Towards a resource-efficient Europe

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1. Introduction

Within the framework of the Europe 2020 Strategy for a smart, sustainable and inclusive economy the European Commission has launched a so-called flagship initiative for a resource efficient Europe. The President of the European Commission, José Manuel Barroso stated in the accompanying press release:[1]

> Continuing our current patterns of resource use is not an option. They put too much pressure on our planet and make our economy more dependent on external supplies. A smarter use of scarce resources is therefore a strategic necessity, but also an economic opportunity. Through more resource efficiency, clearer long-term policies and joint investments in green innovation, we are strengthening the basis for growth and jobs for our citizens and delivering on our climate and energy objectives.

With the flagship initiative the European Commission intends to create a common vision to support a long-term perspective for an efficient use of natural resources. The Commission plans to launch strategies and effective measures in the areas of climate change, energy, transport, raw materials, agriculture, fisheries and biological diversity.

The European Commission's cross-cutting approach seems to reflect the findings of the latest state-of-the-environment and outlook report by the European Environment Agency which reveals an 'enhanced understanding of the links between environmental challenges, combined with unprecedented global megatrends. This has allowed a deeper appreciation

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1. See: `http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/63&format=HTML

of the human-made systemic risks and vulnerabilities that threaten ecosystem security, and insights into the shortcomings of governance' (EEA 2010). Finally, the EEA and the European Commission seem to be turning away from incremental environmental analysis and moving towards a more profound investigation of root causes and possibly a systemic transformation of the EU economy. The fact that the flagship initiative was launched not only by the Directorate General for the Environment, but by the President of the Commission, who has announced initiatives across different policy areas, seems to be a promising start. It remains to be seen whether the European Commission can muster the necessary competences and leadership needed to bring about a resource-efficient Europe.

The ultimate proof will be whether the EU manages to decouple resource use from economic development to such an extent that it decreases the pressure on the global environment in absolute terms. So far, the various EEA assessments of the state of the environment have revealed that the European Union has developed consumption and production patterns which impose unsustainable levels of pressure on ecosystems in Europe and other parts of the world. The flagship initiative promises to 'define medium and long-term objectives and means for achieving them with the main aim of decoupling economic growth from resource use and its environmental impact' (European Commission 2011).

The coupling of economic growth and resource use has become an essential part of our industrial history, our way of life and economic development as we know it. Thus, the flagship initiative seems to have introduced something new and even revolutionary. Is the management of natural resources a new competence of European Union? What is the extent of the EU resource use? What would an improvement in resource efficiency mean for the competiveness of the EU economy? What would a transition towards a resource-efficient economy require? To answer these questions, we need a deeper understanding of what consumption of natural resources really means for the European way of life and the EU economy.

This chapter reflects on the flagship initiative for a resource-efficient Europe of the Europe 2020 strategy. It starts by describing the dependence of industrialised countries on the exploitation of natural resources and attempts to convey the size of EU resource consumption by presenting

the results of EU-wide material flow accounting. The relation between competitiveness and resource consumption is briefly explained. After the description of the state of resource consumption in the EU and its economic implications the chapter proposes ways in which a transition towards a more resource-efficient Europe could be prepared with the policy instruments of the European Union.

2. A material world: the coupling of economic growth and resource use

We live in a material world. The satisfaction of basic needs, our well-being and often our social status depend on what we own and consume. Being rich and powerful is often displayed by means of material goods such as large houses, fast cars, extravagant food and fashionable clothes. In the industrialised world, consumption of material goods is driven by much more than need. To a large extent it has become an end in itself (Fromm 2005).

Many people are preoccupied or even possessed by the pursuit of material happiness, which may be caricatured as the accumulation of things we don't need with money we don't have in order to impress people we don't care about. Indeed, the egalitarian access to material wealth can be seen as one of the driving forces behind the European model of social partnership. However, even though many Europeans still feel disadvantaged the majority of the people in the world have to cope with much worse material deprivation: they have insufficient shelter, not enough or low quality food and insufficient access to clean water.

In the industrialised world, the material goods that help to cover basic needs are usually taken for granted. EU citizens have managed to acquire a material status that allows almost everyone to live decent dwellings, with electricity, plenty of food and water from the tap. Europeans are connected to a material- and energy-intensive infrastructure of roads, railways and electronic communication. Hunger has become rare. Much more common is material wealth and even abundance to the point of decadence. To indulge in material luxury is advertised and displayed by the mass media as a desirable state of being and has become a powerful driving-force of our economy.

3. The materialisation of wealth

In Europe, material abundance and waste of natural resources is no longer confined to the rich. Industrialisation and economic growth have allowed society as a whole to participate to a large extent in a lifestyle characterised by a relatively high degree of material wealth. The economic growth model was the basis for social reconciliation between the capitalists and the working class. In industrialised countries it was coupled with growth in material flows of enormous proportions. The case of the United States of America well illustrates the increase in material flows during the past century (Wagner 2002). At the beginning of the twentieth century, the US economy required about 200 million tons of raw materials. At the end of the century, the US economy consumed more than 17 times more resources: about 3.5 billion tons of minerals, metals, biomass, sand, stone and other materials were being consumed to keep the US economy running. More than the growth of the US population it was the increased productivity of the economy during the twentieth century that required more raw materials. The American way of life allowed the average citizen a standard of living unprecedented in history. Economic growth went hand in hand with a series of technological innovations. The 'modern times' of capitalism – as portrayed by, for example, Charlie Chaplin – came to be synonymous not only with the products of the car manufacturer Ford, but also its production process, which came to be known as 'Fordism' (Gottl-Ottlilienfeld 1926). More and more raw materials could be turned with increased efficiency into more and more consumer goods.

The mechanisation of the production process was mirrored by the technological inventions that considerably improved life and working conditions within households. Washing machines, refrigerators, different generations of ovens (from gas to microwave) and a multitude of other electronic helpers allowed a degree of comfort enjoyed in previous centuries only by the nobles. But even the most powerful emperor could not enjoy the luxury offered by what have become standard consumer goods such as TV sets, water closets or vehicles powered by the equivalent of dozens of horses.

