
Other manufacturing and repair[144]				✓	✓

Source: Lavery/Pennell – Next Manufacturing Revolution Report (2013, p. 135).

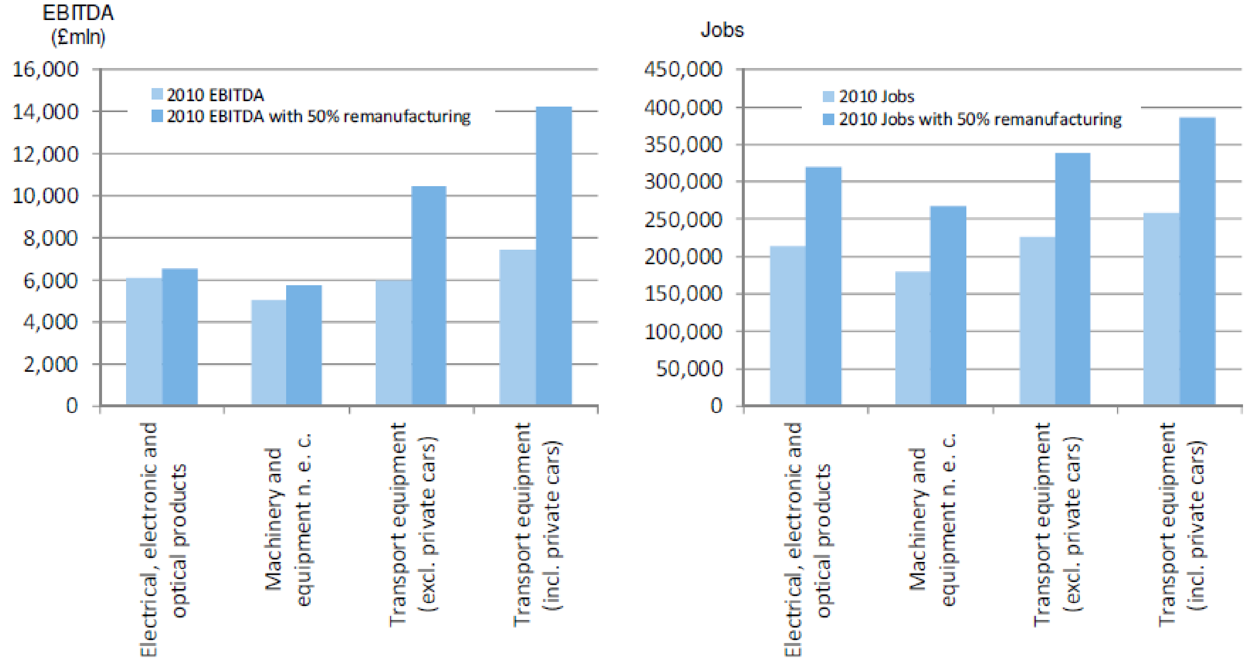
For the food and beverages sector, possibilities for re-use, remanufacturing, cascaded use and recycling are limited. Most sectors are found to have ample possibilities for remanufacturing, cascaded use and recycling.

For policy makers, the job consequences of various resource efficiency concepts are a relevant parameter, next to costs and environmental gains. In Figure 13, an indication is given of the jobs associated with remanufacturing shares of 50% for 3 subsectors in the UK. A shift to 50% manufacturing in the UK is estimated to create 310,000 to 320,000 extra jobs. In POLFREE we will produce our own job estimates for the selected pathways of resource efficiency with the help of the GINFORS and EXIOMOD models. The GINFORS model has been used to calculate the economic and environmental impacts of material input changes in production structures within the EU. Changes in the efficiency of material inputs are found to have distributional consequences both for sectors and countries. Agriculture, mining & quarrying, other non-metallic minerals will face a decline of demand as they produce the intermediate goods that are used less. Most European countries will experience a gain in GDP but some countries (Austia, Lithuania, Romania, Italy and The Netherlands) will experience a reduction in GDP in certain scenarios.

Source: Remanufacturing. Towards a resource efficient economy. A report by the All-Party Parliamentary Sustanable Resource Group

http://www.policyconnect.org.uk/apsrg/sites/site_apsrg/files/apsrg_-_remanufacturing_report.pdf

Figure 13: Impact of Full Remanufacturing on EBITDA and Jobs in the Three In-Scope Sub-sectors



Sources: Society of Motor Manufacturers and Traders, Motor Industry Facts 2012, ; Office for National Statistics, Annual Business Survey, Release Date 17 Nov 2011

Note: EBITDA = Earnings before interest, tax, depreciation and amortization. EBITDA is a profit metric used by companies. The EBITDA figures do not account for the additional capital expense required to establish remanufacturing, which would comprise the space and equipment to disassemble products and cleaning and refurbishment equipment.

Source: Lavery/Pennell – Next Manufacturing Revolution Report (2013, p. 88)

According to the study by Lavery/Pennell and others, resource efficiency may produce significant benefits for the companies involved. For the UK, benefits for manufacturing are estimated to be worth £10 billion p.a. in additional profits for manufacturers – a 12% increase in average annual profits.

The benefits from resource productivity are not reaped without effort but require strategic commitment from the top, skills, knowledge and changes in design as well as collaboration with customers and the overcoming of legal constraints. An interesting question for further research is whether the ESCO business model can also be applied to resource efficiency.

The POLFREE modelling analysis (WP3) will explore the mutual links between energy efficiency and material efficiency in more detail. Previous policy simulations with the GINFORS model found that, for a global temperature rise of two degrees, a policy mix with "classical" climate instruments like carbon price, quotas for renewables, e-mobility, and improvements of energy efficiency of buildings, was not able to reach the global target. In a subsequent simulation run an additional program for resource efficiency was assumed, which reduces the inputs of steel, ceramics and other intermediate products (that are produced with high carbon inputs especially in emerging economies) by 20% till 2050 in later stages of production. With this additional measure the global target could be met. This suggests that RE and EE policies need to go hand-in-hand. The carbon price is not an efficient lever in these productions because of low price elasticities. Also, the world market prices for fossil fuels are low in a world that is close to 2 degrees increase. As mentioned, these modelling analysis will be extended in POLFREE WP3, in which the POLFREE policy mixes of WP2 will be assessed in an inter-connected version of GINFORS with an ecosystem model for land use (LPJml).

8. Towards an integrative understanding of resource inefficiency

Resource efficiency is shown to depend on many factors interacting with each other dynamically. Demand and supply are part of causal loops involving positive stimuli and hampering factors, creating a web of drivers/enablers and a web of constraints. It is important to note that the 'web of constraints' metaphor does not refer to 'a green-minded fly being caught in a web'. It refers to a broader 'web of constraints', a blocking mechanism that includes people's preferences, their life circumstances and various external factors.

The word barrier is misleading in that it suggests a blockage to a desired behaviour, which is not wholly warranted for situations in which the behaviour is not desired but altogether resented by the person. It is best used to refer to factors which stand in the way of what people would like to do (e.g., drive less and eat less meat). When people do not have a desire for driving less, the lack of desire could be considered a barrier but this is not how the person concerned sees it. People's preferences have deeper causes which are difficult to uncover and to determine with any precision.

In this respect, some policy studies think of policy instruments as dikes that can be built to redirect the river. Policy is treated as an exogenous factor and the analysis leans towards the idea of 'manufacturability' of a societal problem. Such a perspective neglects societal rebound effects, the feasibility of policies in the sense of receiving sufficient support, current interests and power distributions, and the effect of the current policy framework. It typically leads to a single policy advice such as a subsidy for desirable products or taxes for undesirable products.

The web-of constraints metaphor that we have proposed moves beyond this perspective and takes an integrative and evolutionary perspective. It also takes on board the constraints acting on policy choices. Policy choices in the EU are subject to specific mechanisms and political influences. 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 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 (Liefferink and Andersen, 2005; Jordan and Fairbrass, 2005). Traditionally, Germany, Denmark and The Netherlands acted as leaders in the environmental agenda and pushed the adoption of more stringent environmental standards, joined later by Austria, Finland and Sweden (which entered the Union in 1995). The enlargement of the EU to Central and Eastern European countries with weak environmental frameworks has strengthened the leader-laggard dynamic and increased national divergences in the adoption and implementation of the common EU legislative framework on resource efficiency. 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.

