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WP 4 – Synthesis of Project Results

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1. INTRODUCTION

The main aim of this report is to summarise key findings from working package 1 (WP1) and working package 2 (WP2). The focus of WP1 is to contribute to the understanding of why resources are being used inefficiently from a myriad of different angles, ranging from the regulatory and legislative frameworks to business and individual behaviour. WP2's main focus was to propose policies and policy mixes to address the 'web of constraints' to resource efficiency, and create suitable framework conditions to produce radical improvements in the efficiency with which resources are used while maintaining economic and social wellbeing in Europe.

All reports summarised here are specified below and can be downloaded from www.polfree.eu:

1.1 Analytical Framework for Resource Efficiency
1.2 EU Policy Experiences With Policies Relevant to Resource Efficiency
1.3 Drivers for Resource Decoupling and the Role of National Policies
1.4 Report about resource reduction cost curves for material consumption in different MS and sectors
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2. WHY HAVE RESOURCES BEEN USED INEFFICIENTLY?

The main purpose of the POLFREE project is to identify policy mixes and a vision for moving towards a resource-efficient economy in Europe, and to understand the implications and impacts of policy mixes in terms of economic growth and jobs, but also resource use, GHG emissions and land use. In order to do this it was necessary to first address the causal loops behind inefficient use of resources. The question that guided the work undertaken in WP1 is: "why have resources been used inefficiently?'. This is a complex question and does not have a straightforward answer, for a number of reasons. In the first place resources are diverse, including biotic and abiotic materials, energy, water, soil, and ecosystem services. Most human activities and policies involve, directly and indirectly, multiple resources being consumed and released back into natural ecosystems in the form of emissions and waste. 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 much mileage. For instance, green values are not a good predictor for green behaviour: values tend to interplay with many other things, such as with costs, preferences, social norms, convenience, infrastructural context, policies, etc., often dampening the influence of green values. In other words, the answer to the question of inefficient resource use is a compound and complex one. The sections below explore from different angles why resources are being used inefficiently, and the complex interaction of factors that determine patterns of resource use.

2.1. From resource efficiency barriers to the notion of a web of constraints

Given the complexity of the question, POLFREE has developed an analytical framework that moves 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 a more 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 the public discourse.

2.2. Highlights of the EU policy review

The policy focus on resource efficiency in recent years has been the necessary bridge to embed environmental concerns into the core of the development strategy of the EU. This policy focus has translated into a number of important initiatives in the area of resource efficiency that culminated with the release of the circular economy package in the summer of 2014. The EU parliament elections in May 2014 and the Commission changes introduced important changes in the political discourse which led to the controversial withdrawal of the package, with the commitment that a 'more ambitious' and 'flexible' package would be put forward by the end of 2015.

The analysis of the current legislative framework suggests that binding objectives largely concentrate on the output side of resource use, that is control of emissions

and waste, while the input side, resource use, is either overlooked or addressed though aspirational, non-binding objectives. From the perspective of political feasibility, there is evidence that suggests increasing resistance from Member State (MSs) to agree on quantitative targets. The process of reviewing waste-related legislation has revealed opposition by a number of MSs 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 and 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.

The study has identified multiple cross-influences of EU directives and instruments (explicitly on resource efficiency and tangentially) operating in the various areas of relevance, some of a synergistic nature (mutually reinforcing incentives towards renewable energy (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 a single, harmonised internal market, and thus ensuring the free movement of people and goods. However, transport is also a significant source of air pollution, land use and fragmentation, and material use. While the link between transport and air pollution has been the primary focus of sustainable transport policies at the EU level, less attention has been paid to the material and land use implications of transport policies. 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.

Another example of inconsistency in EU policy over time is waste policy. After years of investing heavily in incineration (resulting in the establishment of expensive incineration infrastructure), the EU shifted discourse to emphasise the promotion of recycling. The roadmap to a Resource Efficient Europe and the withdrawn circular economy package proposed to limit incineration to non-recyclable materials. While from resource efficiency perspective this may be justified, in economic terms, this implies a double investment in waste management infrastructure, increasing costs substantially (particularly the case given that 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 given period of time. This may lock existing waste management practices in to a certain technology path, increasing the costs of switching to recycling. Also, 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. 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 thus far been far from simple. The standards are commonly biased towards a few environmental impacts and limited to energy using and energy-related products. 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’. The cost of waste management

across countries varies significantly according to a number of parameters such as technology availability and deployment, infrastructures, logistics and collection systems. Unit costs and benchmark costs are extremely difficult to calculate as well as other relevant 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 modelling results need to be taken with caution, given the large number of variables influencing levels of recycling.

In light of these complex interactions, a consistent resource efficiency policy agenda needs to acknowledge potential trade-offs between different dimensions of resource efficiency, while also navigating the boundaries of feasibility of policy-making realities. A policy strategy that relies mainly on the output side of the material and energy systems is unlikely to bring the transformative change needed for a truly resource efficient economy that operates within the carrying capacity of ecosystems (or safe operating space, as defined by 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, and are 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. However, these measures are clearly insufficient if they simply supplement rather than substitute primary material consumption. It is also generally true that increasing circularity would not only yield an increase 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 full implications of increasing circularity.

2.3. Highlights of national policies for resource efficiency

To complement the wider picture provided by the analysis of EU policy framework on resource efficiency, POLFREE undertook a screening of resource policies in a number of selected Member States.

The study of resource productivity, measured as the ration between Domestic Material Consumption (DMC) and GDP, across MSs revealed that between 2000-2009 resource productivity has increased in most countries and several countries show an absolute decoupling. One explanatory factor for the decrease in DMC is the growing outsourcing of primary material extraction. No relation was found between DMC per capita and the eco-innovation scoreboard index for MSs and no clear evidence was found on the relation between the share of manufacturing industries and resource consumption per capita.

Environmental taxation can be classified into four main categories: energy, transport, pollution and resources. The weighted average of the revenue by environmental taxes in EU-27 is marginal compared to other types of taxes and in 2008 represented about 2.4% of GDP. Moreover, environmental taxes apply mainly to energy and transport, while pollution and resource taxes represented about 5% of all environmental taxes and 0.1% of GDP.

