Ressourcen Politik

PolRess – Final Report

Innovation-oriented resource policy within planetary boundaries

Klaus Jacob
Stefan Werland
Lisa Graaf (FU Berlin)

Martin Hirschnitz-Garbers
Susanne Langsdorf
Mandy Hinzmann (Ecologic Institute)

Doris Bergmann
Thomas Lehr (EUSG)

Mark Meyer (GWS)

Gerd Scholl (IÖW)

Falk Schulze
Andreas Hermann
Friedhelm Keimeyer (Öko Institut)

Stefan Bringezu
Bettina Bahn-Walkowiak
Henning Wilts (Wuppertal Institut)

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PolRess – Resource Policy

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Contact at UBA

Judit Kanthak

Umweltbundesamt

E-Mail: judit.kanthak@uba.de

Tel.: +49 340 2103 2072

Contact research partners

Dr. Klaus Jacob

Freie Universität Berlin

E-Mail: klaus.jacob@fu-berlin.de

Tel.: + 49 30 838 54492

Research Partners:

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1. Preface

This report summarizes conclusions of the research project PolRess for the further development of the German resource policy. PolRess was commissioned by the German Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMUB) and the Federal Environmental Agency (UBA) and was carried out from January 2012 until August 2015 by a consortium consisting of:

- Freie Universität Berlin (Environmental Research Centre)
- Ecologic Institute
- European School of Governance (EUSG)
- Institute of Economic Structures Research (GWS)
- Institute for Ecological Economy Research (IÖW)
- Institute for Applied Ecology (Öko-Institut) and
- Wuppertal Institute for Climate, Environment, Energy.

During the project, instruments and strategic approaches of resource policies were analyzed from political, economic and legal perspectives. Furthermore, debates of different actors were analyzed and initiated. The findings of the project are documented in approximately 60 different discussion papers, all of which can be found on the project's website www.ressourcenpolitik.de.

In the following, the project team summarizes considerations and conclusions, which emerged of the conducted research and are meant to provide a stimulus regarding the further development of resource policy.

2. Resource Policy: Need for Action and Targets

Why should environmental policy address natural resources and especially the use of raw materials and materials after all? Should environmental policy not primarily target the prevention of harmful emissions and the safeguarding of a good environmental quality? Would not such an environmental policy be sufficient to sustain natural resources? A similar question could be raised for other issue areas: Climate policy not only addresses the amount of carbon dioxide in the atmosphere or emissions. It also considers the use of energy and energy sources, which constitute a decisive input for the economy and determinate the amount of emissions. The same applies for other natural resources that serve as input to the economy – the amount and quality of materials, land, water, soils and other natural resources used for economic activities is crucial for the impacts on eco systems and hence addressing the inputs to the value-added chain addresses the causal factors of environmental degradation.

From the perspective of environmental policy such an input-orientation is especially imperative with regard to materials: Their extraction, preparation, transport, processing, use and recycling are linked through each step of the value-added chain, be it through the use of energy, water, land, and other natural resources. These, in turn, impact the quality of eco-systems; contribute to climate warming or the loss of biodiversity. The scale of inputs in primary materials mainly determines the resulting output of wastes and emissions. Due to given spatial and technical patterns of resource supply, of production and consumption, as well as of waste disposal environmental effects of material flows can only be mitigated by reducing the input, for instance, through measures to improve material and energy efficiency or through recycling (Bringezu 2015). If a sustainable development has to take place within the limits of natural ecosystems, not only the availability of materials will have to be assessed, but also the environmental effects caused by their usage.

Besides the environmental impacts of raw materials usage, the availability and quality of natural resources need to be assessed from an economic perspective. Economic activities rely on natural resources: natural resources such as land, biodiversity, water or the climate yield ecosystem services, which are crucial for every type of economic activity. A number of studies estimates the volume of natural resources' ecosystem services, such as studies demonstrating costs of climate change (Stern 2006, IPCC 2014) or the ecosystem services of biodiversity (TEEB 2010). From this perspective a sustainable use of natural resources is not only required eco-politically, but also in order to sustain the economic capabilities.

The use of materials and resulting environmental impacts on further natural resources are nevertheless rising: on a global scale as a result of population growth and rising consumption levels (Krausmann, Gingrich, et al. 2009; Schaffartzik et al. 2014).,At the same time the specific environmental impacts per unit of material are increasing not least because growing demand and new extractive technologies facilitate the exploitation of as yet inaccessible resources or from low concentrations, making them technically viable and economically interesting (Mudd 2009). Furthermore, the increasing demand is served from regions and countries, where social basic needs are not secured, armed conflicts are waged over commodities or where such conflicts might even be financed by exporting raw materials (UN 2009). Finally, international trading of raw materials may be used for political gains and that limiting trade with rare raw materials as a means of exerting political pressure.

In Germany, the amount of domestic use of abiotic raw materials (such as construction materials, ores, industrial minerals, fossil energies, imports) declined by 14,4% between 1994 and 2012 (Destatis 2014). In contrast, the material utilization from abroad increased, which is caused indirectly during the production of import commodities. When taking into consideration that industrial production mainly takes place abroad and also considering that imported products consume raw materials during the production process, even though they might not be part of the end product (but are considered in the so called raw materials equivalents), the material utilization in Germany just declined by 5,3%. At the same time the gross domestic product increased by 27%. Both trends – the decrease of material utilization and the increase of value added – contributed to increase the raw material productivity by 49% (neglecting the relocation abroad). The goal of the Federal Government to double raw material productivity until 2020 is not being achieved as a result of business as usual, but requires additional efforts.