The speed of material innovations was as remarkable as the speed with which people took them for granted. Unprecedented innovations and their material basis became the foundation of prosperity and progress, but one cannot assume that this can continue forever.

4. Early warnings

Public confidence in eternal economic growth was shaken in the early 1970s. From 1972 until 1974 commodity prices increased steeply, driven primarily by the oil crisis. Public concern in the oil-dependent industrialised world rose accordingly. A landmark publication was the study *Limits to Growth* by Donella and Dennis Meadows, published in 1972 by the Club of Rome (Meadows 1972). The study was based on scenarios showing that dwindling supplies of natural resources were a threat to global economic development.

Since then, prices of natural resources and public concern about their use have oscillated at a high level, although it has turned out that the negative impacts of resource use – for example, climate change and loss of biodiversity – are of more concern than the scarcity of resources. Nevertheless, a number of scholars have stressed that a more systemic understanding of the relations between the rapidly growing economy and its physical basis is needed. Robert U. Ayres drew attention to the 'industrial metabolism', proposing a more systematic accounting of material use (Ayres 1978) (Ayres & Simonis 1994). Others followed and managed to measure resource dependency from the economic macro level (whole economies) down to the micro level of single products (Moriguchi 2007). In the context of the emerging industrial ecology and ecological economy a number of scholars have discussed the need for fundamental changes in human development and the economy. A prominent example was a senior economist of the World Bank, Herman Daly, who proposed a steady state economy as an answer to the physical limits of economic growth (Daly 1973). Eventually, Schmidt-Bleek proposed a fundamental dematerialisation of the economy by decoupling economic development from material consumption (Schmidt-Bleek 2006).

The fundamental insight that humanity and society are constrained by their physical basis has a much longer history. In 1798, Thomas Malthus warned that geometrical growth of the population would ultimately be limited by the arithmetical growth of food production (Malthus 1798). Fifty years later, the Great Famine in Ireland during which hundreds of thousands of people died or emigrated showed the grim reality behind Malthus's theories. The introduction of artificial fertiliser in the succeeding decades considerably increased harvests and made it possible to feed the rapidly expanding population of Europe during early industrialisation. With his invention of artificial fertiliser German chemist Justus

Liebig proved that technological innovations and fossil energy can help to expand – to a certain degree – the limits of nature. Around the same time, in 1866, Ernst Haeckel created the concept of ecology (Haeckel 1866). According to his definition, ecology is the science of living beings and their connectedness to their natural environment by physical and energetic exchange processes (metabolism). From an ecological point of view, the sustainable use and management of resources is of fundamental importance for the development of societies and humankind in general. The essential role of resources for the development of societies in history had already been pointed out in the first half of the twentieth century by Karl Wittfogel (Wittfogel 1981). He described the collective control of water as one of the distinguishing features of the totalitarian states that flourished in the stone-and-copper age. He claimed that having control of scarce natural resources is equal to controlling society.

In fact, many historical developments are connected to alterations of the physical basis of human development. For example, the settlement of major civilisations along rivers; the rise and fall of the Polynesians; the industrialisation of coal mining regions; and the Gulf wars of our times have a physical background, reflecting dependence on natural resources. Even the foundations of the European Union can be traced back to an institution for the joint management of natural resources: the European Community for Coal and Steel. The institutional predecessor of the European Union was founded in 1951 by Belgium, Germany, France, Italy, Luxemburg and the Netherlands. Main objective of the European Community was to secure peace by joint management of coal and steel. The founders of the European Union understood that natural resources were not only key to the post-war reconstruction of Europe and its economic prosperity, but also for its peaceful development. According to French foreign minister Robert Schuman the aim was to 'make war not only unthinkable but materially impossible'.

5. Resource use in the European Union

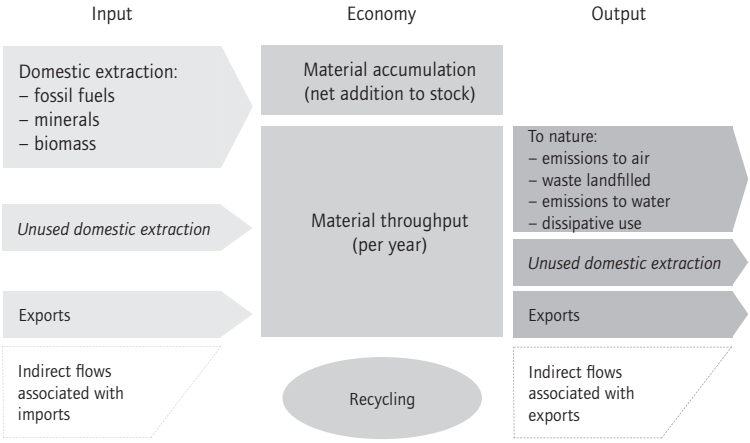
Although the joint management of natural resources was a prominent motive for the founders of the European Union it is of little importance for contemporary EU decision-makers. In general, interest in the sustainable management of natural resources is low. Consequently, neither the EU nor its member states have invested significantly in developing a sound knowledge base for a resource-efficient Europe. Nevertheless,

what we already know is sufficient to make decisions leading in the right direction (Schepelmann, Schütz, *et al.* 2006).

A time series of the US flow of raw materials during the twentieth century was compiled by the US Geological Survey. The EU, on the other hand, does not even have a geological survey. In general, the data on the EU's resource consumption are dispersed and the collection of data and the establishment of a knowledge base have been core objectives of the European Commission's Thematic Strategy for the Sustainable Use of Natural Resources. An essential foundation of a knowledge base on the consumption of natural resources is so-called material flow accounting (MFA). Some basic figures on material flows may illustrate the extent of resource use in the European Union.

In cooperation with EUROSTAT the OECD has prepared methodological guidelines for material flow accounting for their member states. An overview of accounting economy-wide material flows is given in Figure 1, while Table 1 lists a number of indicators applied by European statistical services.

Figure 1 **Economy-wide balance scheme**



Note: Water flows are excluded because they represent enormous mass flows (one order of magnitude more than all other materials). Accounts for water flows should therefore be drawn up and presented separately (Eurostat 2001). Air is omitted for the same reason. Emissions to soils are included in the category 'dissipative use'.
Source: Eurostat 2001.