The study focused on a detailed analysis of four MSs: Austria, Germany, Hungary and the Netherlands. Resource policies and frameworks differ widely among these countries. While the Netherlands lacks targets for resource efficiency or resource productivity, the three remaining countries studies had targets on resource efficiency, resource productivity, energy consumption and land use. The study also revealed wide differences in terms of institutional configuration, incentives and parallel policies in the area of resource efficiency. In general, the study identified several weaknesses in the form of non-action, frequent use of qualitative targets, insufficient horizontal policy coherence, orientation and information deficits and strong influence of vested interests. Germany and Austria are pioneering countries with advanced resource efficiency policies that set quantitative targets and timelines for selected indicators. However, even in these countries, responsibilities between different ministries are unclear and greater policy coherence is needed.

Correlating resource efficiency policy with resource use outcomes is a highly complex exercise and the interaction of several factors and different political and institutional factors makes it difficult to isolate individual 'success factors'. All the countries studied have implemented resource policies to a varying degree and with varying success. Economic and geological individualities create path dependencies with regards to the types of interventions preferred and sectors tackled. Direct and indirect subsidies to resource intensive sectors are common. The overall picture is a rather fragmented and not always coherent. Although green economic incentives are common in the areas of energy and transport, there is resistance to the introduction of resource-based taxation and green tax reforms are politically very difficult to implement. A deeper look at waste policies reveals inconsistencies between policy principles and objectives and instruments and implementation. The study has shown policy incongruences in the application of the waste hierarchy and pre-eminence of solutions that do not contribute to resource optimisation. The focus on landfill diversion has led in many cases to promotion of waste-to-energy and incineration that compete for the same waste streams as recycling, as discussed above. Also the interpretation of the principle of high quality recycling varies considerably between MSs. Generally, targets are set for collection and volumes to send to recycling rather on the quality of the recyclates obtained. The study also points to policies that could steer waste to be used as a resource by: 1) introducing targets on recycling efficiencies or quality of recyclates; 2) Integrating eco-design principles that favour reuse, reparability and dissembling and 3) introducing tax incentives, such as VAT differentials, to steer consumption towards more environmentally friendly products/ materials.

2.4. Highlights of the citizen-consumer perspective

POLFREE has undertaken a study of household behaviour to investigate the web of constraints that shape citizen-consumer behaviour. The study focused on the areas of mobility, food and heating, which represent the most resource-intensive areas of consumption. The study uses a combination of a large survey and other qualitative methods, such as interviews and focus groups, to provide some insights on the factors influencing individual consumption practices. In general, the findings suggest individuals show interest in resource efficient practices, such as driving less, eating less meat or improving the insulation of their home. However, in most cases these practices are motivated by factors other than resource efficiency itself, such as cost-savings, health or even the environment more generally. However, slightly more than half of the respondents did not show an interest in resource-efficient practices and

gave different reasons for it, ranging from pleasure of eating meat or driving, to social practices and settings that made other options less appealing, such as, for example, the absence of a good public transport network. In general terms, people seem to act toward resource efficiency when it is in their self-interest, especially through cost savings.

The study also found that motivating and hampering factors come together in feedback loops, and supply and demand are interlinked and mutually influenced. For example, the supply of local sourced food can have a positive influence in the demand for this type of food, but both are shaped by social settings and practices and interactions with other supply chains. To offer additional insights into people's behaviour, the study also examined the consistency between practices in a number of different realms, illustrated through the analysis of the interconnection between food consumption and food buying practices through a combination of correlation analysis and interviews. Findings seem to suggest that people's behaviour was quite consistent in the area of food, for example, people that tend to buy regionally/ locally sourced ingredients are also those more likely to buy seasonable produce, however, inconsistencies were also found in other areas. Waste separation does not seem to be correlated to sustainable food practices, more resource efficient behaviours while driving or more energy-efficient housing. Turning down the heating when airing a room though is significantly positively correlated with driving in a more efficient way but unrelated to waste separation or eating organic food. The reasons for non-consistency of green behaviour across domains is that choices in these different domains may be motivated by different factors, such as cost-savings, health or other considerations.

Using Max Neef's (1991) approach to needs, the study also undertook an analysis of people's needs and their ranking for a small sample in Austria and Hungary. In general, no significant difference was found between ranking of needs between people that showed green behaviour and practices and those that didn't. This seems to stress the point highlighted above that practices are entangled in a web of factors that contribute to shape behaviour, influenced by product supply/offer, life circumstances, convenience, costs, systems of provision and other social settings.

The study on individual behaviour concluded with a discussion on the link between materialistic lifestyles and happiness and the wellbeing effects of reduced material consumption.

2.5. Highlights of business barriers

Businesses play a key role in resource efficiency both as catalysts for change but also as inefficient users of resources. POLFREE set out to analyse why firms behave inefficiently and, more importantly, what the drivers that motivate firms to introduce "resource efficient measures" (REM) are. REM are defined in a similar way 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 resource use (including energy use) compared to relevant alternatives*" (Kemp and Pearson, 2008).

Based on an analysis of 150 recent case studies of implementation of REMs, the research aims to shed some light on the drivers and barriers for the adoption and implementation of REMs by firms. REMs have been categorised into operation-

focused measures, product-focused measures and life-cycle measures. The analysis suggests that three key measures concentrated the highest potential in terms of potential impact not only for their contribution to resource efficiency, but also to business competitiveness across the value chain. These three key measures are green business services, cradle-to-cradle design and industrial symbiosis. An example of green business services is energy service companies (ESCOs). The authors found that these companies help to tackle the web of constraints for energy efficiency in buildings and turn it into a web of drivers by simultaneously promoting awareness, focusing on demand measures, reducing the resistance generated by high up-front investment costs and reducing risk and learning costs. There are, however, barriers to the ESCO model. Examples include resistance to the (perceived or actual) loss of control over the energy infrastructure, and financial issues linked to difficulties to secure funding for projects. Cradle to cradle design offers a more circular approach to resource efficiency by considering the recyclability and cyclical use of resources at the product design stage. Products and materials are designed to maintain value over multiple uses and accumulate intelligence over time. Barriers to this model also exist, as collection and recycling systems may not be effectively designed to recover materials even if they have been designed for recyclability. The model also entails an intensive data system on the substances being used along the whole supply chain and requires companies to work closely with suppliers to ensure consistency with the cradle-to-cradle principles. Finally, industrial symbiosis is another promising area for resource efficiency gains, promoting the collaborative exchange of waste streams from one facility/ industry to be used as substitutes for raw materials in another industry/facility. However, the approach also requires a comprehensive data and knowledge system to track material flows as well as technical expertise to assist and support the innovative component of potential synergies. Based on the analysis, the study concludes that there can be various motivations or drivers to introduce REMs. On the supply side, costs may be reduced and security of supply of certain critical materials may be increased. On the demand side, new customer niches (either through products or services) may be tapped or new forms of customer intimacy may be reached. Beside these obvious benefits, companies may also be active in this field to be seen as a reliable employer or to improve its image and reputation These findings are 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.