Compared internationally, these changes regarding raw material productivity take place at a high per-capita level in Germany. The mild decrease of raw material consumption per capita and the increase in resource productivity do not change this in substance (Bringezu and Schütz 2014). Furthermore, not only the unequal distribution per-capita use of raw materials but also the international unequal distribution of environmental pollution caused by extraction need to be addressed. Environmental impacts in developing countries are caused by the use of raw materials in industrialized countries. The value creation from material use takes place rather in later stages of the value chain, albeit in industrialized economies.

However, industrialized and emerging economies do have the technical capabilities needed to mitigate these problems. German providers of environmental friendlier technologies that avoid environmental pollution throughout the value chain dispose of considerable market shares (BMUB 2014).

Besides environmental reasons and the imperative of international fairness, economic reasons call for a reduction of material usage or at least for making it more efficient. The costs for material usage in manufacturing industries increased from 577 billion Euros to about 861 billion Euros between 2002 and 2013, on average constituting about 45% of the costs and being considerably higher than expenses for energy (2%) or labor (18%) (demea without year, destatis 2015). Therefore, from an economic perspective, an improved material efficiency entails substantial cost-saving potentials.

In terms of the macro economy, there are arguments supporting a more efficient use of materials. Germany has a number of resources at its disposal, especially energy resources, construction materials, minerals used by the chemical industry, and biotic materials. Regarding mineral ores as well as a number of important industrial materials, the German economy is dependent on imports (Werland 2013). The increasing international demand for such materials from emerging economies led to temporary rising and volatile prices on the commodity markets. Although the markets stabilized in the last few years and the supply of „critical“ materials seems to be secured, the question remains whether this will be the case in the future or if the prices and availability of raw materials will remain volatile. Improving efficiency at the recycling level and increasing the usage of secondary resources are therefore necessary, too. Last but not least, rapidly growing global markets can be supplied by marketing innovative, resource efficient technologies. The global total volume of markets for resource efficient products, technologies, and services was estimated at about 1 trillion EUR in 2011 and despite of the international economic crises has increased even more rapidly than anticipated (von Geibler, Rohn, et al. 2011; BMUB 2013).

In conclusion, there are several different reasons supporting a reduction of material usage and an increase in resource efficiency. These reasons are reflected in the various facets of public debates addressing resource efficiency (Jacob, Werland, et al. 2013). From the viewpoint of a sustainable development which aims to assure the natural livelihoods the central motive of resource policies should be a reduction of environmental impacts caused by resource extraction its usage throughout the value-added chains until recycling. Ultimately, natural resources are needed for any sort of economic activity, therefore constituting the boundaries of social and economic development.

In the light of economic rationales and the advantages of an improved resource efficiency as well as a reduced material usage, an ambitious resource policy shows win-win potentials: minimizing environmental effects, saving operational costs, and macroeconomic improvements are not contradictory. A more just distribution of resource utilization and the distribution of related environmental impacts between industrialized and emerging economies constitutes yet another benefit of resource policy. The necessity of natural resource conservation has been stressed in various environmental sciences publications (e.g. Rockström, Steffen et al. 2009, Steffen, Richardson, et al. 2015) as well as in position papers on green economy, a resource-efficient Europe and the Sustainable Development Goals (OECD 2011, UNEP 2011, EU COM 2011, UN 2014). Even though the material utilization is not continuously addressed in these documents, there is a strong evidence on the interdependencies of material use with other natural resources (Graaf, Werland, et al. 2015; Wunder, Hirschnitz-Garbers, et al. 2015; Werland, Graaf, et al. 2014).

Goals and indicators of resource policy: Options for future developments

In 2002 the Federal Government adopted in its strategy for sustainable development to double the resource productivity until 2020 (compared to 1994). To reach that target the „Resource Efficiency Program – ProgRess“ was introduced in 2012. It determines the global responsibility of Germany as a guiding principle and its ambition to gain a leading role in resource policies. By increasing resource efficiency the dependency of the German industry on imports of raw materials should be reduced (BMU 2012).

In international comparison Germany plays, indeed, a pioneer role regarding the formulation of national resource policies, even though other countries are on their way of developing respective policies. An analysis of existing resource targets reveals a globally fragmented, incoherent picture of divergent and oftentimes not very substantial targets (Bahn-Walkowiak, Steger 2013; Bahn-Walkowiak, Steger 2015). The input-oriented targets set by countries are usually motivated by an immediate shortage of certain raw materials (e.g. Sweden to reduce gravel mining, United Kingdome to decline the extraction of stones and earths, Finland due to large sources of critical metals). Despite of the fragmentation, there is an increasing number of resource related targets and a rising awareness for their necessity. Aside from Germany, China, Japan, Austria and Hungary have set first quantitative and scheduled targets. The usefulness of such targets is still discussed controversially in various countries. The debates evolve around the question, whether quantitative single targets and target systems for raw materials and resources can be justified, as long as the downstream environmental impacts, interactions, and shortages cannot be assessed sufficiently, let alone understood entirely (BIO IS, Institute for Social Ecology et al. 2012; SRU 2012; Bleischwitz et al. 2009). Moreover, basic conflicts of interest and contradictions in regard of the connection between economic prosperity and resource usage cannot be solved. As a result of the insufficient knowledge basis and the controversies, there is no consensus among political actors on which decisive steps to take (Deutscher Bundestag 2013). Nevertheless, targets constitute an important part of environmental policy and provide orientation and reliable guidance (BIO IS et al. 2012; Jänicke 2000).