Similarly, this type of dynamics can also occur at the business and individual level. An example is the emergence of electrical car sharing in Paris, Autolib. Introduced in late 2011, it attracted 70,000 users by April 2013. Autolib is bigger than similar schemes in Berlin and Stuttgart, mainly because of three local drivers occurring simultaneously. First, the project has become a shop window for the French billionaire Vincent Bolloré, who invested two billion euros in electric vehicle technology without shareholder pressure. Secondly, the scheme is also a prestige project of the Socialists, Paris' largest party, and part of their drive to win a third term in Paris' municipal elections in 2014. The city of Paris has invested 35 million euros in the charging points (although it remains a majority privately-funded scheme, with Bolloré spending 50 million euros a year to run Autolib). Thirdly, many local travellers are familiar with the successful bicycle sharing service Velib, making car sharing a relatively small step for those tired of the parking pressure in Paris. These three factors can reinforce each other further.

But concurrently there are also developments that promote alternatives or weaken Autolib: the development of cleaner ICE vehicles will decrease the relative environmental attractiveness of electric vehicles, the local political climate may shift and Autolib may stop to be a prestige project, Bolloré being the single operator slows the speed of learning of Autolib and some green travellers may shift to public transportation when the system grows in seize. The web-of-drivers then develop back into a web-of-constraints.

The example shows that innovation (be it new business initiatives or new policies) take place amidst an existing web of relationships that include 'webs-of-drivers' and 'web of constraints'. Policies are only one among many types of factors and relations. This web greatly affects the further progression and impact of the innovation and the scheme helps to put a single development in its socio-technical context.

9. Policy for resource efficiency: possibilities and limits

Resource efficiency is gaining increasing attention by policy makers in Europe. The growing attention was sparked by the boom in commodity prices (which began in 2000) and by concerns about resource dependencies and competitive advantages. The resource agenda has built around issues of supply security, environmental protection and potential of economic and competitive gains derived from improved resource efficiency. By joining together economic and environmental concerns, resource efficiency has entered the core of the policy strategy at the EU level.

In July 2014, the European Commission adopted the Communication "Towards a circular economy: a zero waste programme for Europe" and an annex to establish a common and coherent EU framework to promote the circular economy. The earmarks of the circular economy package are:

- 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.

Key measures of the package are the definition of 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.

As part of the circular economy package, the Commission has adopted a legislative proposal to review recycling and other waste-related targets in the EU. Achieving the new waste targets is said to create 180.000 new jobs, while making Europe more competitive and reducing demand for costly scarce resources. Furthermore, to help the circular economy become reality, the Commission adopted other initiatives, such as proposals for sustainable buildings, green employment and green action for SMEs.[18] With the circular economy package and related initiatives the Commission shows leadership on the issue of resource efficiency.

Although resource efficiency has been at the core of the 2020 strategy, headline targets focused exclusively on the energy and climate change dimensions. Discussions at the European Parliament and Commission pointed to the need to include targets to address resource efficiency, as agreed in the 7th EAP. In its last set of recommendations, published in March 2014, The European Resource Efficiency Platform, a high-level consultative body created by the European Commission to advance the resource efficiency agenda, proposed the introduction of a lead indicator and target that could provide guidance to the European Semester. The indicator proposed was, as noted above, a resource productivity indicator, GDP relative to Raw Material Consumption (RMC). Based on modelling exercises, expected resource productivity growth under the business as usual scenarios is 15% between 2014-2030, so the target proposed aims to double this and increase resource productivity by 30%. Modelling consistently has shown a positive impact of increasing resource productivity on job creation and GDP growth, which is also consistent with the findings from deliverable 1.4 on resource reduction cost curves that points to win-win situations derived from reductions in

[18] Source: http://ec.europa.eu/environment/circular-economy/

resource use. Currently, the adoption of this target and its inclusion as part of the 2020 strategy is under discussion in the on-going review of the strategy.

With regard to the specific mix of policies that would deliver the 30% target, the circular economy package have provided some coherent framework to work towards reducing primary material use, by proposing a review of waste targets and proposing stricter recycling targets, promoting secondary markets and measures to improve resource management in the building sector, the most resource intensive sector. However, while the EU provides a common ground field, the target would not have a binding character at the EU level. It could, though, help MSs that lack specific frameworks to address resource efficiency to develop measures and policy framework that help them advance in that direction. Much of the responsibility to attain the target thus lies at the level of Member States. The policy mixes that MSs could adopt towards improving resource efficiency are varied and are briefly discussed below. In parallel with the headline indicator, the commission is developing a resource efficiency scoreboard that provides a wider picture of the use of resources in the EU such as carbon and materials but also water and land.

Section 2 of this document, discussed some highlights of the current regulatory framework on resource efficiency at the EU level. The resource efficiency agenda has built on the existing environmental policy providing a comprehensive framework of policies aiming at reducing the environmental impacts associated with resource use and promoting the recycling and recovery of resources. Of special importance are the policies for waste management and energy efficiency, two areas in which the EU has been particularly active. In many cases, EU legislation has become an important driver for resource efficiency improvements. However, as also discussed in section 2, the complexity of resource use, has meant that in some cases efforts to improve resource efficiency has been undermined by policy objectives in other areas. One of the elements of the waste framework, the End-of-Life Vehicles Directive, is a clear example of how EU policy can positively influence resource efficiency, but also an example of how the effectiveness of the directive can be undermined by other developments, some triggered by other legislation.

Rules governing the treatment of end-of-life vehicles were laid down in EU Directive 2000/53/ec (End-of-Life Vehicles Directive). This directive was implemented subsequently in the member states over the following years, in The Netherlands for instance through the End-of-Life Vehicles Management Decree (2002). The decree acts as a leitmotif for all activities related to the treatment of end-of-life vehicles. For example, the decree prescribes that at least 85% of the weight of end-of-life vehicles a country must be recycled or reused by 2006 (with the percentage and year the same for all member states). At least 80% must be recovered by recycling or reuse, while a maximum of 5% can be achieved through energy recovery. The weight target has been increased with effect from 2015 to 95%, of which at least 85% through recycling and a maximum of 10% through energy recovery.

The European Commission has drawn up detailed rules on how member states should collect data and compute their national percentages. Member States must follow these rules in their reporting to the Commission in order to ensure that they report in a comparable way. The EU uses these reports to verify that the objectives laid down in Directive 2000/53/ec are being met.

In 2009 the European Commission had a study made of the reports by the Member States with regard to the End-of-Life Vehicles Directive. It has come out of the twenty-five reports received by the Commission that certain provisions of the Directive have not been completely transposed or they have been done so incorrectly. A large number of Member States did not achieve their targets for re-use/recycling/recovery in 2006. For example, only nineteen (out of 25) Member States met the target of re-using/recycling 80% and thirteen met the target of reuse/recovery set at 85%. As these reports show significant variations, there are considerable doubts about the correctness of the recycling performances that are presented. Eurostat compared and analysed the Member States' reports and the European Commission also commissioned an external integrity review. It has set up a working group with representatives of the Member States, the motor industry and the dismantling sector, in order to arrive at a uniform method with which the Member States' reports must comply. This will probably lead to a new directive on how Member States should deliver unambiguous reports.

The Netherlands is one of the frontrunners in Europe in terms of car recycling. End-of-life vehicle recycling is made possible by the disposal fee of € 45 paid by every new car buyer. Thanks to this fee, the businesses in the car recycling chain (vehicle dismantling, collection, recycling and shredder companies) recycle large part of the cars. In 2012, 83.7% by weight of end-of-life vehicles was recycled in addition to which 12.4% by weight was recovered as energy.

The positive effects of EU regulation on car recycling even reach beyond Europe. For instance, car producing factories in Russia that want to sell their vehicle in the EU also need to comply to the EU norms of 80% recyclability, and they also need to have a system in place to facilitate the recycling of vehicles.

In order to reach a high level of car recycling, the government policy on waste incineration furnaces is critical. According to the National Waste Management Plan 2009-2021 in the Netherlands, it is permissible to incinerate car shredder waste. The overcapacity at waste incineration furnaces has resulted in a huge downturn in incineration charges. This development is having negative consequences for car recycling, forcing the recycling firms to set its processing charges for car shredder waste well below cost price. Without the necessary support from the (national) government to ensure relatively high prices for waste incineration, all post-separation techniques lose much of their justification, and the recycling market will fail.

One of the challenges in achieving greater raw material efficiency in cars relates to developments within the automotive industry itself. The search for lighter materials in order to reduce fuel use (and emissions) has led to the introduction of fibre-reinforced plastics, replacing metals. However, these new materials are more difficult to recycle than traditional steel and aluminium. The emissions and energy requirements during the use of these cars will fall, but the total energy requirement for raw material extraction and recycling will rise.