The study concludes that setting the right framework conditions may help to realise the potential of resource efficiency and transform the web of constraints into web of drivers. This requires policies to support new business models and help to internalise externalities associated with material use, but also measures to ensure more transparency and information sharing along the supply chain and with customers, to enhance recycling levels and standards.

2.6. Markets for secondary materials

In POLFREE we did not undertake an empirical investigation of the markets for secondary materials, however, the concept of the web of constraints was applied to analyse the complex range of factors that operate at the supply and demand side of secondary material markets. Moving waste up the waste hierarchy is a prerequisite for the successful implementation of the circular economy concept. Increasing recycling requires a parallel increase in the demand for recyclates that absorbs the supply and eventually displaces primary raw materials.

The analysis concludes that although secondary markets are subjected to some of the dynamics that operate on commodity markets, they are faced with additional barriers. These barriers operate both at the supply and demand sides. 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 the creation of 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 for 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 policy perspective, the analysis points to the need for measures that help to ensure: a) high levels of quality recycling and b) mature enough secondary materials markets capable of absorbing the surplus of recycled materials. Although current waste framework and targets on collection and recycling have contributed to increasing recycling levels, the lack of targets on the actual performance or outputs of the recycling process has meant the downgrading of resources through low quality recycling in many cases. Moreover, end of life regulations 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. From the pull side, the introduction of clearer guidelines on Green Public Procurement (GPP) and measures to introduce legal requirements on recycled content for a number of product categories could help to increase the demand for secondary materials and thus foster secondary materials markets. Differentiated VAT rates depending on whether a product uses primary or recycled materials could also increase the demand for recyclates 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 demand for secondary materials. Measures such as the European Declaration of Paper Recycling have proved successful in promoting increased volumes of secondary materials consumed in paper mills. 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 at the national level of the introduction of a construction minerals levy or charge exist and further analysis is needed to evaluate their potential.

2.7. Resource efficiency and energy efficiency

Although the focus of POLFREE is to investigate policies for resource efficiency, the issue of the interconnections between energy and resource efficiency are of key relevance for the analysis. The relationship between resource and energy efficiency is not exempt from complexities, and policies and measures may not always work in the same direction. This issue has been briefly examined for the case of recycling.

Recycling, as a resource efficient strategy, may lead to lower energy consumption, as the energy required producing the recyclates is generally lower than the energy required to produce the virgin commodity. However, the energy required to produce/recover a recyclate depends on the energy involved in the collection and transport of the waste materials and the energy needed for processing them, 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 may affect the energy balance negatively and which may mean that materials would have to be cascaded down a usage hierarchy if the affected properties are the ones that really matter.

The energy consequences from the use of virgin material and recycling are thus strongly related to supply chain geographies and logistics between virgin materials and waste streams. Virgin materials usually have concentrated sources upstream in the supply chain, whether these are mines, wells, agricultural regions or others. 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 are often found in association with a wide range of different materials - sometimes as composites that can be hard to separate. As the supply of recyclable material for the production of recyclates is a lot less predictable and secure 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.

The overall conclusion is that recycling has a non-negligible 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 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, have been adequately considered.

2.8. 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 preferences of individuals, 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 dykes 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, narrow policy instrument or direction, 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 subjected 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 divergence 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.

3. POLICY MIXES FOR RESOURCE EFFICIENCY

The concept of the web of constraints has provided a complex picture to the question of why resources have been used inefficiently. Against this background, POLFREE explored in WP2 what kind of policy mixes and policy frameworks are needed to dramatically increase resource efficiency in Europe and overcome main constraints to achieve a reduction of both primary resources and environmental burdens. In WP2, POLFREE has: 1) reviewed visions, concepts and paradigms that can help to frame a new narrative for resource efficiency; 2) proposed a vision of resource efficiency that identifies clear and shared goals for a sustainable, circular and resource efficient economy in Europe; 3) developed policy mixes to fulfill the goals of the vision and 4) studied the role of the business and global governance dimensions to ensure that policy developments align with business opportunities to optimise synergies and address trade-offs as well as acknowledge a context characterised by globalised supply chains and EU reliance on imports in absence of governance structures addressing resource use issues from a global perspective.

3.1. New concepts and paradigms for resource efficiency

The POLFREE project reviewed a long list of concepts developed in recent decades to assess their relevance in guiding a transition towards a more resource efficient Europe. Concepts were assessed against an analytical framework based on three main categories:

1) **Scope of change**, which refers to the specific system covered by the concept (specific industry sector, value chain and societal sub-system).
2) **Paradigmatic degree of change**, that varies between market-based solutions (no paradigmatic change), to intermediate paradigmatic change (which recognises the “public-good” character of resource-related issues) and fundamental paradigmatic change (which imply revolutionary changes at the societal scale including values, practices, institutions and economic system)
3) **Plausibility of pathways**, which refers to the clarity with which pathways of change are defined and the extent to which they are feasible considering a variety of factors such as technology, institutions, resource scarcity or social issues.

Table 1 below provides a summary of the mapping of key concepts according to the framework proposed, +1 being high and -1 being low.