In the light of limited resources, regionally and globally restricted capacities of eco systems, as well as inter- and intra-generational distribution aspects – and also taking into account the uncertainty about the actual availability of certain raw materials and the specific impacts of raw material usage – there seems to be a need to formulate environmental targets that follow a precautionary principle. Resource policy should reduce long-term risks regarding the total scale of using materials . Doing so, the global impacts of raw material utilization need to be considered in order to prevent that improvements are achieved by relocating resource intensive processes abroad.

Besides reducing risks, setting targets should also consider necessary conditions of sustaining a socio-industrial metabolism in the long term. In an ideal state of a environmentally sustainable economy, materials and energy would be founded on a regenerative base and on a minimal extraction of natural resources (inputs) and harmful environmental outputs. One could imagine this as a circular economy, which is driven by renewable energies. The extraction of primary materials would just substitute inevitable material losses (through corrosion, dissipation). In order for the system of societal metabolism to not supersede or overuse the surrounding bio-geo-sphere, the material stock (buildings, infrastructure, durable goods) must not surpass a critical level. In the long term, only an input-output-equilibrium can be maintained, in which the stock could be renewed in an environmentally friendly manner on demand without growing further (Bringezu and Schütz 2013).

This implies that the current stage of physically growing material stocks of the techno-sphere (buildings, infrastructure, durable goods) shifts more and more towards an equilibrium stage of stock maintenance. This trend is already becoming apparent for industrialized countries and can contribute to reduce demands for primary materials and raising the share of secondary inputs for different areas of applications (production, maintenance). However, to this day, the current expenditure of primary materials of the German economy remains very high, even in EU and certainly in international comparison (Bringezu and Schütz 2013).

Against this backdrop, indicators need to be assessed which can be used for the targets of a resource policy. We suggest a step-by-step extension of indicators to be observed regarding material turnover. From the perspective of an environmentally sustainable global economy not only the domestic usage of raw materials needs to be considered, but also the material usage abroad which was caused by imported goods. Furthermore from an environmental perspective it appears imperative to look not only at materials which feed in economic utilization, but also to consider unused extraction. We recommend to use the Total Material Requirement (TMR) as a base for calculating the total resource productivity and the Total Material Consumption (TMC) per capita for international comparisons; additionally, the composition of metals, industrial materials, construction materials etc. or foreign/domestic extraction or used/unused should be made visible in order to create an overall picture of the German material and raw material consumption. Unused extractions do not necessarily need to be surveyed in the same periods as the raw material usage. The amount of unused materials primarily depends on applied extractive technologies and accessed deposits. Through innovations in extractive technologies or through opening new deposits the amount of unused materials can change, which should be assessed regularly, but not necessarily annually as would be the case for the raw material consumption (RMC).

The system boundary of indicators should not be chosen merely on economic-technological criteria, but especially in regards of potential environmental impacts. This particularly implies assessing the use of fossil energy resources, too. Environmental impacts caused by lignite and coal mines have to be addressed in a further developed resource policy by including energy resources in resource policy.

Regarding tangible target values the question arises, which extraction level of primary material can be viewed globally acceptable concerning risks, without having firm evidence on the exact planetary limits of resource usage. For an orientation target, we suggest to restore the global extraction (until 2050) to the level in 2000. It can be questioned whether the usage of raw materials and materials was really environmentally sustainable in the year 2000. However, the further increase by 27% between 2000 and 2008 under no circumstances represent an improvement. The year 2000 is a moderate target following a precautionary approach, which possibly needs to be tightened, if further evidence is found on natural limits of material use. Furthermore, such a ceiling of material use should be distributed equally. We suggest to assign the same rights of use per person. From this assumption an orientation target of 10 t TMC_{abiot} per person for the year 2050 can be derived (by an expected population of 9 billion people). Based on the reference year of 2008 this would implicate a reduction of the overall consumption of abiotic resources from 31 t/person TMC_{abiot} by 68% for the EU-27, a decrease from 43 t/person TMCabiot by 77% for Germany. Pursuing this target would contribute to reaching the above-mentioned ideal state, in which the economy is less based on primary extractions and more on recycling, without deferring problems by material substitution between single minerals and metals.

To achieve this until 2050, a reduction of consumption by 2% on average per year would be necessary. Mathematically, this reduction target could be reached considering a realistically expected economic growth for the next decades by doubling resource productivity (GDP/TMR), which is proposed as a target until 2030 (base year 2010) (Bringezu and Schütz 2014).

3. Resource Policy as an Integration Task

Neither the short-term target of the Federal Government to double resource productivity until 2020 in comparison to 1994, nor a possible long-term target to reduce global materials input to 10 t TMC_{abiot} per capita until 2050 can be achieved by environmental policies alone. The utilization of material is to a large degree determined by industrial and infrastructure policy, by construction and housing policy, or energy policy. Moreover, the jurisdiction for these policy fields lies at the municipal, the Federal State and the national, as well as the European level. International dimensions of resource policy affect trade policy as well as economic development cooperation with developing and industrialized countries. Finally, research and innovation policy are policy fields pertinent to the development and proliferation of resource efficient technologies.

Within these policy fields, resource policy encounters different, partly competing understandings of needs for action and prioritization (Jacob, Werland, et al. 2013). On economic-political grounds resource policy is justified with price volatility and increasing competition with developing countries with high import dependency. Securing the supply of critical raw materials is a top priority. Approaches include bilateral trade agreements, protecting free international trade, the promotion of recycling as a raw material source, improving efficiency and developing domestic raw material extraction. According to this understanding, governmental resource policy is indispensable, firstly as it concerns foreign relations (especially foreign trade and development cooperation) and secondly as markets themselves do not provide the necessary incentives for the development of innovations due to spillover effects. Accordingly, trade and innovation policy instruments have priority from an economic-political perspective.