Table 1 **Macro-indicators for material flows**

Indicator	Formula	Subject
Total Material Requirement (TMR)	DMI + indirect flows	Domestic and imported resources, including their 'ecological rucksacks', which are required for domestic production and consumption
Total Material Consumption (TMC)	TMR – (exports + indirect flows of exports)	Domestic and imported resources including their 'ecological rucksacks', which are required for domestic consumption only (excluding exports)
Direct Material Input (DMI)	Domestic material used + imports	Domestic and imported resources without 'ecological rucksacks', which are used for domestic production and consumption
Domestic Material Consumption (DMC)	DMI – exports	Domestic and imported resources without 'ecological rucksacks', which are used for domestic consumption only (excluding exports)

Most meaningful is the indicator Total Material Requirement (TMR). It not only accounts for natural resources extracted and used within an economy, but also for the so-called 'ecological rucksack'. The 'ecological rucksack' measures hidden material flows connected to the extraction of natural resources. If these indirect material flows are not accounted for it is not possible to assess the increasing environmental pressure connected to trade. For example, if a European contemplating marriage buys a platinum ring, it requires the import of about 4 grams of platinum. Thus, the indicator Domestic Material Consumption (DMC), which Eurostat currently applies, would account for 4 grams of domestic use of platinum. The primary production of 1 gram of platinum is connected to the flow of about 600 kilograms of materials by mining activities and the use of fossil fuels (Saurat & Bringezu 2008). Thus, the 4 grams of imported materials would induce hidden flows, which would be about 600,000 times larger than the final product. The 600 kilograms of overburden, mining wastes and fossil fuels indicate significant environmental destruction at the mining site and beyond. The Blacksmith Institute and the Green Cross (2011) associates mining activities with the worst pollution in the world. Especially in developing countries mining activities are also connected to a number of relevant social and workers' rights

issues. It is therefore relevant not only to measure the direct material consumption of the European Union, but also to take into account the so-called 'hidden flows' triggered by European consumption and production patterns. This would result in the Total Material Requirement (TMR) of the EU, which has reached a considerable size. According to (Schepelmann, Schütz, *et al.* 2006) the EU25 had an annual Total Material Requirement of about 22 billion tons. This would be equivalent to a freight train about 9 million kilometres long. Such a hypothetical freight train with 27 billion wagons would have a length equivalent to 222 times the earth's circumference.

Material flows are indispensable for a number of European industries such as building and construction, the food industry, the metal processing industries, the energy sector and the car industry. In Germany, about 50 per cent of all direct and indirect resource demand results from these five sectors.

The EU economy is increasingly dependent on resource imports from other world regions. Not only imports of metals, oil and gas need to be secured, but also critical metals such as antimony, gallium, germanium, indium, platinum and others. High-tech industries, in particular the information and communication sector, will be affected by declining availability of precious metals. Also eco-innovations such as photovoltaic or electric cars will be determined by the availability of gallium or lithium. It can be expected that worldwide competition for these resources will increase significantly in the near future. An increased awareness of the importance and value of the material dependency and vulnerability of the EU economy is needed. With the European Community of Coal and Steel, joint management of natural resources was the cradle of the European Union. It is high time that today's political and economic leaders rediscovered the importance of natural resources and material flows for the functioning of the EU economy.

6. Competitiveness and productivity in the EU

The founders of the European Community of Coal and Steel understood that the EU's industrial base depends on secure material flows. The economy has changed since then and so has the relevance of different materials for the functioning of the European economy. But even though products and materials have changed, access to affordable natural re-

sources is still a prerequisite for manufacturing. Therefore, resource efficiency affects the European economy as a whole. On the one hand, the efficiency of resource use will influence demand, which will affect the prices of global commodities. On the other hand, resource efficiency decreases dependence on external suppliers. From an ecological point of view a smaller throughput of natural resources will put less pressure on the earth's carrying capacity. Thus, resource efficiency is one of the key challenges for the future of the EU's economy.

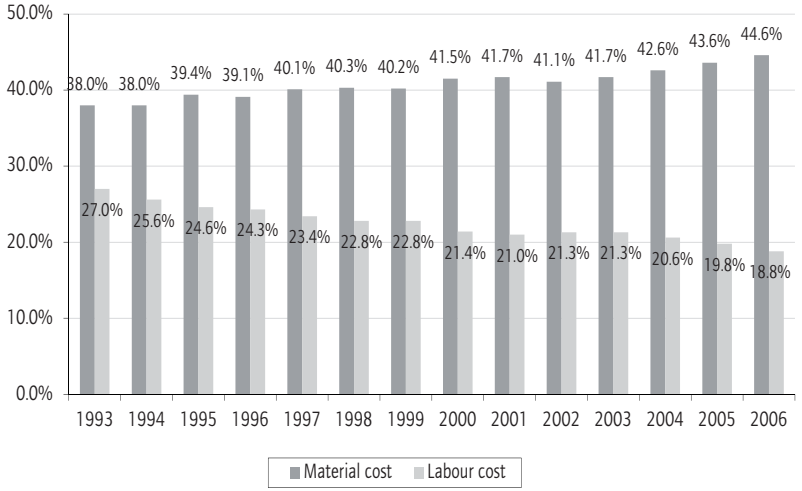
These general assumptions also have concrete implications for meeting the EU's economic targets. For example, one of the paramount objectives of the Lisbon Strategy and Europe 2020 is improving the competitiveness of the EU industry. There is no indication of a trade-off between the environmental objective of resource efficiency and the economic objective of competitiveness. Bleischwitz, Steger *et al.* (2009) have even shown a correlation between competitiveness and resource productivity. This has been expressed in a positive relationship between the Growth Competitiveness Index,[2] as measured by the Davos World Economic Forum, and resource efficiency (Domestic Material Consumption, DMC, divided by Gross Domestic Product, GDP): the most competitive industries are the most resource efficient, and vice versa.