Table 1: Mapping of resource efficient concepts

No.		Scope of Change	Paradigmatic Degree	Plausibility of Paths
1	Industrial Ecology	1	-1	0
2	Industrial Symbiosis	0	-1	0
3	Waste Prevention	0	0	1
4	EPR	0	-1	1
5	Supply chain management	0	-1	1
6	Leasing society	1	1	-1
7	Ecological economics	1	1	0
8	Natural step	1	1	0
9	Weak	1	-1	1
10	Strong	1	0	1
11	Small is beautiful	1	1	0
12	Eco Innovation	1	0	1
13	Transition management	1	0	0

14	Green growth	1	-1	1
15	Green economy	1	0	1
16	Beyond GDP	1	-1	0
17	Cleaner production	0	-1	1
18	Eco-efficiency	0	-1	1
19	Resource efficiency	0	0	0
20	Pollution prevention pays	0	-1	1
21	SCP	1	0	0
22	PSS	1	1	0
23	Circular economy	1	-1	0
24	3R	1	-1	0
25	De-growth	1	1	0
26	Resilience, SOP	1	1	0
27	Hannover principles	-1	1	-1
28	BoP business models	0	-1	0
29	Leapfrogging	0	0	0
30	Slow food, transition towns	1	1	0

Source: Tucker et al., 2013.

From the analysis, one may conclude that:

1) There is no single concept scoring +1 in all three dimensions
2) Concepts that have a credible/plausible pathways of change do not generally aim at a high degree of paradigmatic change
3) Concepts that aim at a high level of paradigmatic change have at best just a conceptual explanation of the pathways of change

Radical and paradigmatic change implies a shift from existing economic and social trajectories and a new institutional order. As such, this results in significant resistance to change by existing systems and dominant actors. Transition management theory indicates that for change to happen, existing systems have to be under significant pressure. The analysis of exogenous factors in POLFREE questions the plausibility of a 'resource revolution' at this stage, as real scarcity issues may not be as strong as they need to be to unchain the transition. A look at energy materials, biotic materials, building and construction materials, metal ores and industrial minerals indicates that scarcity issues by themselves are unlikely to drive a strong, wide resource revolution, apart from a limited number of specific critical metal ores and industrial minerals and improvements required in the extraction and use of biotic materials. Drivers are more likely to emerge from the natural capital/output side where there is growing evidence of the limitations of natural systems of providing life-supporting services under increased pressure. The implication of this is that policy and societal will are essential in driving change in the shorter term.

3.2. A Vision for a resource efficient economy

The POLFREE vision aims to establish clear and shared goals to drive policy action towards a resource efficient economy in Europe. The overall objective of the vision is to achieve absolute resource decoupling through resource efficiency while maintaining high levels of human wellbeing. The vision is based on credible, scientifically derived and measurable targets for the four main resource categories: materials, land, waster and carbon. A total of eight quantitative headline targets for 2050 are proposed (see Table 2), which are complemented with additional targets for different subcategories.

Table 2: A vision for a resource Efficient Europe

Category	Perspective	Target 2050	Sources	Rationale
Materials	Global consumption	5t RMC/cap	BIO IS 2012 Bringezu 2013 Data: Eurostat	Returning to a level of global raw material extraction equivalent tot he year 2000 and distributing this level equally among the expected world population in 2050 (Bringezu et al. 2013)
	EU supply	No net additions to stock	BIO IS 2012	European demand for primary resources is reduced tot he point that they can be nearly sourced within the built environment through e.g. urban mining. This also implies a reduced land take and much higher levels of renovation oft he existing building stock.
Water	Global (consumption)	Mean water footprint per capita reduced 30-50% below 2004 levels*	Open EU project calculated EU water footprint for 4 scenarios. Range of results used here	The water footprint covers not only the demand consumption of water directly but also the water in imported goods
	EU supply	Water exploitation index below 20% in all European Countries	EU Roadmap and EEA	At 20% a region is defined as being under „water stress“
Carbon	Global (consumption)	Mean carbon footprint per capita reduced 60-80% below 2004 levels	Open EU project calculated EU carbon footprint for 4 scenarios. Range of results used here	Considers the impacts of goods and services imported into the EU
	EU supply	GHG emissions reduced by 80 to 95% (compared to 1990)	Target from the Roadmap to a low carbon economy	To keep climate change below 2 degrees C. << target could be related to any base year, e.g. 2005, to make it comparable >>
Land	Global (consumption)	Cropland reduced to 0.17 to 0.20 ha/person, or by 34 to 44% (compared to 2005)	- Low target: based on planetary boundary of Rockström et al. 2009 (15% of ice-free surface for cropland, or plus around 400 Mha from 2005) adjusted for population - High target: UNEP 2014 (+104 Mha net and nearly 200 Mha gross from 2005) and adjusted for 2050[1] - Per capita cropland area in 2007: Bringezu et al. 2012	Low target: planetary boundary for land use change to limit effects of climate change High Target: Halt the loss of biodiversity and keep land use change within the safe operating space
	EU supply	No net loss of cropland	Combining targets from the RE Roadmap on non et land take and on soil fertility	No net land take (target from the Roadmap) due to expansion of built-up land and no soil degradation (implies long-term maintenance of soil fertility through good agricultural practices to ensure production over the years to come). Overarching rationale ist o prevent the loss of fertile cropland in the EU.

Source: POLFREE Vision, Jaeger et al., 2014.

[1] The study discusses targets for 2030, which have been recalculated here for 2050

The targets are accompanied by a narrative that describes what a resource efficient economy may look like in 2050 and by a description of the pathways to achieve such a vision (as in Box below).

A safe and fair use of global resources by 2050
European consumption of global resources is both within the safe operating space of planetary boundaries and fair. This means that consumption levels are (1) below environmental limits and (2) below limits of equal resource distribution—per capita use of global resources is below or equal to per capita world availability. Overall, resource efficiency is improved across the life-cycle of resource use with a multitude of benefits for nature and for people.

Materials

Mining is characterized by high levels of transparency and accountability, dedication to worker safety, and reduced environmental impacts. Materials are managed so that they do not become waste. Effective systems of material stewardship and global extended producer responsibility support the production and use of resource-light products. Information and Communication Technology devices and infrastructures have lead to massive increases in resource-efficiency of consumption patterns – and no longer rely on critical raw materials.

Energy

In 2050 Europe has an energy system that is low-carbon, resource-efficient, secure and competitive. Energy supply in 2050 is provided through a low-carbon energy system (emissions of CO2 have been reduced by 80% compared to 1990) that is based on a mix of predominantly renewables supplemented where necessary by natural gas. Primary energy demand is around 40% lower in 2050 than in 2005. Decentralisation of the power system and heat generation is higher due to more renewable generation.

Land

The global expansion of cropland, pastures, and fast-growing tree plantations into grasslands, savannahs and forests was halted in 2020. The EU has met both its target initiatives for no net loss of biodiversity and for reducing its level of global cropland use to sustainable levels.