A development cooperation perspective focuses on impacts of the production of raw materials in developing countries. From this perspective the compliance with social standards during the production of raw materials is especially problematic. Furthermore, it is imperative to avoid a relocation of environmentally harmful activities from industrialized to developing countries. Against this background actors of development cooperation particularly criticize the non-transparency of the supply chain (Werland 2012). Instruments therefore include traditional instruments of development cooperation for capacity building, the implementation of environmental and social standards, as well as for developing business for the processing of natural resources and instruments for providing transparency in supply chains. First approaches for proofs of origin and use prohibitions currently exist in the USA (Dodd Frank Act) or are currently under way in the EU.

From an environmental perspective unexploited potentials for efficiency play a crucial role, as it would indeed be possible to realize them in an economically profitable way, but so far they are of low priority for businesses. Accordingly, provision of guidance and subsidies are seen as key instruments for realizing these potentials. Moreover, a need for innovation is identified, not least to supply the international demand for resource efficiency technologies. From the perspective of interdependencies between use of materials and further natural resources and emissions, either economic instruments or regulatory measures for production processes or products are suggested.

Resource policy is not limited to the national state level. Especially municipalities contribute to material streams through acquisition as well as through planning of infrastructure and buildings. Material streams can be effectively reduced by compact infrastructure, by considering material efficiency in procurement processes and especially in construction projects, during the designation of building areas and industrial parks as well as in context of municipal waste policy. In addition, municipalities play a decisive role in providing a framework for the selection of energy sources and can contribute to a departure from - material intensive – fossil energy sources. Especially area-conserving planning and urban renewal can exploit advantages both regarding reduced materials input and decreased land consumption (Wunder, Hirschnitz-Garbers, et al. 2015). These manifold potentials of municipalities have not been tapped yet (Werland 2015c).

Notwithstanding the varieties regarding priorities, targets, and instruments of a resource policy in the different policy fields, consensuses can be found in terms of evaluating needs for action, targets, and instruments: The overarching target of efficiency improvement is widely shared, an increased transparency in import of natural resources and the promotion of innovations in resource efficient technologies is considered necessary and the usage of recycling products should be amplified. A series of proposals for resource-policy instruments is made in the resource-efficiency program ProgRess as well as in political debates in Germany, such as in the German Bundestag's Enquete Commission „Growth, Prosperity, Life Quality“ (Graaf 2015). In the following some of these instruments are bundled into a coherent, given the present state of debate approvable policy mix and analyzed regarding their effectiveness.

4. Resource Policy Mix

There is not an individual resource-policy instrument to address the above-mentioned needs for action, the distributed responsibilities, and the different material flows and technologies fields that could meet all demands and could be used in diverging contexts. In fact, a policy mix is necessary, which can address diverging required actions and compensate potential deficits of individual approaches.

Resource efficiency potentials in production processes and products are often not unlocked due to lacking incentives for technical and social innovations and their dissemination. Environmental policy can and should stimulate the demand for resource efficient innovations. Thereby, learning effects and economies of scale can be achieved, which help to reduce the costs involved with technology application. Arguments and approaches for designing a demand-driven innovation policy are discussed in existing literature (Hinzmann and Hirschnitz-Garbers 2015).

For a resource policy that promotes the demand side of resource efficient technologies a number of strategic starting points can be used. Strategic starting points address specific obstacles for an improved resource efficiency. Based on this, intervention mechanisms are suggested in order to overcome these obstacles.

Strategic starting point: creating awareness for resource efficiency

One of the main obstacles to an efficient usage of materials are lacking information and awareness. Especially on the consumer's side, but also in processing industries and in trade potentials for a better resource efficiency could be tapped by disclosure of information throughout the value-added chain or by educational advertising on saving potentials.

Possible instruments to address such obstacles would be:

- Expansion of products equipped with eco-labels in trade(Scholl and Herr 2014; Scholl 2015),
- Consultancy for businesses(Bienge and Berg 2015),
- Information campaigns for consumers (Hirschnitz-Garbers and Langsdorf 2015),
- Promotion of environmental management systems (Werland und Range 2015),
- Development of key performance indicators for businesses (Bienge und Berg 2015).

Such persuasive instruments can be problematic regarding their effectiveness. Assessing the quality of information provided by firms on resource utilization can be especially challenging and there is the risk of a „Greenwashing“. Accordingly, instruments, which increase credibility and liability, such as rights to complaints or judicial remedies for environmental associations, transparency rules, and evaluations, could be used complementary.

Moreover, the effectiveness of persuasive instruments is questioned in eco-political discussions. It is questionable whether the provision of information alone can be a sufficient incentive to save resources. Additional incentives could be imparted by linking the above-mentioned instruments with economic incentives (e.g. linking of public procurement) or by facilitating regulatory requirements, such as information requirements (Werland and Range 2015).

Strategic starting point: providing price signals for resource efficiency

Along the value chain there are further impacts on natural resources and emissions connected with the use of materials. However, they are not completely reflected in prices for materials and, accordingly, are not included in the decision making process of economic actors. From this perspective a governmental intervention in the cost structures of resource utilization is justified and needed in order to create incentives for a more efficient dealing with materials.

Efficiency potentials are especially present in processing industries. These are realized inasmuch as they provide short-term cost reductions within the business. If environmental impacts, for instance, are not priced for further natural resources and ecosystems that are affected by material extraction or if these impacts occur abroad, the respective innovations become economically unattractive. Through a taxation of resource utilization incentives should be provided to increase efficiency potentials.