Another challenging development is the introduction of hybrid and electric vehicles, partly triggered by EU Regulation No 443/2009 which sets an average CO_2 emissions target for new passenger cars. These new types of vehicles greatly increase the number of disposed batteries. There is a separate initiative for recycling of batteries, which is relevant with regard to the emergence of hybrid and electric vehicles. For the purposes of a Batteries and Accumulators Directive, preparations were made in 2009 for consultation with a Technical Adaptation Committee (TAC). The TAC supports the Commission in defining measures for the execution of a decision. The TAC consists of national officials and is chaired by a representative of the European Commission. A decision has still to be taken regarding the calculation method for end-of-life batteries and accumulators.

The introduction of the End-of-Life Vehicles Directive show how the effectiveness of EU Directives can be critically dependent on national policies (such as on waste incineration) and on other EU Directives (such as emission standards).

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*" (Liefferink and Andersen, 2005: 50). 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 increased academic interest (see, for example, Weale, 1996; Putnam, 1988; Hajer, 1996) 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 transition in a context of weakened institutions and rise of Eurosceptic fractions in the parliament.

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 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 leader 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 acts 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 or in the classical example of the Danish bottle system that was perceived as being conflicting with the internal market and indirectly led to the drafting of the waste packaging directive (Liefferink and Andersen, 2005).

In POLFREE, we did not engage in a study of the political economy of EU regulation and national environmental regulation. The political economy of environmental policy is an under-researched topic. Our understanding of it is that for an environmental policy to be chosen five conditions appear to be necessary: 1) it must address an environmental problem which is accepted by science and policy makers and politicians as a problem, 2) there should be an advocacy coalition for the policy intervention, 3) acceptance for the policy solution must be won (obtained) from the problem holder, 4) government is authorised to act legally, 5) society must view the policy intervention as reasonable and not an unduly infringement of freedom or as distributionally unfair, if not the policy intervention will meet with public ridicule which is actively sought and publicised by the popular press and exploited by anti-government political parties.

With regard to the first issue, it bears noting that the issue of resource efficiency is significantly different to that of climate change because though there is some evidence to over exploitation of a number of resource scientific models are not so advance to set clear objectives in terms of what is “acceptable” consumption of a resource. Of the five conditions, the second and last condition usually constitutes the biggest problem from the point of view of policy making. To make a sector accept a policy which imposes costs and some kind of adjustment on them is hard because they do not like this and will marshal knowledge resources and political power to avoid those policies and to revise them. Industry is likely to opt for voluntary action (as an alternative to regulation), to argue for derogations and flexible implementation which gives them an influence on the details to which they will be held. It will fund studies that will show negative employment consequences based on inflated cost estimates. National industries will seek support from national authorities and internationally they will lobby the Commission via DG Enterprise and Industry, as their ally. Public acceptance to policy interventions appears to be deteriorating but deeper research is needed on this. It is hard to obtain support for deeply entrenched practices but interestingly the interviews and survey analysis revealed that a significant part of the population is interested in driving less, eating less meat/fish and heating their homes more efficiently. Reversely, a significant part of the population expressed a clear disinterest in this.

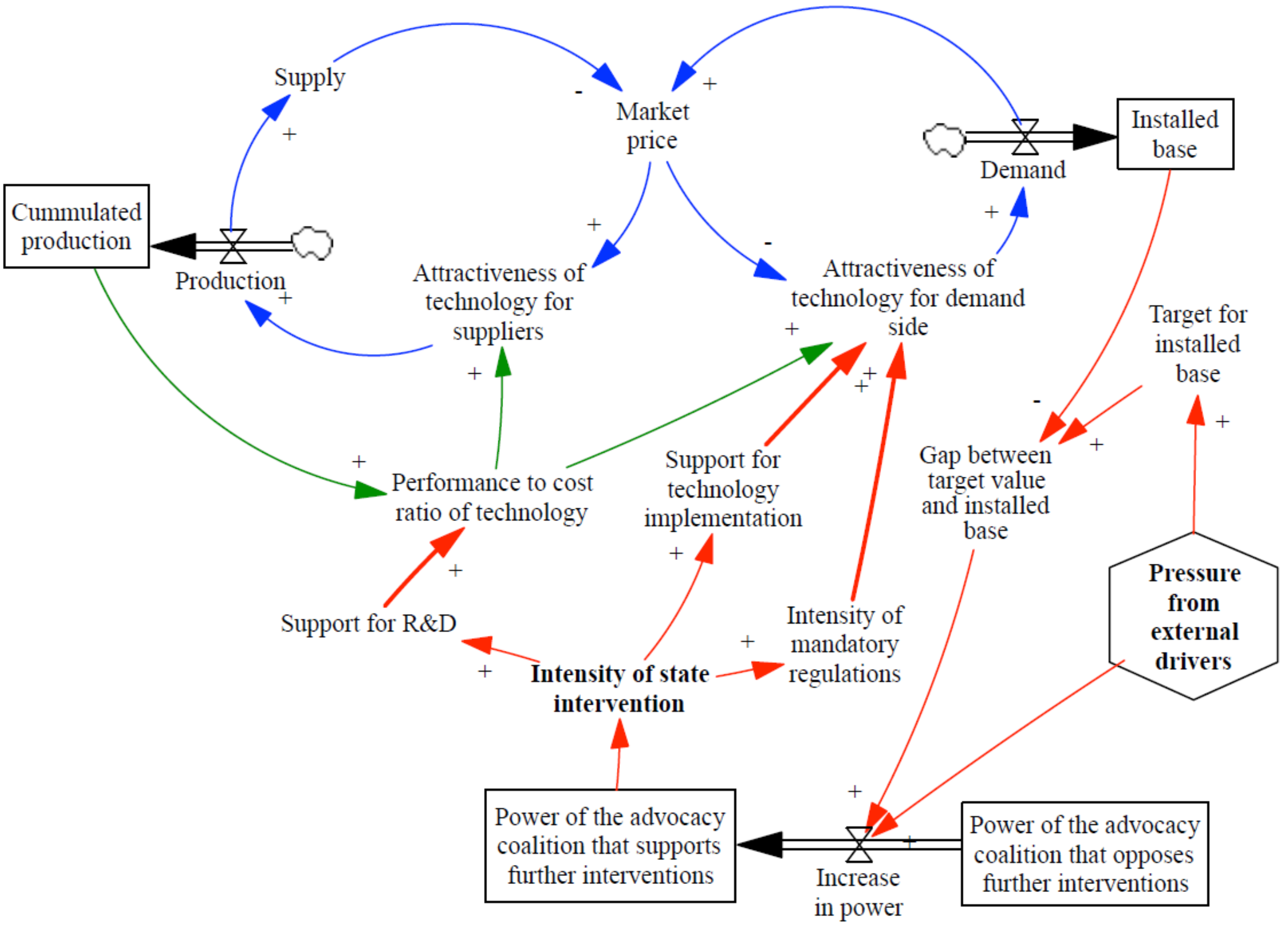
From the perspective of consumer resistance, the ban of light bulbs is remarkable. Despite public opposition by the European Consumers' Organisation BEUC in 2009 (who said that phasing out incandescent bulbs will be detrimental for people suffering light-related health issues, and called for the continued availability of incandescent bulbs), the EU agreed to a progressive phase-out of incandescent light bulbs by 2012. The ban of the light bulb is really an exceptional case of a consumer product which is being banned from the market. If it was not supported by the European light bulb producers industry who saw the ban as a way of selling products with greater profit margins, it would not have happened.

An example where opposition from the industry was effective to delay and relax RE-policy is CO_2 regulation for passenger vehicles. It started as a voluntary agreement between the EU and the automotive industry in 1998, but by 2006 it turned out manufacturers were unlikely to meet the 2008 targets (partly due to consumer preferences for larger, heavier, faster cars). In June 2007, the EU decided to change the voluntary agreement, because of lack of success, to a compulsory requirement for 2010: a CO_2 emission of 130 g/km, which was later postponed to 2012. Industry lobbying (backed by some countries with automotive industry) prevented the target being adopted and pushed it back to 2015. Especially the German government, often a proponent of climate policy, used its power to protect the German automotive industry (offering primarily larger vehicles) to block EU voting on stricter vehicle CO_2 emissions requirements at an advanced stage of negotiations.

The intensity of state intervention depends on the power of the advocacy coalition that supports particular interventions, the power of the advocacy coalition that opposes the interventions and the gap between targets values and the environmental reality in terms of emissions, recycling, and installed base of renewables. From the point of effectiveness, multiple interventions are desirable for the reason of addressing multiple barriers and for overcoming the resistance to hard interventions which necessitate adjustment by industry.

In Figure 14 a political economy element in inserted into the generic model for the diffusion of sustainability technologies. It elaborates in a stylized way how the power of advocacy coalitions affect the intensity of state intervention. The power of each coalition depends on the constituency for it. New technologies often suffer from a weak advocacy coalition. Once the technologies are better developed, as is happening in the case of many renewable energy technologies, it becomes easier to argue for them and to fight opposition from incumbents.