The correlation between resource productivity and competitiveness calls for more in-depth research to establish sound causal explanations. However, cost arguments could explain the positive correlation. Manufacturing companies that use fewer natural resources have smaller production costs. Actually, the use of fewer materials in the value chain offers three major saving opportunities: first, a resource-efficient company would have to pay less for buying resources on the world market; second, the company would have to transport and process less mass within the production chain; and third, the company would pay less for recycling and/or depositing the resulting waste.

The higher the prices of resources become, the more relevant is resource efficiency for the overall cost structure of manufacturing industries. This

2. The Growth Competitiveness Index is supposed to measure the competitiveness of economies. It has been developed by the World Economic Forum and consist of three indices for 'technology', 'public institutions' and 'macro-economy'. These indices are based on a combination of data (for example, on inflation) and surveys (for example, the so-called 'Executive Opinion Survey'). Both data sets can be accessed at: http://gcr.weforum.org/gcr2010/

Figure 2 **Development of material and labour costs in German manufacturing industry**



Source: Federal Statistical Service (2008).

argumentation can be supported with national data from Germany. According to the German Federal Statistical Office the share of material costs in German manufacturing industries increased from 37 per cent to 43 per cent between 1995 and 2006, while labour costs decreased from 25 per cent to 18 per cent (Bleischwitz *et al.* 2009; see Figure 2).

These figures imply that for reducing costs in manufacturing industries resource costs have become more significant than labour costs. We may assume that natural resources have also become more relevant for improving overall competitiveness.

This has major implications for any economic strategy seeking to improve competitiveness, regardless of whether it would be on the macro level of the Europe 2020 Strategy or the micro level of individual companies. It would certainly require a major revision of established economic thinking as it is still the prevailing opinion among CEOs and other economic decision-makers as well as their consultants that labour offers the highest potential for reducing production costs. Nevertheless, the data from Germany suggest that this widespread notion needs to be revised, at least in manufacturing companies that process large amounts of

expensive natural resources (for example, steel processing industries). Thus, strategies for resource management have the potential to put less pressure on labour. Econometric calculations on the macro level have even shown large positive effects of resource efficiency strategies on employment (Meyer *et al*. 2007).

In 2006, former German Minister of the Environment, Sigmar Gabriel, at the first joint conference of the German Federal Ministry for the Environment and the German Metalworkers Union, IG Metall, said of resource efficiency: 'Our joint demand is that before cutbacks in staff and firing of workers and employees are considered, allegedly to improve competitiveness, it is better to ask the numerous clever engineers and managers to develop strategies to improve materials and energy productivity' (Bundesministerium für Umwelt Naturschutz und Reaktorsicherheit *et al*. 2006, author's translation).

At the microeconomic scale of individual companies there are many examples of successful strategies for improving resource productivity, such as by closing water cycles, reducing energy and material costs and improvements in material quality.

Although the relevance of cost arguments increases with rising prices for natural resources such as oil or minerals and metals, resource dependency in the EU and its member states is still growing. Despite striking differences between countries, resource productivity is increasing more slowly than GDP (Bleischwitz & Steger *et al*. 2009). The annual average improvement of resource productivity indicates that further innovation is needed to meet the annual 3 per cent target formulated by the European Commission in the Thematic Strategy for the Sustainable Use of Natural Resources. To meet the target, there must be investment in technologies, know-how and services for improving the overall resource productivity of European economies.

7. From environmental policy towards a European transition agenda

European environmental policy can boast a number of success stories. Compared to the 1970s, when most European citizens first became aware of environmental problems, the European Union has achieved what Article 2 of the EU Treaty refers to as 'a high level of protection and

improvement of the quality of the environment', notably in the areas of water and air quality. The European Union has been a driver of progress by passing ambitious environmental legislation. The main thrust of this legislation has been reactive, aimed mainly at the 'end-of-pipe'. EU pollution control has led to substantial investments, for example, in air filter and waste water treatment installations. According to the European Commission's estimates for two decades (1990–2010) the implementation of seven directives in the area of water and air protection required capital expenditure of around 230 billion euros, with annual operating costs of around 10 billion euros (Andrews *et al.* 2000). These investments in air and water protection have not only improved the quality of the environment, but have also created around 300,000 jobs in a highly competitive European eco-industry.

The reactive 'end-of-pipe' approach of traditional environmental policy has been expanded against the background of climate change and other profound global challenges of the twenty-first century. While climate change mitigation policies were induced by the consumption of fossil energy carriers it has become more and more evident that not only the consumption of resources for energy production needs to be reduced and changed, but that the whole 'diet' of industrial societies is not sustainable. Closer investigation of the industrial metabolism reveals that the resource requirements of industrial societies are in many areas too large, too dirty, economically unfair, socially exclusive and a threat to global security. The cultural, social, economic and technological innovations that are required to meet the challenge of a transition towards a sustainable industrial metabolism will also offer new growth and employment opportunities. If they are well prepared, these opportunities will most likely be much larger than the economic opportunities that have already been realised with 'green growth' strategies connected to traditional 'end-of-pipe' environmental regulation.

Although the EU flagship initiative might introduce a new generation of more profound transition policies there is still room for improving the implementation of existing joint Community legislation. Even though it has resulted in a healthier environment and better protection of habitats in the European Union, there is still a considerable gap between the 'old' and the 'new' member states. This is not only true for Central and Eastern European countries but also with regard to the southern EU member states. In order to protect the landscape and biological diversity of Europe, and for more harmonious implementation of the environmental

acquis communautaire, the European Union will have to strengthen environmental cohesion between south, north, west and east.

From past experience with high environmental standards lessons could be drawn with potential implications for economic development in the new EU member states and candidate countries.

On the one hand, the successful environmental clean-up in Europe shows that ambitious environmental standards and economic success are not at odds. On the contrary, the richest nations seem to have the highest standards. On the other hand, traditional pollution control tends to be a very cost-intensive exercise. The strategy 'get rich first and clean up later' has proven to be short-sighted because it shifts costs to future generations. It seems more intelligent to prevent damage from occurring in the first place. In this light it would be advisable to re-evaluate the European model of industrialisation and environmental protection. This could create an opportunity to learn from mistakes, avoid damage to nature, human health and the economy and shape a more cost- and resource-efficient environmental policy.