Possible instruments would be:

- Imposing taxes on the use of primary raw materials (Keimeyer et al. 2013),
- Abolition of environmentally harmful subsidies (Münch und Jacob 2014; Werland 2013),
- Refined value-added taxes (Bahn-Walkowiak 2015),
- Guarantees for financing activities to increase resource efficiency (Hirschnitz-Garbers und Porsch 2013),
- Levies in support of resource efficient products (Jacob und Schulz 2015).

A number of concerns have been brought forward regarding the price increase of raw material prices or resource intensive products, for which, however, compensatory measures could be taken. Regarding environmental taxes a regressive effect is generally assumed. Low income recipients would thus be stronger affected by an increased rate of value-added tax or a taxation of construction materials than high-income individuals. At this point allowances or other hardship clauses could serve as a compensation (Jacob, Guske et al. 2015). Furthermore, it is argued that economic instruments can cause an adaptive reaction, which in turn entails environmental pollution due to not or lower taxed alternatives. Amongst other aspects, the issue of possible environmental impacts of recycling is raised: While impacts on landscape, soil, and water regime can be attributed to extracting primary raw materials, unwanted pollutions or the energy input for recycling or transportation of recycled construction materials can be problematic as well. Thus, the appearance of adaptive reactions and their evaluation should be assessed during the design of resource taxes. Comparative life cycle analyses could be used for this. Finally, it is argued that an unilateral increase of raw material prices through environmental taxes could adversely affect international competitiveness. Even though there is a vast evidence that additional costs can be compensated through increased efficiency and (exportable) innovations (Quitzow 2014 with further references), it is possible to design instruments in such a way that competitive disadvantages can be avoided. In particular, a border tax adjustment within the European Single Market can be implemented (Keimeyer, Schulze, et al. 2013). Beyond that, the revenue could be used for (temporary) subsidies of eco-friendly alternatives.

Strategic starting point: promoting a resource efficient modernization

Lacking technologies are still seen as an obstacle to a more efficient resource usage, as well as incentives to invest in the development and application of efficient technologies. Spillover-effects require an innovation policy: the possibility to imitate innovations diminishes incentives to invest in their development and R&D efforts would remain at a lower level than economically desirable. Addressees of research and innovation policy are businesses and research institutes. Providing subsidies and tax benefits should stimulate their innovation activities.

Possible instruments are the following:

- Research and innovation promotion through subsidies (Bär 2015) or tax incentives (Graaf and Jacob 2015)
- Resource efficiency during the economic-activity promotion of municipalities (Werland 2015c)
- Resource efficiency and innovation orientation in public procurement (Münch and Jacob 2013)

Possible deadweight effects, diffusion impediments through the protection of intellectual property rights as well as related costs are particularly problematic. Deadweight effects can be avoided by designing frameworks in such a way that funding is transparent. Involving civil society in the development of programs and, where appropriate, in their assessment could especially enhance transparency. Furthermore, designing the own contribution to funding could degressively reduce deadweight effects, hence, timely applicants are provided with a larger share than late applicants. This way, innovative businesses, which have already developed ideas and plans, should be favored (first-come first-served principle). However, ecologic criteria should also be central during the designing of innovation programs. Long-term benefits should be contrasted with costs associated with funding. If need be, intellectual property of funded technologies rights could be placed under a special regime (e.g. privileged access to the use of patents for participating in a program).

Strategic starting point: establishing a regulatory framework for resource efficiency

This starting point is based on the premise that markets can only function, if there are binding rules, which are followed by all market players. Under the persistent opportunity to (over)use raw materials at the expense of the environment market players can achieve competitive advantages over players who take environmental aspects into account in their decision about production and consumption.

Possible instruments include:

- Norms (Werland 2015a)
- Rules on standards during the extraction (Schulze and Keimeyer 2014)
- Rules on minimum proportion of secondary raw materials (Schule 2015)
- Recovery quotas (Hermann and Schulze 2014)
- Extended producer responsibility (Wilts and von Gries 2014; Lambert, Hirschnitz-Garbers, et al. 2014)

Two problematic aspects have to be considered: On the one hand possible expenses for the implementation and on the other hand possible competitive disadvantages against foreign competitors. Compensatory measures to monitor compliance could be solutions close to the market. Moreover, environmental standards could be disseminated as part of an environmental foreign policy (Werland 2015b).

Strategic starting point: implementing resource efficiency in foreign trade

Such an approach mainly addresses two targets: Firstly, it reduces ecologically harmful effects of raw materials extraction and in the early stages of the value-added chain, which (apart from construction materials) take place abroad (often outside of the EU). Secondly, resource efficient technologies could become marketable abroad and thus achieve economies of scale, which reduce costs for products produced by such technologies and increase domestic demand.

Possible instruments are:

- Environmentally orientated framing of resource partnerships (Ferretti, Jacob, et al. 2013)
- Promotion of exports (Range 2014)
- Promotion of policy transfer (Werland 2015b)

Possible disadvantages are disadvantages for competitiveness, if environmentally compatible extraction of raw materials implies additional costs for commodity imports for the domestic industry, for instance, if ambitious environmental requirements are arranged during the extraction as part of resource partnerships. However, Ferretti, Jacob, et al. (2013) showed that the negative effects depend on the specific agreements reached with the partner countries and can be avoided.

5. Legal Innovations

Explicit and substantial regulations for resource protection and the management of the material cycle should be incorporated more comprehensively in existing legislation than hitherto. The currently existing focus of approaches of environmental law on emissions and product characteristics should be extended to observing material inputs. The guiding principle of resource preservation should be explicitly regulated in fields of law relevant to resources. Numerous legal fields are worth considering regarding such an interpretation; the mining law (Schulze and Keimeyer 2014) as well as the planning regulations (Schulze and Keimeyer 2015) were assessed as part of the project and appear as priorities given their importance for the extraction and use of materials.