Figure 14: A system dynamics model of diffusion of sustainable technologies



Source: Müller (2012, p. 353)

The diagram highlights the role of advocacy coalitions in the web-of-constraints to resource efficiency. There is a positive relationship between technology, demand and power of the advocacy coalition. In general, advocates of immature technologies frequently face entrenched incumbents who are in a better position to influence expectations due to a superior access to funding, media and politicians. Policy makers have therefore to manoeuvre in a political minefield. Decision makers must, consequently, develop an independent position and critically assess attempts to shape the perceived desirability of various technologies.[19] In Europe, the Joint Research Centres of the European Commission fulfils the important task of assessing cases for support.

Citizen support for RE Policy

In the citizen-consumer survey, people's acceptance of energy efficiency regulations and support for resource efficiency regulations is being examined. The results indicate that the vast majority of the respondents in Austria, Hungary and the Netherlands support the use of energy efficiency regulations for new appliances. The results also indicate some, yet far weaker support for stricter regulations, particularly in Austria. Of the three countries, respondents in Hungary are found to be more in favour of stricter energy efficiency regulations than those in Austria and the Netherlands. In Hungary, only a small proportion of the respondents is against such regulations.

[19] From internal memo of Staffan Jacobsson for the chapter Policies for capacity development of the book Global Energy Assessment - Toward a Sustainable Future, Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria (Mytelka et al., 2013).

When people say they support policies for stricter energy efficiency regulations, they probably mean that they agree with the policy goal to reduce energy use and are not against policies towards this end.

In the survey, we also asked people whether they support regulations on resource consumption. The results are given in Figures 15 and 16. Many people agreed with the statement that national or EU government should regulate resource consumption to safeguard the well-being of future generations, but there was also a good deal of disagreement with that statement. Surprisingly, adding the statement that such policies could affect them personally did not alter the results significantly, which suggests that such consequences were already anticipated.

Figure 15: Support for regulation on resource consumption to safeguard the well-being of future generations (in %, n=1217)

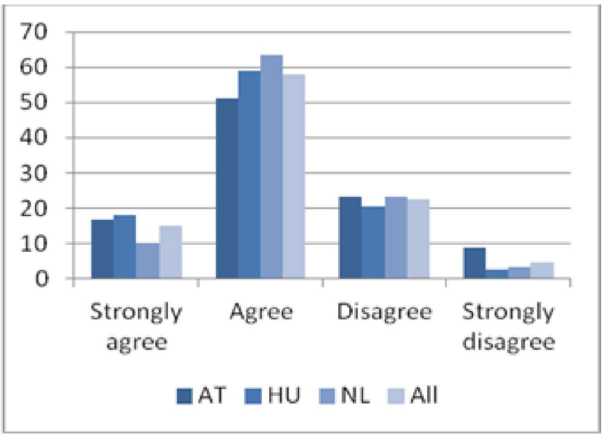
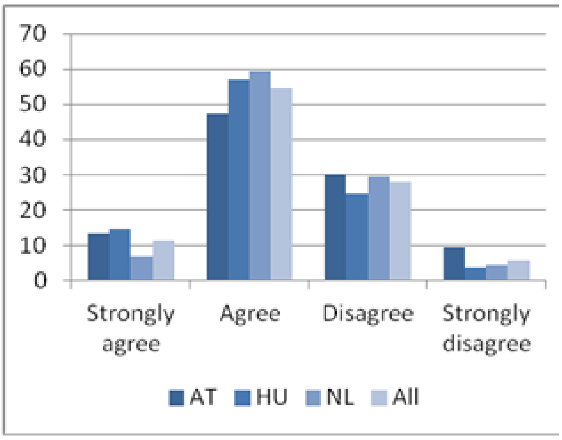


Figure 16: Support for regulation on resource consumption even if it requires changes in personal habits (in%, n=1217)



The majority of the respondents appears willing to accept policies for resource consumption, even if this implies that they have to change their personal consumption habits. A further investigation of specific policies revealed that support for information and education is bigger than support for taxes.

Figure 17: Desirability of information on product resource intensity (in %, n=1217)

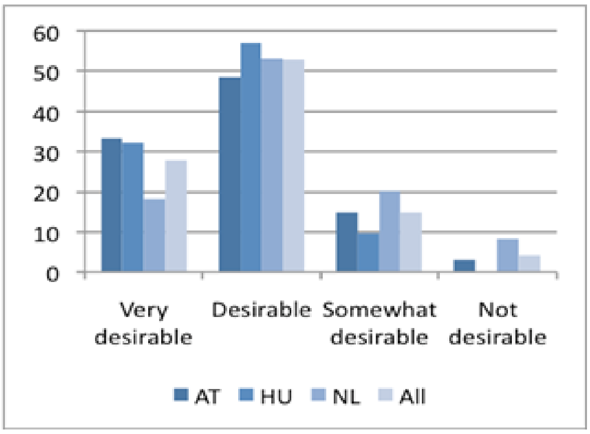


Figure 18: Desirability of higher taxes on resource-intensive products (in %, n=1217)

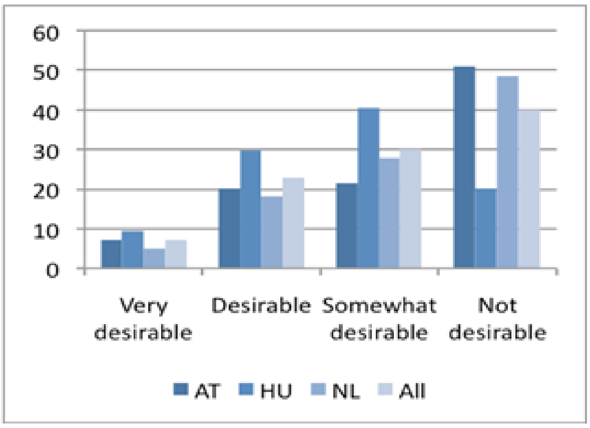


Figure 19: Desirability of campaigns inviting consumption reduction (in %, n=1217)

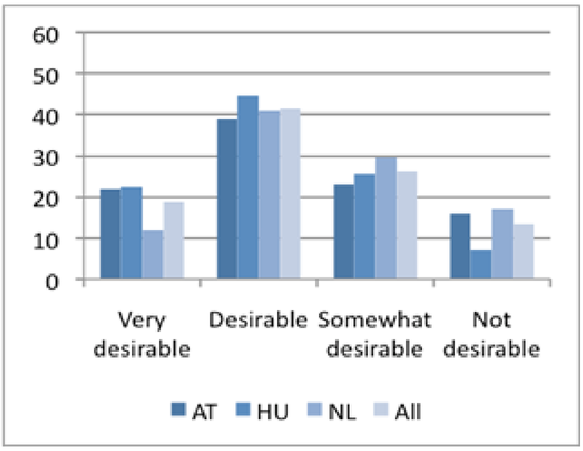
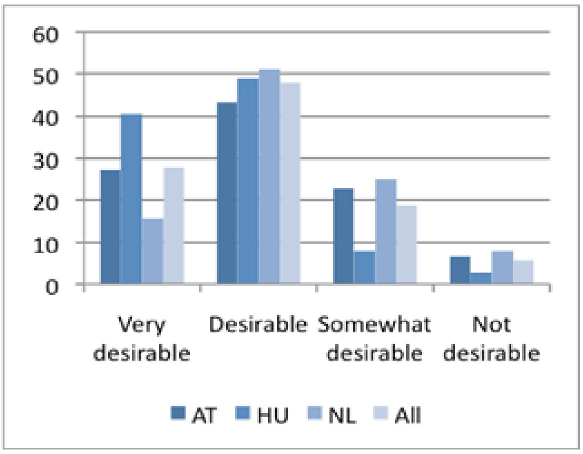


Figure 20: Desirability of support for cities aiming to reduce consumption (in %, n=1217)



Taxes on resource-intensive products are viewed as very desirable by 7% of the respondents, as desirable by 22% and somewhat desirable by 30%. 40% of the respondents considered taxes undesirable. Taxes are especially disfavoured by people in Hungary and the Netherlands. The rather negative view on taxes contrasts with the more positive views on the acceptance of energy and resource efficiency regulations earlier reported.

A possible reason for taxes not being popular might be that the costs of information-based measures are less visible to people than higher taxes on products and constitute less of a financial burden for people. Remarkably, taxes are viewed the least effective measure of the five measures studied. This is a puzzling result, which is not brought out by studies into the effectiveness of different environmental policy measures (Kemp, 2000).