Agriculture

Widespread application of the principles of agro-ecology enhance soil fertility, nutrient cycling and water cycling in both conventional and organic farming systems, and the use of fertilizers, pesticides and water are reduced overall. Livestock production is more climate-friendly in 2050, mostly due to a reduction in the demand for meat in the EU, enabling a combination of grassland-based production systems and sustainable intensification (especially in the tropics).

Forestry

The forest industry in the EU is characterized by its dedication to optimizing “cascades”, which means first producing the most value-added from virgin timber, optimizing reuse and recycling, and only using the raw material for energy at the end of its life-cycle.

Water

Water scarcity in Europe is reduced through highly efficient irrigation systems, closed loop water use systems and increased use of rain-fed crops. Most significant is the full implementation of integrated resource (water and land) governance and management at the water basin level. Ocean acidification has been halted and pollution of the oceans (waste, oil, plastics etc.) is drastically reduced.

A Resource-Efficient Economy

In a resource-efficient economy citizens and public authorities have the right incentives to choose the most resource efficient products and services, through appropriate price signals and clear environmental information. Morover, purchasing choices stimulate companies to innovate and to supply more resource efficient goods and services.

Labour, Industry and Technology

A working time reduction allows more free time for caring for the elderly or working for the community and also contributes to lowering resource use.The manufacturing industry has been transformed to respect the limits of non-renewable resources. In 2050 the leading companies are those that, through their core businesses, help society manage the world’s major challenges.

Housing

The housing and building sector use a significantly lower amount of land, water and energy in 2050. Green buildings are the norm for all public buildings. The construction industry contributes to the resource efficient economy through renovation and refurbishment, increasingly sourcing recycled materials from urban mining, and employing ever-increasing resource-light innovations in (re)construction.

Mobility
Europe has a new understanding of mobility. It is not about travelling a lot and fast, but little and mainly for only short distances. This means that the transport system is low-carbon, resource-efficient, secure and competitive and uses clean technologies and transformed transport networks.
Values
All forms of diversity are important, not only the biological but also cultural diversity and diversity of social and economic systems. Human rights are upheld and people have equal access to chances and capabilities. Other leading principles for behaviour are peace, reaching social, cultural and environmental targets and allowing for personal development and flourishing.
Governance
With a multi-level, polycentric governance system, cooperation rather than competition guides the approaches to dealing with resource efficiency. Long-term, iterative and structured participatory processes lead to increased trust.
Development
In 2050 the world population has stabilized at about 9 (at least 8) billion people. Basic needs (e.g., food, shelter, access to basic education and health care, sanitation and water) can be met all over the world and in addition it is possible to meet the human needs that go beyond the basic ones, such as security, identity, social interactions and freedom.
Open knowledge society
In 2050 Europe has an innovative, open knowledge system, which is based on the fact that there are multiple forms of knowledge and not just scientific knowledge. The general ambition is to protect, promote and whenever possible integrate the diversity of languages, concepts, models and forms of knowledge in ways that support transitions to sustainability.

Source: POLFREE Vision, Jaeger et al., 2014.

3.3. A new policy mix for a resource efficient economy in Europe

POLFREE has developed a policy mix that aims to enable Europe to radically increase resource efficiency and help overcoming the web of constraints to the inefficient use of resources, to achieve the common goals and targets set by the POLFREE vision. This raises the question of why policy interventions are necessary in the first place. From the theoretical point of view, environmental legislation has based its legitimacy on the existence of market failures. This concept has been recently reviewing towards the concept of 'systems failures' (OECD, 2006) that better captures the systemic character of those failures that include not only markets but also institutions. From a more empirical perspective, a number of trends showing increased resource use, rebound effects and mounting pressure and distress to natural ecosystems contribute to legitimate policy action in the area of resource efficiency.

In POLFREE the process of developing the policy mix aimed to go beyond the identification of a list of promising instruments to the definition of a coherent and consistent set of instruments that maximise synergies and avoid trade-offs between policy actions in different areas. Nine key policy fields were identified and three instruments proposed for each field. The first instrument looked at low-hanging fruits, the second instrument focus on market interventions, while the third instrument aimed at systemic changes. Each instrument has been described and its design characteristics analysed (stringency, profitability, predictability, flexibility, differentiation and depth), as summarised in table 3 below (on a scale of 1-5, 1 being low ambition/effort and 5 very high ambition/ effort).

Table 3: A policy mix for a resource efficient Europe

		Stringency	Profitability	Predictability	Flexibility	Differentiation	Depth
Minimization of food waste losses	Resource efficiency across the supply chain - Supporting cooperation, capacity building and innovation	1	3	5	5	4	4
	Green Public Procurement	5	2	3	4	1	3
	Courtauld commitment of food waste prevention	1	5	5	5	5	5
Zero Energy and material efficient buildings	Landfill bans and landfill targets on C&D waste	4	1	4	4	5	1
	End of life of buildings and building passports	5	1	5	3	1	5
	Promoting "co-housing alternatives" and living together through economic and planning instruments	1	3	5	5	3	5
Fuel efficient mobility	Strict CO_2 emission standards	4	1	5	5	2	1
	Vehicle and road tax	4	1	5	5	1	5
	Prioritizing urban non-car infrastructure	4	2	5	5	1	3
Electricity production and distribution	Smart grids	5	4	1	5	5	5
	Effective levels of carbon taxation through changes in the ETS and carbon border adjustments	2	1	4	5	5	5
	Integrated micro-generating systems and through incentives and subsidies in industries and households accompanied with energy efficiency audits	4	3	3	5	5	5
Industrial symbiosis network	Landfill taxes, bans and end of waste criteria	3	3	4	4	5	3
	Pan-European network of industrial symbiosis programmes/ coordinating bodies	1	3	5	5	5	4
	Incorporating IS requirements in regional planning and activity permits	5	2	5	2	1	1
Product Service Systems	Awareness raising campaign about existence and advantages of PSSs	1	4	5	5	5	4
Circular Economy	Individual producer responsibility	1	3	5	5	1	5
	Mandatory eco-design standards for reuse and repair-ability	2	1	1	1	5	1
	Waste targets for resource efficiency	5	1	5	4	2	1
Phasing out environmental harmful subsidies	A comprehensive inventory of EHS in the EU	4	3	5	1	1	-
	Environmental Subsidy Controlling: The „Environmental Check" for Subsidies	5	4	3	1	1	-
	Systematic phasing out of EHS	3	1	4	5	5	4
Internalisation of external costs	European-wide harmonization and introduction of construction minerals taxes (incl. border tax adjustment) _ Construction Minerals Directive	1	3	3	4	3	4
	TMR-based material input taxes	5	3	1	5	1	5
	LCA-based Value Added Taxes	4	1	1	5	1	5

Source: POLFREE policy mixes for Resource Efficiency, Wilts et al. (2014).