End-of-pipe solutions seem to be the most cost-intensive option because the economy suffers from damage inflicted on nature and human beings and, in addition, will have to pay to put things right. Therefore, it makes more sense for environmental policies to try to move away from end-of-pipe solutions by tackling environmental problems at their root. For example, SO_2 and NO_x emissions from the burning of fossil fuels can be reduced by expensive filter technologies. A more advanced solution is to improve energy efficiency by reducing the consumption of fossil fuels. This would not only reduce the costs of buying fossil fuels, but would also reduce SO_2 and NO_x emissions (including emissions that cannot be filtered, for example, CO_2).

These systemic considerations require a different kind of policy design. In the case of energy efficiency, the implementation of stricter standards would not only affect environmental policy, but also other non-environmental policy areas, such as housing, mobility and industrial development.

Thus, a resource-efficient Europe would require ambitious environmental standards and strict regimes of implementation, but also the transformation of consumption and production patterns, resulting in struc-

tural change in virtually all economic sectors. Such a structural change would require massive public investments in infrastructure and production facilities. As the European Union is a complex multi-level governance system, political compromise is often difficult to achieve, especially when linked to a substantial allocation of funds. A sustainable transition agenda would have to be integrated within the existing strategies and instruments. In addition, it would require development and adjustment of targets, timetables and monitoring mechanisms. Furthermore, the existing arsenal of research and technological as well as financial instruments would have to be considered. Therefore, a quick overview of the main EU strategies, programmes and policies that will be affected by a transition agenda towards a resource-efficient Europe is required.

– *strategic objectives and indicators* defining the broad guidelines of EU policies;
– *policies* setting the framework for the economies of the EU member states and initiating structural interventions;
– *programmes* with the potential to stimulate resource efficiency.

8. Strategic objectives and indicators

At the strategic level, a guiding vision is still lacking for a transition towards a resource-efficient Europe. So far, the Lisbon Strategy has been the most prominent attempt to define strategic economic objectives and indicators for the European Union as a whole. Adopted in March 2000, the Lisbon Strategy aimed at making the EU the world's most competitive knowledge-based economy, with sustainable economic growth, more and better employment opportunities and greater social cohesion. The Strategy was accompanied by a set of so-called Structural Indicators. The choice of Structural Indicators was based on previous procedures and they were used for two purposes:

(i) monitoring progress in both achieving the identified targets and implementing policies; and
(ii) assessing the effectiveness of policies.

While the first goal can be easily achieved, evaluating the implementation of measures is not well developed in the EU and most of its member states.

In March 2001, the European Council expanded the scope of the structural indicators from purely socio-economic objectives to sustainability. The main objective of this broadened scope was to find out how eco-industries could promote growth and employment. Thus, in October 2001, the European Commission proposed new environmental indicators, which were approved in December 2001 by the European Council in Laeken.

After the Lisbon Strategy the first Sustainable Development Strategy (SDS) was agreed at the European Council in 2001. Subsequently, in 2005, the revised SDS formed the basis for working towards effective responses to global development risks.

Most of the social issues addressed in the SDS are persistent social, economic and environmental problems which require structural changes in society. Therefore, the SDS can be considered a long-term strategy for the EU.

The renewed Strategy adopted by the European Council addresses seven key challenges:

(i) climate change and clean energy;
(ii) sustainable transport;
(iii) sustainable consumption and production;
(iv) conservation and management of natural resources;
(v) public health;
(vi) social inclusion, demography and migration;
(vii) global poverty.

In February 2005, the European Commission adopted a set of sustainable development indicators (SDIs) for monitoring the implementation of the Sustainable Development Strategy (SDS).

In order to group the 155 or so SDIs, Eurostat proposed a multi-layer system with three levels:

(a) Headline indicators for initial policy analysis and monitoring progress towards headline policy objectives. They are intended for high-level policy makers and the general public.
(b) Indicators to support the evaluation of core policy areas and more detailed monitoring of progress in achieving headline objectives. They are constructed for policymakers and the general public.

(c) The third level is supposed to be used by a more specialised audience for further policy analysis and better understanding of the trends and complexity of issues associated with the themes or interlinkages with other themes in the SDI framework.

The question is whether the Structural Indicators or the SDI could be used to guide and monitor a transition to a resource-efficient Europe. Both indicator systems are so broad that they seem able to reflect sufficiently different political agendas, including resource efficiency. In fact, their political inconsistency is one of their weaknesses. To some extent, the SDI and the Structural Indicators overlap. This overlap is symptomatic of a weakness in the Sustainable Development Strategy (SDS) and the SDI, which indicates a lack of policy coherence.

It is not clear why the European Commission has developed both the Lisbon Strategy and the Sustainable Development Strategy with indicator systems more or less in parallel. The strategies and indicator systems seem to reflect the complexity of EU policymaking rather than the simplicity of a single political agenda. To achieve the necessary policy coherence three options are available:

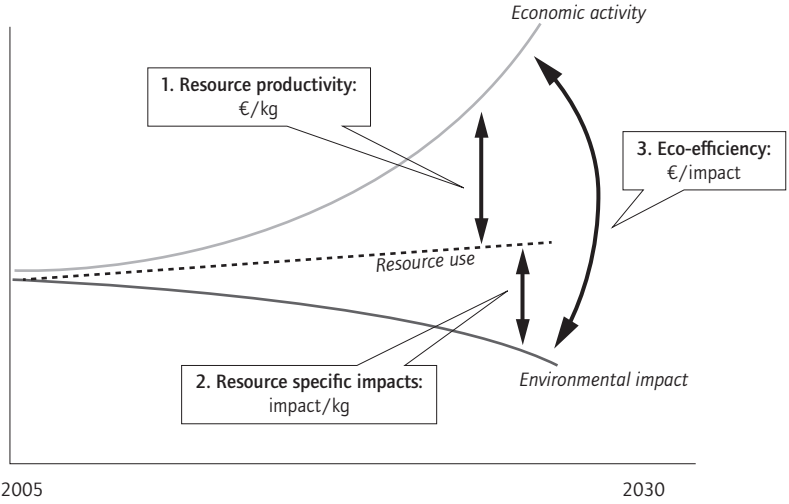
(i) a better and more transparent justification for the concurrency between the two strategies and corresponding indicator systems;
(ii) the abolition of one strategy and indicator system; or
(iii) the merger of the two systems into a comprehensive overarching strategy and indicator system for (sustainable) social, economic and environmental development.