Generally, the results discussed above are in line with findings by Tobler et al. (2012) that older, higher educated people with green values are more inclined to support climate policies. In their study, values and perceived climate change benefits are the strongest predictors for climate policy acceptance, which is also what we have found for resource policy.

One way for government to win people's support for resource policies is to explain the benefits to people. Also in the focus groups and interviews, people expressed a need for better information on resource use of products and casted criticism on the influence of aggressive marketing and advertisement. [20]

Conflict minerals

A topic that we haven't studied and discussed is conflict minerals. The reason for this is that it wasn't part of the tasks. Policies for securing resources are kept outside the analysis of

[20] An example of an information campaign is Generation Awake an awareness-raising campaign of the European Commission (DG Environment) about resource efficiency. Launched in 2011, the campaign is aimed at 25- to 40-year olds, showing what can be done in daily life to reduce waste and use natural resources like water, energy, wood and metals more wisely. By the end of 2013, the campaign website had been visited by over 750,000 people, the videos had been watched over 4.5 million times, the Facebook community consisted of nearly 100,000 followers and PR activities had generated at least 1100 articles about the campaign. From: http://www.generationawake.eu/en/the-campaign/about-the-campaign/

POLFREE whose focus is on resource efficiency, not resource security. We want to note than in March 2014, the European Commission released its long-expected draft Regulation on responsible conflict minerals sourcing. The Regulation proposes a voluntary self-certification scheme supported by due diligence for importers of 3TG into the European Union for the following materials: tantalum, tin, tungsten and gold.[21]

Box 2. Conflict minerals: The Dark Side of Natural Resources

Natural resources often lie at the heart of wars and civil strife. Huge mining and resource companies maneuver for control of enormously valuable oilfields and mineral lodes. There are many other players, including shadowy resource traders, smugglers, corrupt local officials, arms dealers, transport operators and mercenary companies. Increasing scarcity of resources further sharpens such conflicts, in which powerful governments and their military/intelligence arms are always deeply involved.

Oil and Natural Gas are the world's most valuable traded resources and probably the most conflict-prone. This section illustrates how the world's great companies in the sector, like Exxon, Shell, Total, and Lukoil, roam the planet in search of new reserves, often generating wars and civil conflicts as they vie (with help from their governments) for control of the hugely profitable fields.

Water may be a "renewable" resource, but growing consumption puts increasing pressure on the world freshwater supplies. Local conflicts over water have long existed, but today a combination of water shortage and transboundary waterways gives rise to escalating international conflicts.

Timber is another source of deadly conflict, as the world's forests disappear, timber prices soar, and illegal logging thrives in war zones.

In Africa, there are many cases of diamond-related conflicts. In Angola, rebel groups financed a long, violent civil war by selling diamonds on the black market.

Minerals such as cobalt, coltan, copper, uranium and gold have fueled many civil and interstate wars in Africa. Sometimes these minerals provide rebel groups with revenue to purchase arms, and sometimes they provide governments with the resources to establish a repressive military presence in mineral-producing regions.

Taken from: https://www.globalpolicy.org/dark-side-of-natural-resources.html

The input side versus the output side

From an input-output (industrial metabolism) perspective, EU Resource policy is acting mostly on the output side, only lightly and indirectly acting on the input side. The main output policies are greenhouse reduction policies and policies to avert waste from landfilling. The eco-design Directive and energy efficiency regulations are examples of policies acting on the input side. One reason for why the focus is so much on the output side is that input policies are very much resented by business. A second reason is that tax decisions are firmly with Member States. The Commission is a long-time advocate of ecological tax reform but has very little influence on this matter.

Moving towards the top of the waste hierarchy

For achieving step changes in resource efficiency we should move to the top of the waste hierarchy rather than moving from the worst option to the next worst option. There is a need for policies that address resource efficiency by promoting options and strategies at the top of

[21] Source: http://www.srz.com/European_Commission_Proposes_EU_Conflict_Minerals_Legislation_Takeaways_for_US_Registrants_and_Other_Companies/

the waste hierarchy (prevention/reduction, reuse, recycling) rather than putting the stress on policies focussed on the bottom of the waste hierarchy (landfilling), since the danger is that responses to policies focussed on landfilling is to 'divert' waste to the next cheapest option, often incineration, or (something almost as bad) to promote 'cosmetic' solutions, such as bio-mechanical treatments that deliver an often unusable 'product', which may be called a 'compost' but often finds application only as a capping treatment for use at operating landfills.

So we need policies to drive resource efficiency improvements at the top of the hierarchy rather than ones that encourage or drive diversion of waste from the bottom of the hierarchy upward implying only a stepwise shift in waste management options up the waste hierarchy from the worst to the next worst option. For this the following policies appear useful: the introduction and strengthening of producer take-back legislation, lengthening of statutory warrant periods for durable groups and the imposition of a graduated tax on the advertising of durable goods based upon the material- and pollution-intensity of the advertised product (ultimately to impose high rates of advertising tax on products and services that impose high environmental burden), and active public procurement regimes that buy services preferentially and allow for procurement of re-manufactured products (something that is often administratively barred by codes of practice that have become institutionalised, but which are now inappropriate) (Weaver, 2008, p. 328).

Downshifting and product sharing

A potential target for resource policy is the sharing economy in which people share products. There has been a big increase in ride sharing, car sharing and the sharing of living space with the help of peer-peer systems. In co-housing projects and eco-villages people share goods and space on a non-commercial basis. There may be resource efficiency gains in product sharing but greater resource use gains are likely to be found when people start to work less. Labour time reduction is not an official aim of the European Commission but fits with the goal of inclusive development. For people who are involuntary downshifters, product sharing is a way to gain access to services. In the survey analysis we did, people's willingness to accept income cuts in exchange for working less is revealed to be rather low, as a negative factor.

Policy frameworks for evaluation

The decoupling of resource use and environmental impact from economic growth requires frameworks for evaluation. In POLFREE we compared four countries on the basis of a simple evaluation framework consisting of 11 criteria (Table.10). Further work in this direction is being recommended. We should say that Table 10 is really a first attempt at evaluation based on expert judgment. In general, the knowledge base for resource policy should be improved. There is especially a need to create frameworks for the transition to a circular economy - an industrial system that is restorative by design. Building blocks of such a framework (from the Ellen MacArthur foundation) are given in Annex 2.

Table 10: Tentative assessment scheme of the institutional set-up, incentives and side policies criteria with scores for Austria, Germany, Hungary and The Netherlands

Pillar	Criterion	Assessment	AT	DE	HU	NL
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

Source: Bahn-Walkowiak et al (2014) Comparing trends and policies of key countries: Report about barriers for resource efficiency and the role of national policies, D1.3 for POLFREE.

Policy intervention
There are many possible ways for policy to intervene. Causal loop diagrams may help to identify useful intervention points and consider positive cycles and balancing developments[22]. An illustration for the case of home heating is provided in Figure 21, which includes the following interventions: information campaigns about the benefits of energy efficiency, energy efficiency labels and regulations, energy/carbon taxes, research and innovation policies and subsidies for energy efficiency improvements. Each of the interventions affects a particular aspect: awareness, knowledge, split incentives, costs of investments for producers and product offerings by producers. The precise influence of the instruments on energy use is difficult to disentangle ex ante (and even ex post). The web of constraints approach does not offer a tool for assessment. Its value lies in putting the attention to specific barriers and the interplay of constraints and drivers/enablers.