For the management of material flows, there are several possible legal intervention points. Feasible approaches include selecting explicit addressees (target groups), selecting points of intervention along the value-added chain (raw material extraction, production, use phase, recirculation, disposal) or focusing individual raw materials or material flows (e.g. phosphorus, indium).

Further on, the creation of international law needs to be promoted: Particularly the principle of resource preservation needs to be embedded in existing international treaties of international trade law. The long-term target of the Federal Government is the establishment of an international convention on the protection of natural resources (BMU 2012).

The legal codification of resource preservation should aim at promoting economic development on the one hand and at the same time ensuring durable availability of natural resources and ecosystem services as well as the protection of the environment and human health. In this regard, it can basically be distinguished between production standards to regulate characteristics of a product, production and process standards („processes and production methods“, PPM's) as specifications for production processes as well as standards of conduct and system standards to improve business processes and internal environmental management. In consideration of the legal framework of world trade Germany should (as part of EU-aspirations) strive for a multilateral agreement on raw materials, in which environmental aspects play a central role. Besides a more general part, the agreement should focus on priority raw materials.

European regulations constitute to a large degree the framework for for national legislation. For the European set of standards regarding resource preservation there are primarily three regulatory areas with particular potentials for resource efficiency: the Waste Law, the Eco design Law, and the Building Products Act. The 2008 redrafted Waste Framework Directive 2008/98/EG plans waste minimization programs, in which avoidance targets and implementation measures should be specified (Faßbender

2011). The Eco design Directive 2009/125/EG already integrates existing resource related requirements, but needs to be broadened. The sustainable utilization of natural resources is one of the main prerequisites for buildings according to Article 3 Paragraph 1 i. V. Annex 1.

In the field of recycling economy, the introduction of a five-step waste hierarchy by the EU-Waste Framework Directive, which prioritizes the avoidance, recycling, and material utilization over energetic utilization and disposal, put a special emphasis on resource preservation. By means of realizing the waste hierarchy in the Law on Closed Cycle Management (cf. § 6 KrWG) another prioritization took place at the federal level. The legislator's intention is therefore clearly focused on the promotion of recycling (cf. §§ 1, 3 Para. 19 KrWG).

The Law on Closed Cycle Management should play a substantial role in the closing of material cycles. Necessary instruments were created by legally differentiating between by-product and waste according to § 4 KrWG as well as by regulations concerning the end of waste characteristics in § 5 KrWG. According to that, if a substance or an object accumulates during the manufacturing process, whose primary objective is not aimed at the production of said substance or object, it has to be regarded as a by-product and not as waste, if the legal requirements of § 4 KrWG are met.

It must be taken into consideration that producer responsibility is one of the key components to reach a circular economy (see also Wilts and von Gries 2014). This covers the entire life cycle from product planning and production, over the utilization phase to the disposal of a product. Product planning is of greatest significance for the durability, the reparability, and the usability of products. Thereby, the selection of design, materials and linkages should have a positive influence in terms of a resource saving economy. To achieve this, the specification of the Eco Design Directive in regard to material efficiency standards analogous to existing energy efficiency standards would be one possible step.

In doing so, it could be built on the considerable dynamic in the fields of research and development on the efficient use of raw materials, especially regarding critical raw materials. Examples include the optimization of platinum use in catalysts, the emphasized research on the substitution of indium or research efforts on reducing the share of rare-earth components in permanent magnets.

These innovations could facilitate legislations, which aim to manage the material input during the product designing as part of the Eco Design Directive. The Eco Design Directive as a framework follows a two-step regulatory approach. It sets the framework for the definition of common Eco Design requirements and it regulates the technical as well as other details of the requirements for different products in implementation measures adapted to the respective product groups. Self-regulation measures would be an option, too.

So far, the Commission has hardly taken the material use into account in implementation measures, neither in general nor in specific Eco Design requirements for products. On the contrary, it has almost exclusively focused on improving the energy efficiency of the regulated products. Nevertheless, first approaches can be noticed which give more weight to resource-specific raw material utilization. Besides requirements for energy use, there is a need to stronger assess to what extent requirements, which are not energy-related and target resource efficiency, can be addressed in relevant implementing regulations. This especially concerns the material input of products. A starting point could be requirements for the extractability of valuable components of electronic screens (e.g. thin-film transistors and printed circuit boards). Hereby, the setting of time standards for the removal of such components could be one possible criteria. These guidelines address the manufacturer of the devices and leave them to the design method to realize such time frames. In doing so, the greatest possible entrepreneurial freedom would be guaranteed during the implementation. A standardized measuring method to control the application of the criteria would be a necessary condition for the execution.

A legally binding principle of resource preservation has not been embedded into resource-relevant sectorial laws as of yet – with exception of the Recycling Law. This affects the planning and mining law in particular. In order to pursue the target of resource preservation the anchoring of appropriate guiding principles in the ratio legis seems to be an advisable step; since the legislation's purpose reflect the objective of the legislator and is considered during the implementation of the law as an interpretation rule. The inclusion of the principle of resource conservation in the purpose would change the reference to the set of norms and would therefore be an indirect design effect.

6. Impact Assessment of Resource Policy Options

How would a reinforced resource policy impact on economic parameters? Would potential extra costs for raw materials, for resource efficient process technologies or products compromise the competitiveness, hamper the economic growth, and ultimately imply a loss of employment?