It is still unclear whether the EU's Europe 2020 Strategy will follow one of these options or whether it will be yet another 'overarching' strategy, one that simply adds to the existing inconsistency rather than reducing it.

In addition to resolving the inconsistency of political leadership, SDI and Structural Indicator systems need further development and harmonisation. Nevertheless, the complex and highly valuable indicator systems could be used immediately to monitor a transition towards a resource-efficient Europe. For example, modes of transport, energy and resource productivity are already covered by the best available datasets of Eurostat and other European agencies.

The overall guiding objective for a resource-efficient Europe is an improvement in the energy and material productivity of the EU economy. In this context, the European Commission expects to combine the objective of improving resource productivity by decoupling resource use from economic activity with the aim of an absolute reduction in resource-specific impacts, as shown in Figure 3.

Figure 3 **Decoupling economic activity, resource use and environmental impact**

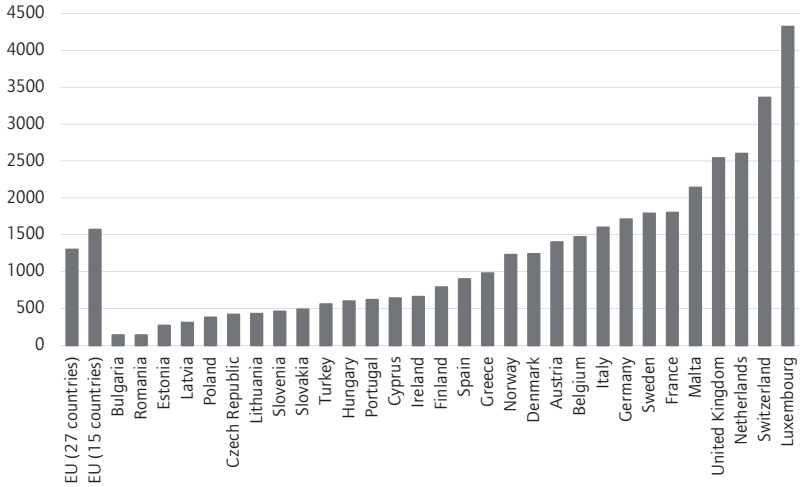


Source: European Commission (2005).

Already, Eurostat reports regularly on the EU's resource productivity by measuring the relationship between the economic growth (GDP) of the member states and their Direct Material Consumption (DMC). Although the reporting needs improvement and deeper analysis, it gives an impression of the magnitude of the challenge involved in overcoming the divide in resource-productivity among EU member states (Figure 4). Currently, the worst performer uses more than 30 times more resources per unit of GDP than the most resource-efficient economy. Compared to the EU27 average the worst performer is still more than a factor of eight behind. In other words, the most resource-intensive economy in the EU could save more than 80 per cent of its resources per unit of GDP if it had average EU production and consumption patterns. The comparison on

the macro level only looks at the symptoms and does not reveal the causes of high or low degrees of resource productivity. For example, service industries require less resources than manufacturing industries. Economies with renewable energies require less materials than those which depend on a steady input of fossil energy carriers. Thus, a resource-efficient Europe will require a diversity of strategies, which take regional characteristics of consumption and production patterns into account. Nevertheless, the country comparison in Figure 4 reveals huge potential for improvement, especially in Central and Eastern Europe.

Figure 4 **Resource productivity in the EU27, 2008**



Note: Gross National Product (GDP) by Domestic Material Consumption (DMC) in 2008.

Source: Eurostat (2011).

9. Policies

Consistent and integrated policies are required to initiate a transition towards a resource-efficient Europe. According to the European Commission, in 2009, 10 per cent of the total EU budget was allocated for environmental purposes. This pales in comparison to the 80 per cent spent on Regional Policy and the Common Agricultural Policy (CAP). In 2009, CAP spending was around 60 billion euros.

A transition towards a resource-efficient Europe would not only improve agricultural production but also minimise external inputs such as chemicals or fertilisers. A green CAP could guarantee high quality and healthy food, safety of food supply as well a high level of environmental protection and nature conservation through productive reorganisation and a high level of sustainable technological innovation.

Since 2007, half of the EU budget has been dedicated to structural intervention within the framework of EU Regional Policy. According to the European Commission, between 2007 and 2013 the total amount of Structural and Cohesion Funds allocated to environmental activities has doubled compared to the previous funding period to around 100 billion euros (30 per cent of total spending). Half of this investment will be devoted to end-of-pipe technology, nature protection and risk prevention. The other half will be spent on indirect investments with an impact on areas such as transport and energy systems, eco-innovation, environmental management for business, urban and rural regeneration and ecotourism. As Schepelmann *et al.* (2009) have outlined, EU Regional Policy could boost overall resource efficiency primarily in resource-intensive CEE industry. However, in reality most of the budget is still primarily dedicated to end-of-pipe environmental protection.

EU member states and regions could be motivated to adapt national stimulus programmes to the objective of improving national resource efficiency, which is already monitored via the Sustainable Development Indicators. Linking EU cohesion funding with national green stimulus programmes, which have emerged in the wake of the 2008 financial crisis and monitoring with EU Sustainable Development Indicators would address two persistent problems of EU Regional Policy: a lack of co-funding and accountability. Using the established Cohesion Funds and reporting mechanisms for monitoring regional policies for improving resource efficiency could allow the Community to implement a transition towards a resource-efficient Europe immediately.

10. Programmes

The European Union already has a number of programmes dedicated to key elements of a transition towards a resource-efficient Europe. The central role of these programmes, combined with other instruments, has been described by Bleischwitz *et al.* (2009) in a study commissioned by

the European Parliament´s Committee on Industry, Research and Energy (ITRE).

The *Competitiveness and Innovation Framework Programme (CIP)* is intended to boost the competitiveness and productivity of European industry, and to promote innovation activities by financing and delivering business support services. The programme period runs from 2007 to 2013 with a budget of 3.6 billion euros.