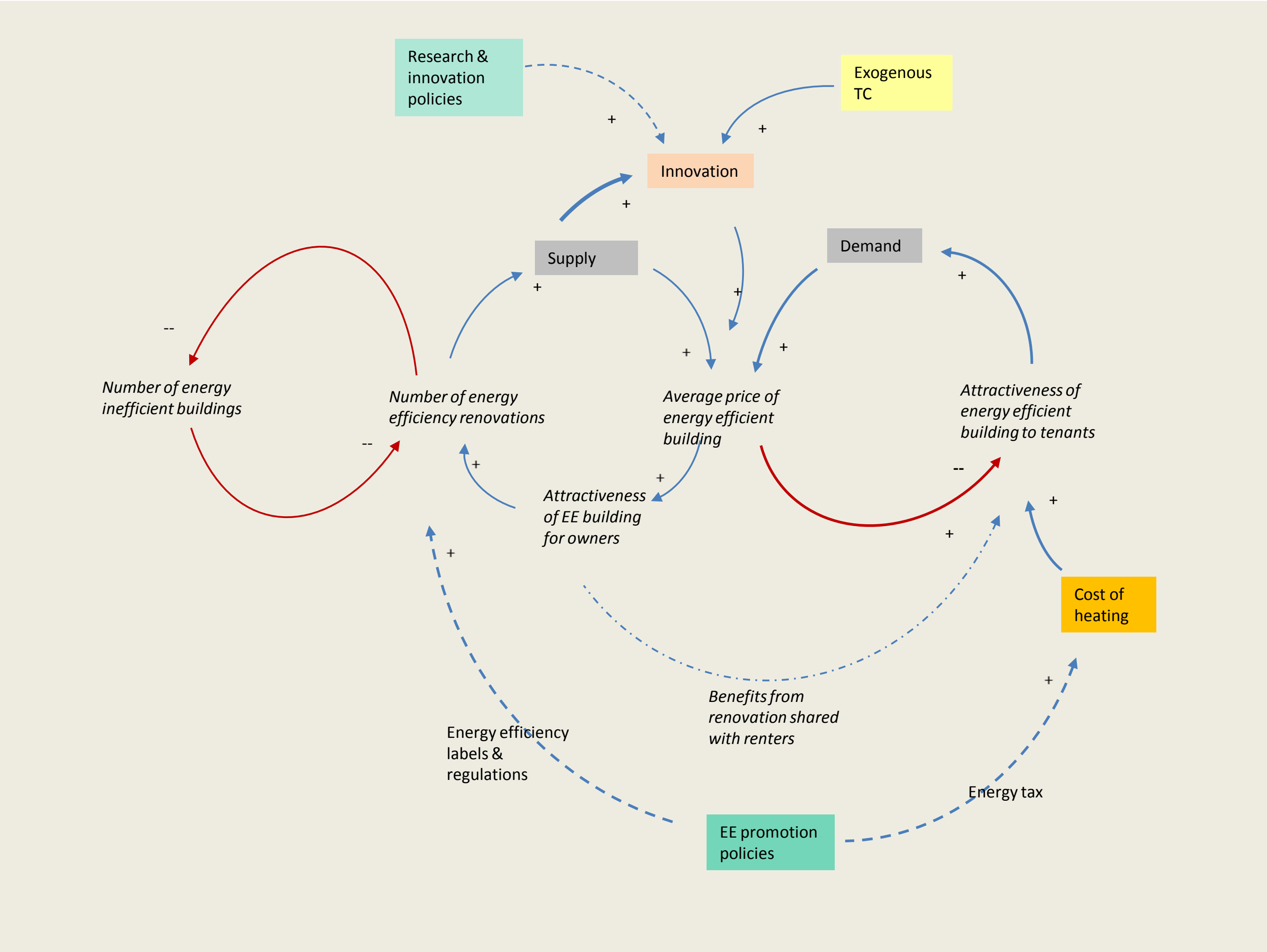
Connecting the findings of POLFREE citizen-consumer survey with the causal loop diagram helps to discuss three key ways of improving energy efficiency in heating the home:

- **Increase energy tax**. This will increase the cost of heating, and correspondingly the potential to save money through energy efficiency investments. The POLFREE survey found that the main driver of household willingness of EE investments (either new heating system or better insulation) is saving cost (63 and 68% of the willing respondents, respectively). Energy tax improves the potential to save cost.
- Create a fund for EE investments (**cheap loans**). Such a fund will decrease the investment cost, which, according to the POLFREE survey, is the key barrier for households not to take EE measures. From the share of households that considered EE measures, 68% didn’t take them because of investment cost (insulation), or 50% (in case of new heating system).
- **A negotiated agreement** across housing corporations or landlords. In the Netherlands housing corporations have agreed to improve their energy standard of their houses. Such an agreement overcomes the barrier of split-incentives between landlord and tenant. The housing corporation can make an agreement with the tenant that the increase of rent will not exceed the decrease in energy cost, in order to let the tenant not bear any negative consequences. But with the current energy prices, there are usually positive consequences for both parties: longer-term benefits for the housing corporation (higher rent), and some short-term benefits for the tenant (in terms of overall cost: rent+ energy cost).

Notably, there is quite often a need for a change in legislation in order to allow landlords to pass on all or part of the cost of the investment to the tenant, mainly through a rent increase

[22] In general causal loop diagrams are useful to highlight the key aggregate dynamics in the issue (e.g. market failures, system level lock-in, self-reinforcing or dampening effects). They are less useful to understand the effect of heterogeneity among e.g. households (such as the distinct behavior of green-valued households). The model only reflects average, estimated relations.

Figure 21: Causal loop diagram for home heating investments



Al-Saleh and Mahroum 2014). A number of such regulatory changes have been introduced across the EU over the past few years. France, for example, adopted a tenants' law in 2009 in order to enable owners to realise energy improvements and share energy-saving benefits with their tenants. In France and the Netherlands, the landlord is required to obtain the consent of the tenant to undertake renovation and the economic gain to the landlord cannot exceed half of the energy cost savings. Additionally, rents are allowed to rise only when the effect of the energy conservation measure has been proven.

A fourth way of intervention are Energy Saving Obligation (ESO) schemes, as earlier discussed in Section 5, these require energy companies to realise energy savings at the level of the end-user (Al-Saleh and Mahroum 2014). They have motivated energy companies to develop business models that realise mandated energy savings (IEA-RETD, 2013). In France, this was carried out through partnerships with electricians and installers to offer new energy-saving services to customers. In Italy, a large part of the obligation was outsourced to Energy Service Companies (ESCOs). In other words, ESO schemes played a role in stimulating the demand for - and growth of - the ESCO market (Boot, 2009).

Van Bueren and De Jong (2007) note that more than even a mix of policies (e.g. of the four interventions mentioned above) will not be effective in promoting resourcing efficiency, without adressing the matter of how to coordinate the actions of the variety of actors. The fragmented, multi-actor context of decision-making in policies for a sustainable built environment (most notably the fragmented context of the design, construction, management and maintenance of buildings) require process-oriented approaches. This means roundtables of stakeholders, which may lead to partnerships between stakeholders. The national government seems the most suitable party to lead or, better, facilitate such periodic meetings. The Dutch energy agreement is a clear example of this approach, in which the government has reached energy-saving accords with various parties in 2013. More than forty organisations – including national, regional and local government, housing corporations, construction companies environmental organisations and financial institutions – have endorsed the Energy Agreement for Sustainable Growth. The core feature of the Agreement is a set of broadly supported provisions regarding energy saving, clean technology, and climate policy. Implementing these provisions is intended to result in an affordable and clean energy supply, jobs, and opportunities for the Netherlands in the market for clean technologies.

Policy mixes

As illustrated above in more detail for the case of heating at home, the existence of multiple barriers interacting each other together with the political constraints to the use of policy instruments call for the use of multiple policies in different domains of practices.

Table 11 provides some ideas of policies for addressing the web of constraints to move towards a more resource efficient Europe. The table is by no means a comprehensive picture of policy mixes, as this is the focus of WP2, but more an indication of the types of policies that could have positive impacts on promoting the systemic change required.

Table 11: Policy mixes for resource efficiency in selected domains

	RE Policy instruments		
Domain	Demand-side	Supply-side	Other / life-cycle
Automotive	• High VAT, strongly connected to Energy labels • High road tax, strongly connected to Energy labels • Incentives to swift to alternative transport modes (such as cycle to work schemes)	Introduce eco-design standards ('design for recycling') and emission standards	• End-of-Life Vehicles Directive • Give priority to non-car infrastructure in urban areas: - public transportation / Park+Ride - Cycling - Car sharing - Car restraining measures
(New) Housing & building construction	• Mandatory smart meters • Support energy prosumers (remove legal barriers)	Energy Performance Directive (NZEB by 2020)	
Existing housing & buildings	• EE-fund (cheap loans) • Energy tax • Mandatory smart meters	• Energy Savings Obligation • Promote ESCO's	• Promote multi-stakeholder platforms for EE partnerships
Recycling	• Product labels on recycling level • VAT connected to (virgin) material intensity • Reduced VAT for	• EU Ecodesign Directive expanded to cover the 20 most material-intensive, non-energy related products (2020s) • Invest in recycling	• Support industrial symbiosis initiatives • Mandatory corporate reporting on material input/output • Standards to improve

	remanufactured/ re-processed products	infrastructure • Align national policies: prevent incineration being cheaper • Targets on recycling efficiencies and qualities of the recyclates	quality of recycling

Source: authors' own elaboration

The policy mixes need to be evaluated in the light of public support and advocacy coalitions. Our survey suggests that raising taxes on resource use is undesired by almost half of the population; however, in terms of behavioural change taxes could play an important role. If the introduction of taxes on resource use or the impacts associated with that are accompanied by reduction of taxes in other areas, such as labour, advocacy of the tax reform could gain more support. Another strategy is to start with relatively low taxes and to ratched them up gradually to provide ever-stronger incentives for change. The introduction of a system of progressive taxes may circumvent opposition by given business time to adjust to higher costs for resource use in a forward looking manner.