The evaluation of resource policy, judgements on its necessity, and requirements for its designing are all depended on the assumptions, how the framework conditions of national and international trends in the economy, technologies, society and other policy areas. From the respective assumptions on innovations, economic development, policies, and culture different scenarios can be developed, which can be used for the evaluation of need and impact of resource policies. For the development of such scenarios, we invited a group of stakeholders from businesses, politics, science and civil society in the development of qualitative scenarios. The participants were invited to develop common assumptions on key parameters. From the combination of key parameters' manifestations consistent future scenarios until 2050 were deduced (e.g. post growth society, high tech society, international conflicts) etc. (Bergmann et al. 2015). These scenarios can be used for evaluating the necessity, the design or at least for the qualitative assessment of resource policy instruments and strategies.

For a *quantitative* impact assessment an parameterization of key factors and their manifestations would be necessary. This could not be accomplished as part of this project, but is going to be continued in other projects (SimRess, FKZ: 3712 93 102). Hence, for the following presented model calculations it was drawn on „Shared Socio Economic Pathways" (SSP Scenarios) developed as part of the IPCC, as international projections for the development of the GDP are publicly available. The quantitative impact assessment is carried out with the help of the global simulation model GINFORS (Meyer, Distelkamp, et al. 2013). The model depicts a central economic parameter for 38 nation states (especially industrialized and emerging economies), as well as the rest of the world. The model can also project important environmental parameters, including the development of greenhouse gas emissions and the utilization of materials. Due to its global coverage the model can particularly show impacts on the competitiveness and the possible relocation of economic activities. With the aim of covering a broadest possible spectrum of imaginable future developments, two alternative baseline scenarios were calibrated in GINFORS modeled after the macroeconomic projection of the SSP scenarios 1 and 3 by Chateau and Dellink (2012). The period analyzed covers the time until the year 2030.

Both of the baseline scenarios are summarized in the following overview (for a detailed description: Meyer, Meyer & Walter 2015):

	SSP1	SSP3
World population	Increase to 8 billion, slowdown of growth to 0,5% p.a. that esp. takes place outside of the 38 states explicitly depicted in the model (rest of the world, RoW) (increase in the share from ca. 40 to ca. 43%)	More dynamic population growth up to 8,5 billion, carried by RoW increase of share up to 45%), China, India, USA; decrease in EU.
Global GDP	Increase by ca. 75%, esp. through growth in rest of the world (increase of share from 13 to 23%), slowdown of growth in India and China. Long-term stable economic growth in EU and USA.	Growth by almost 60% until 2030, carried by RoW, China, India; Stagnation until end of simulation time in EU and USA
CO2 emissions	Significant climate policy improvements in EU. Increase (although slowed down) of emissions in China, India and rest of the world until 2030. Resulting global increase of emissions by a little over 20%.	No improvements in climate policy, not even in the EU, increase of global CO_2 emissions by ca. 50%; stagnation in EU.

Besides these characteristics of both scenarios the model reports on resource utilization (building materials, industrial minerals, ores, fossil resources (coal, gas, oil, other) and biomass), of greenhouse gas emissions, and of macroeconomic indicators (e.g. GDP, private consumption, price level, public spending, gross fixed capital formation, foreign trade, employment level, available income of private households).

For the following impact assessment two policy scenarios are contrasted and compared regarding their impacts on the above-mentioned parameters. On the one hand, we are assessing a policy scenario, which draws on current instruments which are incrementally further developed (Policy Scenario 1: Policy Mix). On the other hand, we analyze a policy scenario, in which a comprehensive structural change is induced at the expense of material intensive sectors and for the benefit of sectors with relatively less material use. For this purpose we assume a fictional tax on commodities (Policy Scenario 2: induced structural change). Hereby, the utilization of resources is taxed indirectly by the introduction of a tax on commodities. In return sectors that are resource efficient in comparison are subsidized.

This policy scenario has to be regarded as a feasibility study in order to analyze the effects of a comprehensive structural change and not as a realistic policy proposal. A policy aiming at a comprehensive structural change could never be solely based on as single instrument, but would have to be accompanied by a comprehensive strategy, which particularly addresses hardships for individual branches and regions and which allows for a long-term adaption process. Nevertheless, economic instruments and especially green taxes should play a central part in such a strategy.

Policy Scenario 1: Policy Mix

In this policy scenario the strategic starting points of a resource policy developed in section (4) are taken up and are specified with defined instruments, which are summarized into a coherent strategy. The impacts of the policy mix on the above-mentioned indicators are assessed altogether. In the following the specific instruments are depicted in respective action approaches and assumptions on their effects on the goods and branch structure shown in the model are explained (for a detailed depiction: Meyer, Meyer & Walter 2015):

(1) Creating awareness for resource efficiency
    On the one hand, a comprehensive self-commitment of trade to offer recycled paper in its assortment is modeled. It is assumed that the share of recycling paper in paper products (sanitary paper and office paper) is doubled until 2025. Furthermore, it is assumed that commerce is able to influence consumers to change their demand accordingly (e.g. by raising awareness campaigns). This leads to an increase of the recycling rate in the paper production (+3,1% until 2025). As a result of such an increase of recycling paper, in particular supply of the sector of paper and cardboard production would be particularly affected. Its supply services would decrease by 9,1% until the year 2025.
    Furthermore, a significant extension of comprehensive and low level consultancy for companies is modeled. Companies are offered conversations with consultants. The instrument is addressing mainly SMEs, as these are considered as key for improvements in material efficiency. So far, only a small share of SME is participating in a similar program. By means of actively approaching SME, the gap should be closed and the number of SMEs which have taken part should be increased. All companies in the manufacturing sector (excluding mineral oil) are taken into consideration. In order to take possible restrictions regarding the availability of respective consultancy services adequately into account, it is assumed that per annum additional consultancy services amounting to 30 million Euros are bought, which are subsided by 15 million Euros from public funds. Therefore, significantly less businesses are reached per year in comparison to an earlier feasibility study by Distelkamp et al. (2010). As a result of the consultancy, the material input of the branches will be reduced by 80 million EUR/ year.
(2) Promoting a resource efficient modernization