The CIP is divided into three operational programmes:

(i) *Entrepreneurship and Innovation Programme (EIP)*. The main objectives of the EIP are to support SME start-ups, cooperation and innovation. The four environmental priority areas are material recycling, building and construction, food and drink, greening business and 'smart' purchasing. EIP accounts for around 60 per cent of the total CIP programme.
(ii) *Information Communication Technologies Policy Support Programme (ICT PSPS)*, which would not be a priority area for preparing a transition towards a resource-efficient Europe.
(iii) *Intelligent Energy Europe (IEE)*. The main aim of the IEE programme is to support the use of renewable energy sources and the rational use of energy. It promotes changes in legal and societal framework conditions for initiating change (optimal implementation and preparation of legalisation). The work programme stresses that projects have to be built on well-tested strategies and technologies, and aim to remove non-technological market barriers and to develop new approaches. Keywords of the IEE are 'market transformation' and 'changes of behaviour'.

The *Seventh Framework Programme for research and technological development (FP7)* is the largest research programme in the world. It bundles all research-related EU initiatives together to develop the European Research Area (ERA). It consists of four basic components: cooperation, ideas, people and capacities.

Collaborative research constitutes the core of EU research funding. Within the ten distinct themes of the FP7's 'cooperation' component, several are closely related to central aspects of a resource-efficient Europe such as environment, social science and humanities, nanoproduction, energy, food, agriculture, fisheries and biotechnology.

For a European transition towards a resource-efficient Europe the *Environmental Technology Action Plan (ETAP)* is of particular importance because it is specifically intended to stimulate the development and uptake of environmental technologies on a large scale. It encompasses central aspects of the innovation cycle in a sequence of 28 actions, which can be grouped in nine sections:

(i) research and development;
(ii) technology platforms and public–private partnerships (PPP);
(iii) verification of technologies: establishing networks of testing centres, drafting catalogues of existing environmental technologies;
(iv) definition of targets based on best environmental performance;
(v) mobilisation of financing;
(vi) reviewing Cohesion Funds, state aid guidelines, environmentally harmful subsidies and market-based instruments;
(vii) procurement of environmental technologies;
(viii) business and consumer awareness-raising and targeted training;
(ix) acting globally: promoting environmental technologies in developing countries and countries in economic transition via global financing opportunities and responsible investment and trade.

The dissemination of experiences is supported by national roadmaps and the envisaged Action Plan on Eco-innovation. ETAP's achievements are reported to the European Council and Parliament every two years.

ETAP was introduced in 2004 to remove obstacles preventing full exploitation of environmental technologies to protect the environment while contributing to competitiveness and economic growth (CEC 2004). It was hoped that ETAP would help to ensure a leading role for the EU in developing and applying environmental technologies and mobilising all stakeholders in support of these objectives. ETAP has already had some effect (Ecorys 2009) and the demand for environmental technologies continues to grow. Furthermore, ETAP is increasingly exploring resource efficiency. The Europe 2020 flagship initiatives for a resource-efficient Europe also have implications for ETAP. From an innovation and technology platform it could evolve into a platform from which the transition towards a resource-efficient Europe could be launched.

11. The transition to a resource-efficient Europe

The transition to a resource-efficient economy could be based on the lessons learned from five years of implementing the Environmental Technologies Action Plan, while at the same time broadening its scope from a technology to a transition platform (which could be referred to as the 'European Resource-efficiency Transition Action Platform').

The transition to a resource-efficient economy could reinforce and enhance ETAP in mobilising EU instruments across policy fields. This could further strengthen resource efficiency as a major source of employment and innovation. The flagship initiative for a resource-efficient Europe could improve Europe's industrial base by promoting entrepreneurship and the development of new skills along the value chain of manufacturing industries. Within the framework of the flagship initiative ETAP could mobilise the EU member states and other stakeholders to reinforce policies and action.

The ultimate goal of the flagship initiative for a resource-efficient Europe should be to firmly integrate resource efficiency as an essential part of EU policies, financial instruments, environmental sustainability and ecosystem approaches (Schepelmann *et al*. 2009).

The time is right to develop an ambitious European agenda for resource efficiency: pressing and persistent environmental challenges as well as the economic and social situation call for radical changes in the current economic model to make it more sustainable (Schepelmann *et al*. 2010). Environmental goods and services industries already contribute to economic growth and deliver new jobs and have the potential to become real drivers of economic progress and new job opportunities in the EU (Schepelmann *et al*. 2009). The transition to a resource-efficient Europe is a step forward from mere support for 'green tech' towards a systemic transition of EU economies. The transition to a resource-efficient economy requires revised and reinforced actions reflecting changed priorities as well as drivers and barriers. The ETAP actions should be stepped up and reinforced and additional financial resources would have to be mobilised, including the large financial flows of the CAP and Cohesion Policy.

The transition to a resource-efficient Europe can not only build on the achievements of the first five years of ETAP implementation but also on

the flagship initiative for an Innovation Union. The transition to a resource-efficient economy requires new actions to address systemic failures. Research and development need to broaden their scope by finding relevant answers to a number of systemic challenges. This will include not only a fundamental redefinition of progress and economic development beyond the simplistic GDP-based growth paradigm, but also practical questions for the implementation of the flagship initiative for a resource-efficient Europe. One central question, for example, is how modes of EU governance and social innovations can be combined in order to achieve the necessary transition effects. There are basically three modes of governance that can promote transition: markets, hierarchy and networks (Knill and Lenschow 2003). The market, with its 'invisible hand', coordinates stakeholders that try to maximise their individual benefits. Hierarchies in governments and industry are organised centrally on the basis of command-and-control. In networks, governance is based on negotiations. While failures of networks, the state and markets are broadly acknowledged, integrated solutions for pragmatic policies have been insufficiently explored (Meyer-Stamer 2009) and research and development are required.