There is also evidence that taxes that may be unpopular at the beginning could become popular if the citizens start to appreciate the benefits derived from it. An example of this in the transport sector is the introduction of congestion charges, that may face some opposition at the beginning but that become popular if the benefits of healthier, less polluted city centers are realized (see, for example, the introduction of the congestion charge in London). Therefore support for such an instrument will crucially depend of a convincing idea on how the collected funds will be spent and what would be the benefits of it. IEEP et al. (2012) describes the case of the Dutch commuter subsidy for travel by car. This was abolished within the framework of a major tax reform: „Public and political support for this entire reform package was secured by designing the reform to the effect that it would not lead to larger differences in income distribution and no short term losses for any of the affected socio-economic groups."

An example of an important policy mix is a tax on (mineral) resources and a tax on energy, as this helps to create a positive synergy between resource efficiency and energy efficiency. Effectively, the tax on virgin resources will drive the choice of the most efficient solution in each case. The tax on energy or carbon content of energy is needed to drive strategies other than recycling. Recycling has a high energy cost and should not be the preferred strategy for improving resource efficiency in every case.

Overall, the strategy with possibly the greatest potential is to shift from the business model of selling products to one of selling the services that products deliver. Producer liability would incentivise that shift. The fundamental problem is that we have a system of exchange where the 'institutionalised' norm is that products rather than services are the object of exchange value in markets. We trade materials and products in markets, not the services that these deliver. Shifting to product service systems involves a paradigm shift on the part of business and consumers alike. The ESCO model where customers pay a fee to the servicing company who takes care of the energy efficiency improvements could perhaps also be applied to resource efficiency, with the savings in resource costs being used to pay back the capital investment of the project.
Through our reflections on barriers to, drivers of and policy lessons concerning resource efficiency, this report is a precursor to the deliberations about policy mix choices and modelling analyses (in WP2 and WP3) that will follow.

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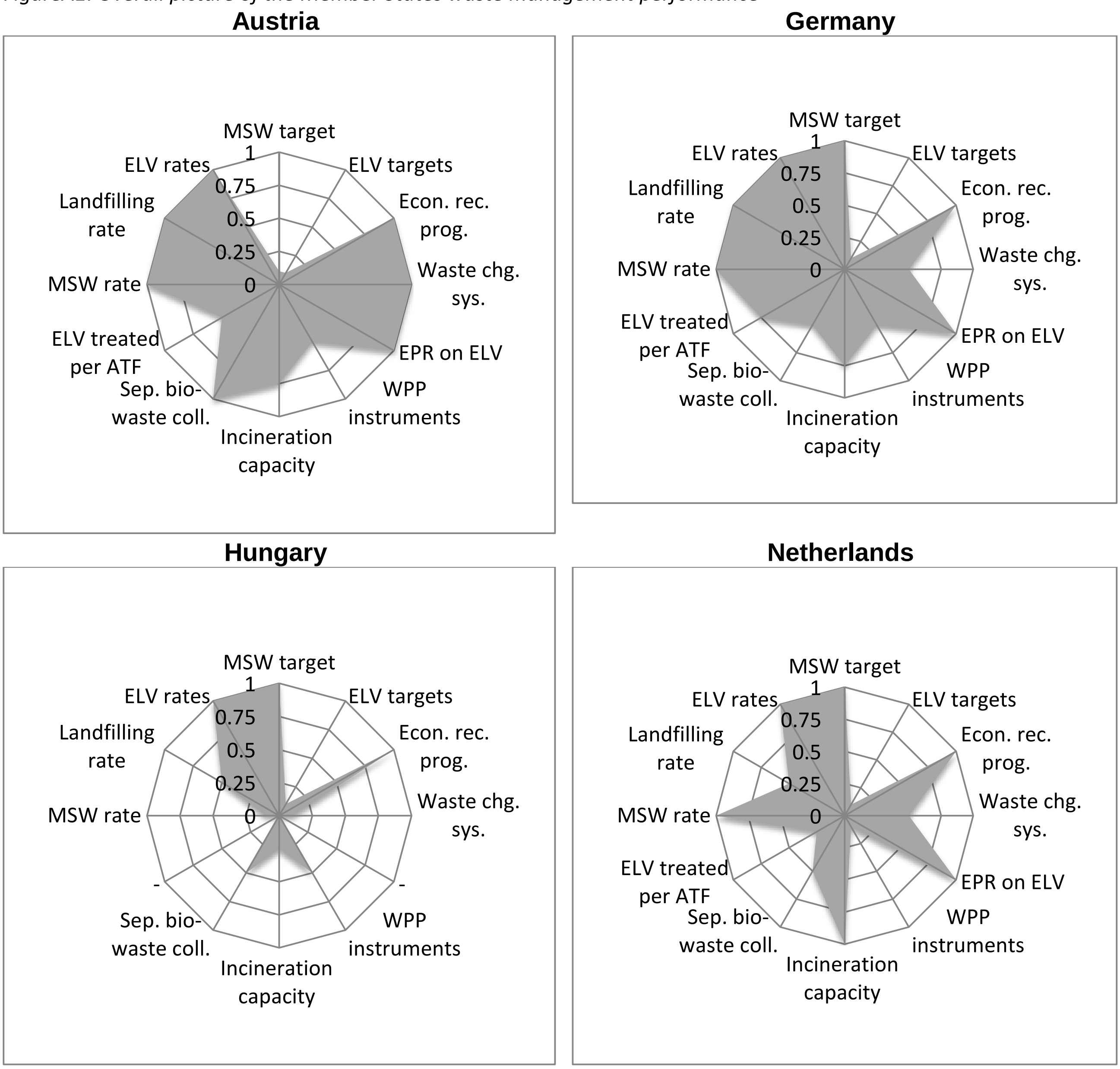
Annex 1: Evaluation of Waste Policies

FigureA1: Overall picture of the Member States waste management performance

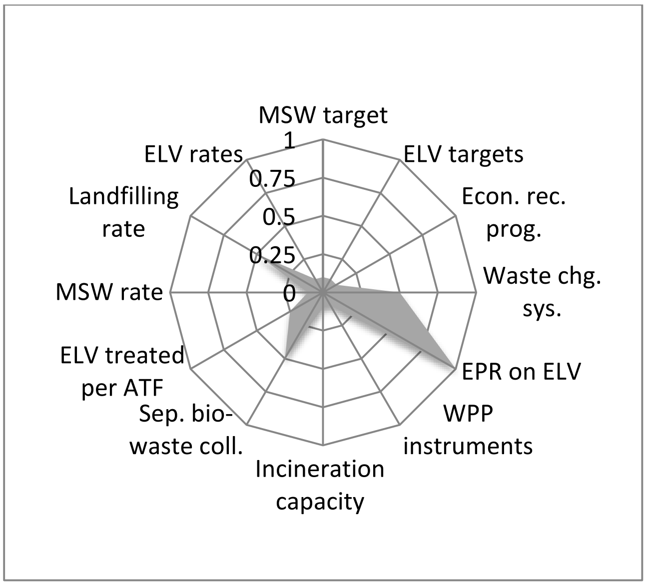


Notes:

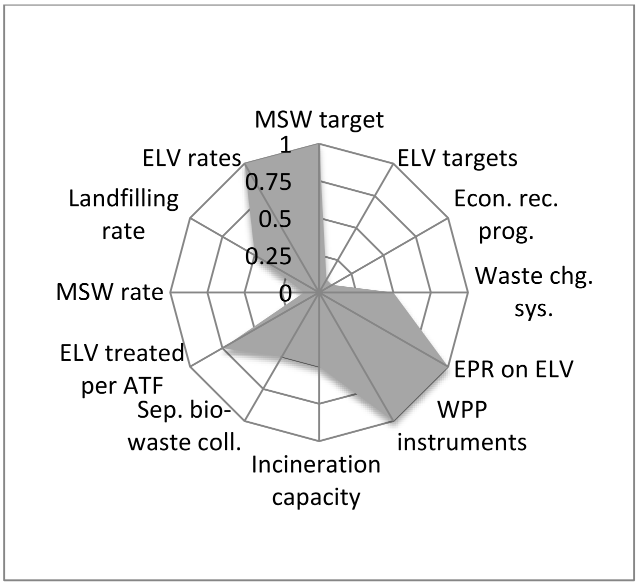
The classification system ranges from 0 for a low fulfilment or low value to 1 for a high fulfilment or high value (see Annex). Due to the consideration of different values and not only clear rateable indicators the results have to be interpreted as characteristics and not as a scoring.