After the analysis of the single instruments, the policy mix was analysed considering: 1) the consistency among different instruments, looking at synergies and potential trade-offs and 2) the coherence between instruments and identified distribution of responsibilities among different levels (sectoral, global, EU, national, regional, local). The analysis reveals potential synergies between instruments that attempt to reduce externalisation of costs. For example, resource intensity-based taxes can foster the uptake of service systems and provide incentives for better use of resources contained in waste. Similarly, phasing out environmentally harmful subsidies could provide incentives to shifting investment to more resource efficient sectors. Similarly, trade-offs and conflicts may arise among some of the proposed instruments, therefore careful consideration to minimise or overcome trade-offs is needed. For example, increasing the energy efficiency of buildings can create waste streams that are more difficult and costly to recycle at the end of the life of a building. Social conflicts and opposition from veto players can also impact the implementation of the policy mix. The phasing out of environmentally harmful subsidies is a clear example of this.

The coherence of the policy mix needs to be assessed taking into account policy processes taking place across different governance levels. In many cases, collaboration between different governance levels is required to ensure successful implementation of the instruments.

3.4. New business models that support resource efficiency

Businesses have proven to be both part of the problem and part of the solution to resource efficiency. In recent years, a number of new business models have emerged in the search for new sources of value through more efficient use of resources. POLFREE has researched over 300 case studies of new business models which have been classified according the a conceptual framework that differentiates the following dimensions:

1) Business model change in the category of 'value proposition' (VP), which focuses on changes in the value embedded in the product/service.
2) Business model change in the category 'supply chain' (SC), which includes changes upstream the supply chain, i.e. changes in the relationship with suppliers.
3) Business model change in the category 'customer interface' (CI), which comprises the structure and management of downstream relationships with customers
4) Business model change in the category of 'financial model' (FM) which refers to changes in the structure of costs and revenues

Table 4 summarises main types of new business models identified in the study and key barriers to their implementation.

Table 4: New Business Models for Resource Efficiency and the Circular Economy

	REM	**#**		**Observation**
Product/Service	Green Products	30	REM	Relatively little combination with other types. No specific industry focus. *Clusters:* • Small-scale product changes; • New product introduction or other complete product overhauls.

			BM Δ	Mostly on the *value* proposition and some in *supply chain* and internal production.
			Barriers	Mainly *technological, behavioural* and *market* barriers, driven by the *value proposition* and the internal production changes.
	Green Services	32	REM	A very broad 'catch-all'- category. A promising number of combinations with *Industrial Symbiosis.* *Clusters:* • Services *to* Value Chains ('*X as a Service*'); • Services *in* Value Chain.
			BM Δ	Prevalence of *value proposition* changes.
			Barriers	Consequently confronted with *market* and *organisational* barriers, either when the service is in an existing market (competition) or when the service is in a new market.
	Service Substitutes	1	REM	A single case: Eco2Distrib.
			BM Δ	*Value proposition* and *customer interface.*
			Barriers	*Market, organisational* and *behavioural* barriers.
	Services instead of Products	13	REM	A focus on sharing and renting, sometimes extended with additional services such as insurance and *take-back management.*
		4.	BM Δ	*Value proposition* and *financial model.*
			Barriers	*Behavioural* barriers due to the new way of offering and *market* barriers due to competition in traditional product market.
	Functional Sales	13	REM	*Clusters:* • Alternative for ownership focuses on material sharing: o Straightforward renting and leasing; o Added value services; Performance contracting allows for choices by the provider.
			BM Δ	This class typically needs changes in the *value proposition* to change both products to services to function and change incentives in usage. Therefore a change in the *financial model* is often occurring too. Sometimes with added value services such as TBM the *supply chain* is affected as well.
			Barriers	Because the class radically changes the proposition known to consumer concepts *market* barriers will have to be overcome. It also involves drastic changes within companies and a restructuring: therefore *behavioural and organisational* barriers are involved.

Source: POLFREE new business models, Diaz Lopez et al. (2014)

Findings suggest that some new business models combine different types of measures and work across different dimensions. Life cycle measures such as cradle-to-cradle approaches generally require action by both the supply and demand sides. The degree and scope of change encompassed by new business models also differs greatly. On the demand side, it was observed that while the introduction of green products generally requires smaller changes in the business model, business models

based on functional sales often imply a much larger reorganisation of the business structure. On the supply side, measures like pollution control or cleaner production generally do not require radical changes in business models, while other measures such as green supply management and industrial symbiosis, which require collaboration across different sectors and actors, imply a greater degree of change in the way businesses operate.

The high number of case studies and variety of new business models identified seem to demonstrate that resource efficiency can be a driver for businesses to exploit win-win opportunities. Reported cases, though, tend to concentrate on successful examples while there is a lack of evidence with regards to business models that have failed to succeed. Additionally, reported case studies tend to focus on the description of the benefits while less attention is given to the obstacles they have encountered during the implementation.

The diverse mix of business models identified points to various alternatives to become more resource efficient and add value to a business. However, the study also reveals a need for more accurate assessment of the impacts of business model change in performance and value creation. A question that arose during the analysis is the role of policy in promoting new business models. The findings suggest that policy could play a relevant role in defining suitable framework conditions that align resource and economic efficiency. However, this is by no means an easy task, as it requires the creation of supporting coalitions of stakeholders and a clear understanding of the barriers and challenges new business models face.

4.1. Global governance for resource efficient economies

The POLFREE project concludes WP2 with an analysis of the global governance structure that would support the move towards a resource efficient economy. The relevance of the global context is justified by two main reasons: 1) Europe's reliance on imports for number of commodities and a business context characterised by the prevalence of global supply chains and 2) the absence of a governance structure at the global level that covers resource issues across environmental, trade, human rights and energy fields. The analysis departs with a characterisation of the existing global architecture, as illustrated in Figure 1.