Moving towards cleaner and more energy- and resource-efficient products and processes will imply a competitive advantage for manufacturing industries, irrespective of sector. This requires a broad policy-mix. For example, by 'getting the prices right' economic allocation mechanisms must be mobilised for a long-term transition of the European economy. In the short and medium terms, public authorities must strengthen underlying incentives if capital is to be deployed to cover the time gap and have the desired impact. Transition to a resource-efficient Europe must therefore give the right price signals for resource efficiency. There is no 'one-size-fits-all' solution. Targets, timetables and mix of governance modes will differ from sector to sector, depending on natural resources, stakeholders and regimes. For example, a transition to more resource efficiency in the context of the Common Agricultural Policy will differ from that in the chemical industry or the iron and steel processing industry.

The challenge facing systemic eco-innovation is enormous as it requires the coordination of research and development, economic stakeholders and political decision-makers at all levels of governance.

12. Elements of a resource-efficient Europe

Resource efficiency should be embedded in a more comprehensive vision of a sustainable metabolism of industrial societies. According to Bringezu (2009) a future sustainable metabolism may be characterised by four paradigmatic and complementary perspectives:

(i) a resource-efficient and recycling-based industry;
(ii) the steady stocks society;
(iii) a solarised infrastructure; and
(iv) a balanced bio-economy which develops even further towards a 'bioniconomy'.

With the flagship initiative the EU might take the first steps towards what is referred to by Bringezu (2009) as 'a smart combination of dematerialization and rematerialization' which could drive innovation in a more sustainable direction. This could lead to a 'steady stocks society' with a dynamic flow equilibrium between material input and output to maintain the stock in buildings and infrastructure, which could be further equipped with solar energy-generating facilities (solarised infrastructure). The use of minerals could be complemented with biomass input to an extent compatible with other land-based and marine functions of biomass use (for example, food production). This balanced bio-economy could be further developed towards an economy based on technologies which apply bionic principles from nature (for example, industrial photosynthesis).

The dynamics and features of visionary elements which Bringezu (2009) has described may provide orientation for long-term technology and policy development. Kristof and Hennicke (2009) propose five core elements for realising the first paradigm of a resource-efficient and recycling-based industry:

(i) sustainable markets, which provide a direction for innovation;
(ii) strong institutions for successful diffusion;
(iii) resource-efficient products and services;
(iv) public procurement using market power and the example-setting function of governments as consumers;
(v) awareness raising.

Sustainable markets of the future – providing a direction for innovation

Markets should promote innovations with a focus on improved resource efficiency. Political arrangement of the market framework conditions should create incentives for the development of resource efficient innovations and reduce counter-productive incentives. As a result research and development would be oriented towards the development of resource-efficient products and services. Resulting innovations need to be introduced and established on the market. Diffusion in the EU and exports to international markets need to be supported by instruments such as trade fairs, market information and technology platforms. Existing research and technological development (RTD) programmes and technology platforms need adjustment to support resource-efficient solutions and their market diffusion.

Strong institutions – key to successful diffusion

Improving a company's resource efficiency is often difficult. Usually, companies lack the expertise and resources needed to implement resource efficiency measures. SMEs in particular have insufficient in-house capacity and often lack the time to launch resource efficiency measures. In order to realise efficiency potentials individual and specialist consultancy services are required. These can adapt to a company's specific situation and handle the whole process of restructuring. This kind of service requires a large pool of consultants. Experience from Germany has shown that an intermediate agent can successfully manage cooperation between companies and consultants. The German Material Efficiency Agency (Demea) and the regional NRW Efficiency Agency (EfA) inform public and private institutions about the necessity and benefits of improved resource efficiency, train consultants, provide access to them and manage knowledge networks to stimulate exchange and cooperation between different companies, consultants, sectors and regions.

Resource-efficient products and services

There are three options for political action to support resource-efficient products and services on the market:

(i) cutting-edge products need to be supported, especially in the phases of design and market introduction;
(ii) standards are needed to direct average mass market products towards improved resource efficiency; existing standards, such as the eco-design directive (2005/32/EC), should be upgraded by including resource efficiency requirements;
(iii) new resource efficiency standards should also contain minimum requirements for products on the market. As a result, products with old, resource consuming designs will be banned.

Government as consumer – setting an example and exercising market power

Strategic consumption can force markets towards more resource-efficient products and services. Governments usually have enormous market power since public procurement has a major share of total market consumption. Resource efficiency can be established as an important decision-making factor through specific public purchasing directives. This would also be an incentive to design resource-efficient products, since the commercial risk is limited by stable demand from public institutions. Moreover, governments can have a pioneering function. If resource efficiency is established and consistently applied, long-term cost advantages can be realised. The state can also set an example with regard to socially responsible behaviour.

Awareness raising and education

The four elements listed above can be realised only when people in institutions, companies and so on understand the importance and opportunities of improved resource efficiency. In order to raise awareness of resource efficiency all communication and education channels must be used. Students need to learn about resource-efficient consumer behaviour. Later on, they should be made aware of resource-efficient technologies and services and be able to get the necessary professional training. Furthermore, awareness-raising campaigns should be launched. Visualisation of the requirements and benefits of resource efficiency with best practice examples is essential to initiate learning processes. Resource-related communication and education must become part of everyday life.

13. Outlook

Improved resource efficiency can result in remarkable cost advantages, as well as benefits for the environment and public health and security of resource supply. However, it needs to overcome the inertia of a society and a market adapted and used to high levels of resource consumption. Therefore, political action on a large scale is needed. A transition towards a resource-efficient economy must introduce knowledge-based innovations. This will require the analysis of production and consumption sectors at the national, regional and international levels. This will be a prerequisite of developing an efficient, harmonised and target-oriented policy mix. As we have seen, the EU already has a large set of policies for initiating a large-scale transition of production and consumption patterns, but they need to be steered in the right direction.

Implementation of a resource-efficient Europe entails maintaining consistency between strategic objectives and indicators, coherent policies and effective programmes. Thus, the development of sustainable consumption and production patterns should be reflected at the strategic level, at the level of individual EU policies and at the programme level.

Like the European Coal and Steel Community, the success of the flagship initiative for a resource-efficient Europe depends on a bold vision and political consensus. It will need the continuous efforts of all stakeholders to build a resource-efficient Europe, but at the moment what is needed most of all is political leadership.

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