A high score on landfilling rate of organic waste means that little organic waste is deferred from landfilling.

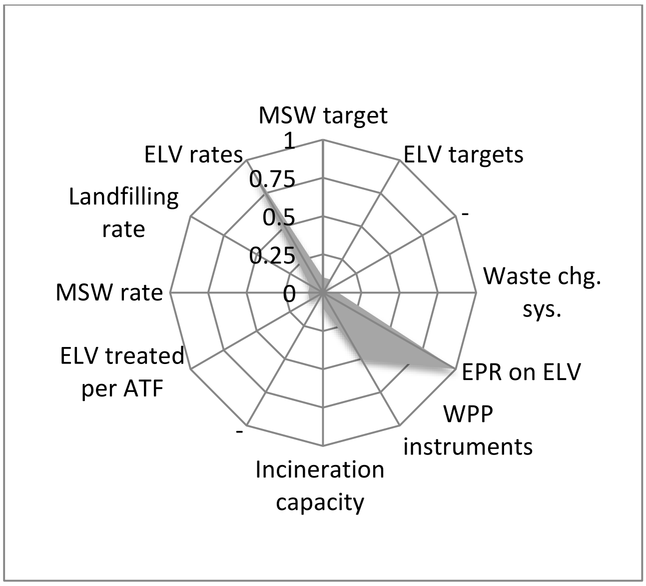
Estonia



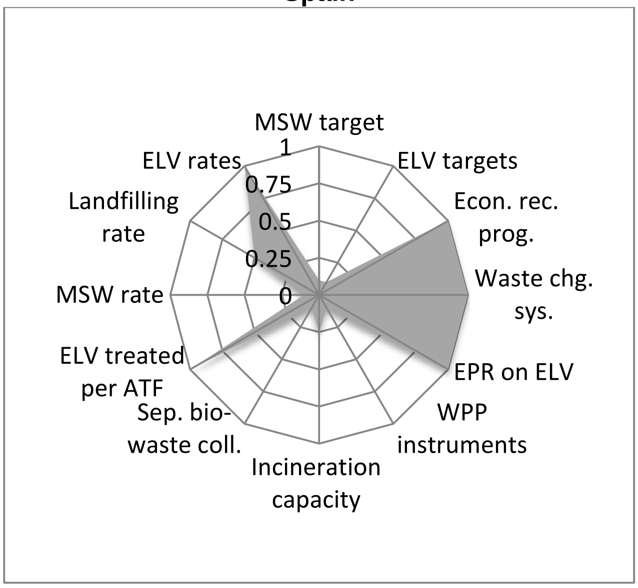
Finland



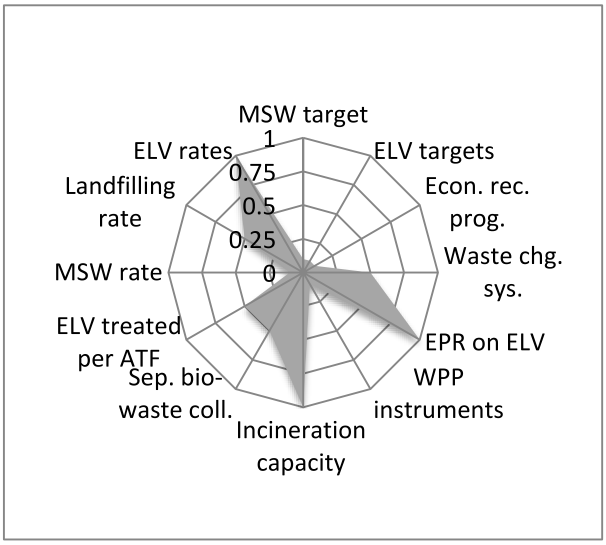
Poland



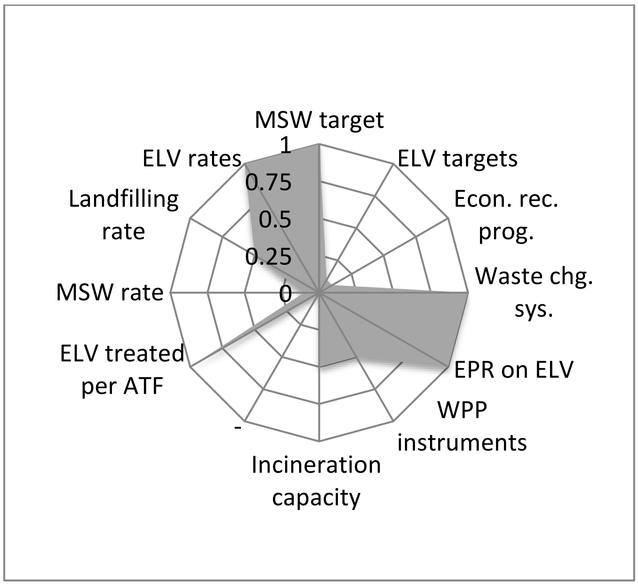
Spain



Sweden

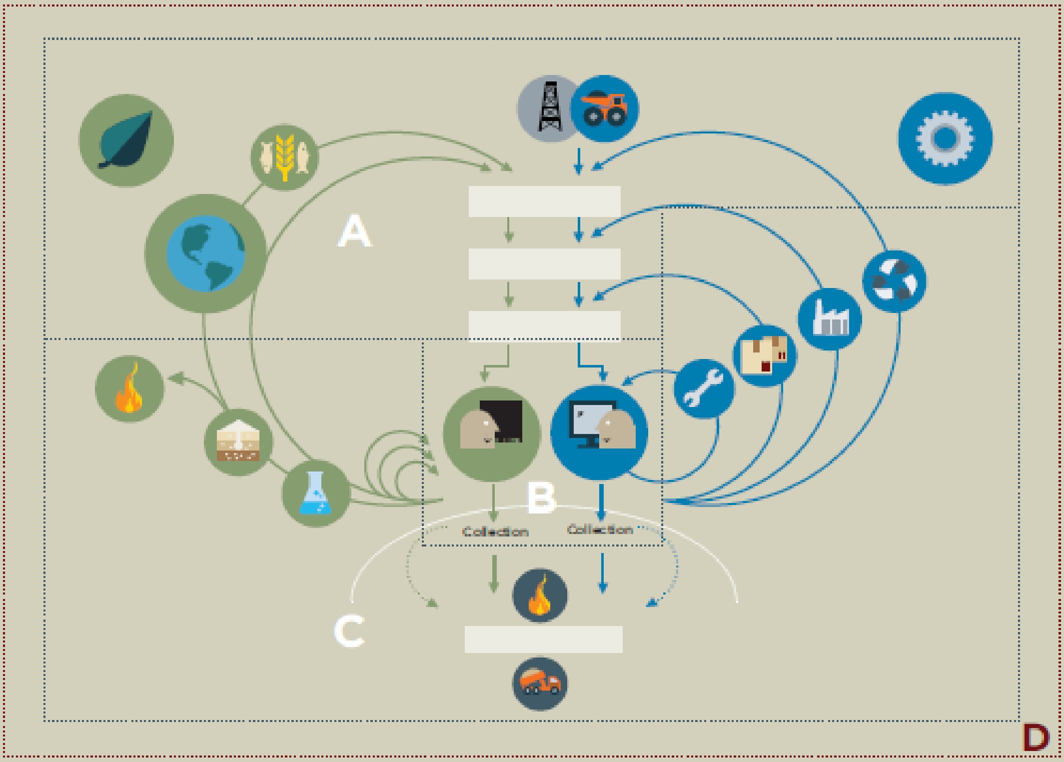


UK



Annex 2: Building blocks of a circular economy

Building blocks of a circular economy—what's needed to win



A

Skills in circular product design and production

- At the production level
- At the process level

B

New business models

- Acceptance and adoption by end-consumer
- Incorporation of new players within and across the value chains
- Information and visibility

C

Skills in building cascades/ reverse cycle

- Reverse logistics
- Technology

D

Enablers to improve cross-cycle and cross-sector performance

1. Develop and reinforce cross-value chain collaboration, joint product development and infrastructure management through

- Development of cross-value chain business models
- Develop visibility of material flow
- Industry standards Match-maker mechanisms

2. Rethink incentives
Align economic incentives

3. Provide a suitable international set of environmental rules

- Adapted certification programs
- More *extended producer responsibility* regulation

4. Lead by example and drive scale-up fast
Opportunities for governments to accelerate the spread of circular setups

5. Access to financing

- Development of private investors
- Access to financing facilitated for circular initiatives

SOURCE: Ellen MacArthur Foundation circular economy team