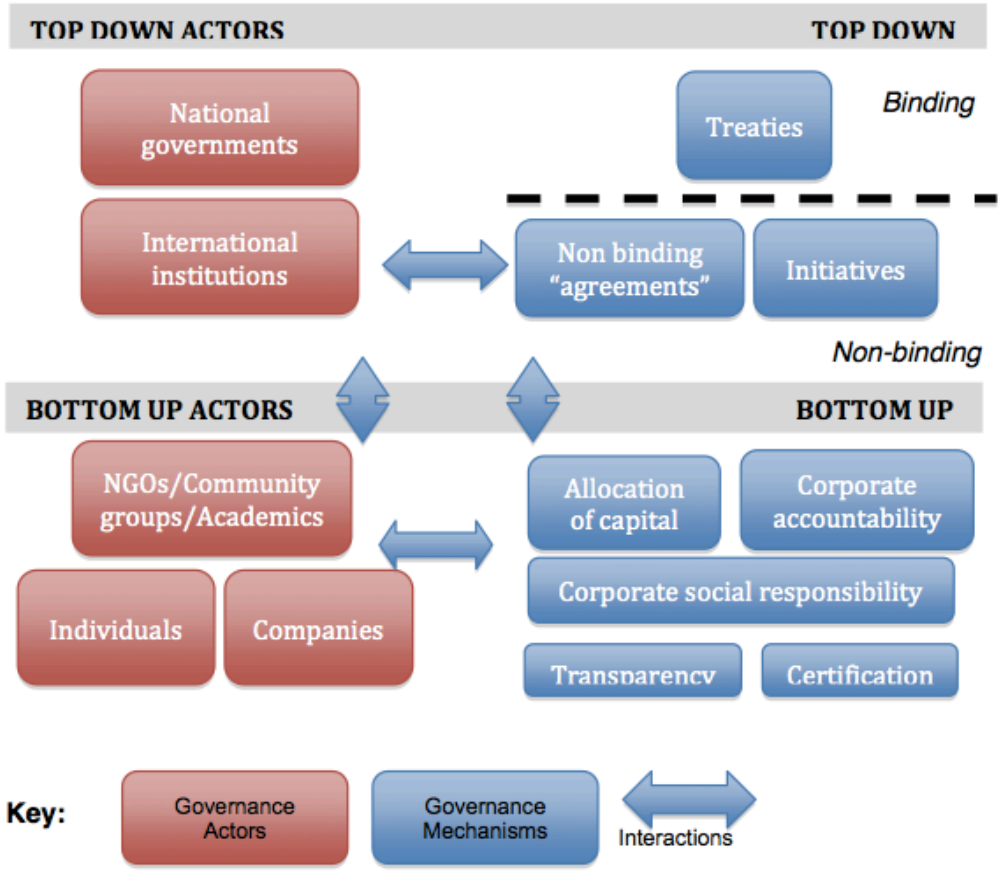

Figure 1: The existing governance architecture for resources

Figure 1: Global Architecture for Sustainable Use of Resources. Source: POLFREE global governance report, O'Keeffe (2013).

In this framework governance mechanisms are classified as top-down (those led by state actors) and bottom-up mechanisms (those which originate from a myriad of sources including the not for profit, academic, business and community sectors). On the basis of the current architecture, POLFREE envisages potential futures for the creation of a global governance structure for sustainable use of resources. The governance system must address the following issues:

• Physical supply and environmental degradation – are sufficient resources available geologically or biologically, and are they in a sufficient state of "health" to be able to support future populations and inter-related ecosystems?

• Access to supply and price volatility – can the resources available be accessed by those that need them in an equitable manner either physically or economically; are the methods of extraction supportive of sustainable long term resource use?

• Socio economic impacts – maximising positive impacts in resource rent capture and reducing negative impacts of competitive land and resource use and degradation of human rights

• Demand reduction – a way of relieving pressure on natural resources but

with equity considerations regarding access and economic potential.

Departing from this background, three potential futures can be envisaged:

1) A multilateral world
2) A coalition driven world
3) A world of unilateral action and bilateral agreements

Key characteristics of these futures are briefly explained in the box below.

A multilateral world

Here the one country one vote, fully multilateral approach is a successful one with all countries recognising the importance of coordinated action. This approach has characterised the later part of the 20th century with a proliferation of multilateral environmental agreements. Less commitment to these approaches is evident at present, however the potential for climate change impacts to galvanise global efforts should not be dismissed. Although the multilateral approach is seen as the outgoing paradigm, a strong multilateral approach in 2050 does not necessarily mean that the same institutions prevail.

A coalition driven world

Here collaboration is occurring but it is in smaller coalitions rather than full multilateral processes. Progress is fragmented but is progress nonetheless, focusing potentially on key issues and maybe key regions. In this future it is important to also consider what Europe's role would be in such a fragmented governance system: is it a strong Europe acting as a driving force for the coalition-based leadership, or is Europe on the side lines with developing and emerging economies taking the lead? The fragmented, coalition based approach is characteristic of today's governance preferences, evident even within multilateral processes.

Unilateral action and bilateral agreements

In this final possible future, cooperation is at a minimum, with countries instead preferring to make unilateral decisions and enter into bilateral trade and resource sharing agreements where necessary. There is a wholesale rejection of the global governance institutions developed since world war two and the concepts of shared responsibilities are side lined.

Source: POLFREE report on Global Governance, O'Keeffe (2013)

The feasibility of these potential futures has been assessed against the cooperation continuum, as illustrated in Figure 2.

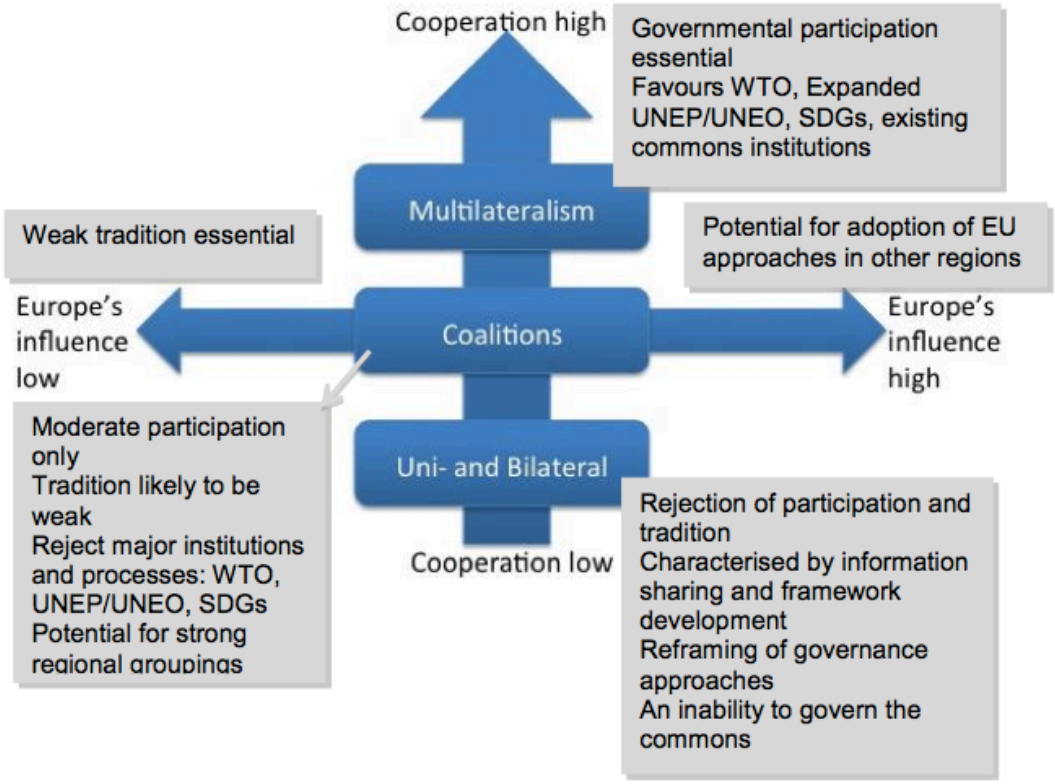

Figure 2: Summary of feasibility assessment

Figure 2: Collaboration continuum of possible futures for Global Governance of Resources. Source: POLFREE global governance report, O'Keeffe (2013).

The research highlights the need to tackle resource use and resource efficiency at the international level but also recognises the challenges to do so, especially in a context of scepticism regarding multilateralism and the lack of harmonised national approaches towards international collaboration. Although no clear governance structure has emerged yet that covers all relevant issues of resource use, the proposal of an *Integrated Resource Management Agency* has shown some potential.

Europe has an important role to play to set the basis for the emergence of a global governance structure for sustainable resource use. As a member of the G8 and largest global importer, Europe can use its influence in agenda setting in international fora. Europe can also provide support to bottom-up initiatives proven to build capacity and support the adoption of new approaches that can be then transferred to top-down governance. Collaboration through existing coalitions can also keep multilateral dialogues open to create future governance structures.

5. CONCLUSIONS

Resource efficiency has been identified as a route to competitiveness in Europe (EC, 2011). Improving resource efficiency can positively contribute to reducing the environmental impacts associated with resource use and may also lead to economic benefits for businesses and society as a whole through reducing the bill of material and import dependency. A number of recent studies have looked at the opportunities of resource efficiency (McKinsey, 2011; AMEC& BIO, 2013; Oakdene Hollins, 2011). If the prize of resource efficiency is potentially so significant, why is the uptake of resource efficiency measures and policies still limited? POLFREE set out to understand why resources are used inefficiently and what kind of policy mixes could deliver a resource efficient economy by 2050. WP1 has undertaken an analysis of the barriers to resource efficiency from different perspectives. It has reviewed obstacles to efficient resource use from the current legislative framework, both at the EU and national level, the business perspective and the individual perspective. The analysis does not provide a straightforward answer to the question but reveals a complex web of simultaneous and dynamic feedback loops that explain the different type of constraints limiting resource efficient practices. These constraints range from embedded values and behaviours, to inertia to legislative and regulatory obstacles. This complex picture of the "web of constraints" to resource efficiency provides justification of the need for enabling policy frameworks that ease the transition to a resource efficient economy. The focus of WP2 is precisely to look at policies and policy mixes required and able to overcome the web of constraints and promote a radical increase in resource efficiency in Europe, addressed both at the individual and business level. Designing a policy mix for resource efficiency is by no means an easy task. The multiplicity of actors, types of resources and levels of decision making provide a very complex background against which to design policies that provide a suitable framework and right set of incentives for resource efficiency. As with any substantial change in the context in which businesses and citizens/consumers operate, trade-offs and resistance are likely to emerge along the process. It is thus essential to have a clear vision of what a resource efficient Europe may look like, supported by quantitative and qualitative targets and milestones that contribute to steer the process in the medium- to long-term. POLFREE has proposed a vision for a resource efficient Europe to guide policy action and provide adequate background to the policy mix. The policy mix proposed in POLFREE combines a number of innovative policy instruments that could deliver important resource efficiency gains in a number of key fields. Careful consideration and the identification of synergies between instruments as well as potential trade-offs was taken during construction of the policy mix. Attention has also been paid to issues of political feasibility and practical implementation. The way policies are sequenced and implemented has an important effect on the overall impact of the policy. It is also important to understand the divergent set of incentives that different types of policies may provide to different actors and explore the feedback loops and interactions between policy areas and stakeholders. Aligning policies with business model change has also been explored in some detail in POLFREE. The study has revealed a wealth of new business models and areas where resource opportunities have led to win-win gains. However, the study also reveals that in most cases these new business models operate in niches and face important barriers that inhibit their increasing implementation. While a growing number of success stories have been reported in the literature, detailed understanding of the cases that failed to succeed may provide important insights into the framework conditions that may impede the dissemination of resource efficient solutions.

The global dimension has also been addressed in POLFREE. The importance of the global dimension is justified by the fact that Europe is an import-dependent region and the predominant global nature of economic and trade relations and environmental challenges. In this context, policies for resource efficiency cannot be considered in isolation but need to be designed in consonance with the international scene. The lack of well-defined international governance architecture on natural resources has been identified as a key factor hampering the introduction of harmonised international action in the area. However, Europe has an important role to play to help set the basis for the emergence of a global governance structure for sustainable resource use, combining top-down and bottom-up approaches and promoting collaboration through existing coalitions to encourage multilateral dialogue.

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