A significant increase of the R&D promotion is modeled as well as the subsequent implementation of resource efficient technologies in the glass and ceramic branches as well as the building industry. A public funding amounting to 50 million EUR (distributed over the entire simulation period) is assumed. If technologies developed in the course of the R&D promotion should be applied extensively, by far higher investments would be necessary. We assume investments in the overall economy in the amount of 39 billion EUR in constant process evenly distributed until 2030. Another assumption is a decrease in supplying sectors corresponding to the efficiency achievements in the industries.

Moreover, it is assumed that building services, which are carried out as part of public procurement, are executed in alignment with material efficiency and particularly the utilization of recycled concrete is predetermined insofar as technologically possible. Furthermore it is assumed that as a part of the standardization of building products and construction services this will become the rule for private investments as well, whereby as a consequence nearly 10,3 million t less gravel and sand are used.

(3) Creating regulatory frameworks for resource efficiency
The production and the exchange of goods and services as well as the extraction and utilization of natural resources are already extensively regulated in the regulatory law and the planning regulations. With that a regulatory framework for the economy is provided. However, this regulatory framework lacks incentives to efficiently use raw materials and natural resources. Several starting points could be found in the planning regulations, the regulation of production processes and products, or in the waste legislation. In the Policy Scenario Policy Mix planning regulation specifications for the design of settlement structures and a waste law instrument are assessed. Additionally, planning regulation instruments (e.g. in the mining law) or product-related instruments (as part of the Eco-Design Directive) were investigated qualitatively.
It is modeled that municipalities develop more compact settlement structures as part of their planning and that this consequently results in a decrease of the demand for the new construction of municipal roads by 0.85 billion EUR / year in comparison to the baseline. It is assumed that hereby a reduction of the material input by 6,3 million t can be achieved.
Moreover, the establishment of mobile return systems for electronic devices is simulated, which is linked with advising consumers on the recovery of old units. The instrument has the target to facilitate the submission of discarded electronic devices and at the same time to create an opportunity to consult users regarding repair options. Hereby, an increased demand for repair services amounting to 2 billion EUR in total is induced.

(4) Implementing resource efficiency in foreign economy
It is assumed that instruments of development policy, resource partnerships, and international agreements in resource-extracting countries work towards the mining industry and the first processing stages complying with the same environmental standards as within the EU. Hereby, additional costs for filter and cleaning technologies as well as other environmental investments and their operation are incurred. Such extra costs cause the world market prices of metals to rise up to 2%. This matches the maximum environmental protection spending of resource-extracting industries in Europe. Furthermore, it is assumed that through different export promotion instruments for resource efficient technologies the global trade shares will increase in the economic sectors chemistry, plastic, metals, electric and optical equipment and construction. The experiences of the export promotion in other technology segments (renewable energies) and other countries are applied.

The presented instruments only compose a selection of possible instruments in the respective strategic approaches, which could be developed within the constraints of the project and as part of the applied model. These were conceptualized as demanding as possible, but at the same time in a realistically manner (particularly: nationwide application). The strategic starting point „Price Signals for Resource Efficiency" will be placed in the center of the second policy scenario and therefore not be included at this point.

Policy Scenario 2: Induced Structural Change

In an alternative policy scenario a tax on commodities and subsidies are simulated, which aim at a comprehensive structural change at the expense of material intensive and in favor of resource efficient industries. The domestic demand for supply with material intensive commodity groups are taxed in this policy scenario, in particular:

- Forestry products and services
- Coal and lignite
- Petroleum, gas; services for gas and petroleum production
- Stones and earths, other mining products
- Tobacco products
- Wood; wood products, articles of cork, basket ware (excluding furniture)
- Publishing and print products, e.g. recording media, image and data carrier
- Rubber and plastic products
- Glass, ceramic, worked stones and earths
- Metal products
- Machines
- Energy (electricity, gas) and energy supply services
- Water and water supply services
- Construction work

A commodity tax rate of 20% introduced in 2015 is assumed. In return, the following supply with the following commodity goods are subsidized:

- Accommodation and catering services
- Messaging services
- Services of credit institutions
- Services of insurances (excluding Social Security)
- Services of credit and insurance funds (*Kredit- und Versicherungshilfsgewerbes*)
- Services of the property and housing sector
- Services of renting of movable property
- Services of data processing and databases
- Services of research and development
- Business-related services
- Services of public administration, defense, social security
- Education and teaching services
- Health, veterinary, and social services
- Sewage, waste, and other disposal services
- Lobby services, churches and other
- Cultural, sport, and entertainment services

- Other services

A subsidies rate of 17,5% is implied. Possibly remaining tax revenue is used for debt repayment. The policy approach is outlined in detail in Meyer (2015).

The commodity tax has to be regarded as a thought experiment and not as a policy recommendation. It is analyzed, what effects a comprehensive structural change would bring about, if it was at the expense of resource intensive and in favor of resource-light goods and services. The presented and described commodity tax is supposed to induce a structural change.

In the following, the effects on environmental-economic indicators of both policy approaches (Policy Mix and Induced Structural Change) are presented in a comparative overview.

Economic Performance:

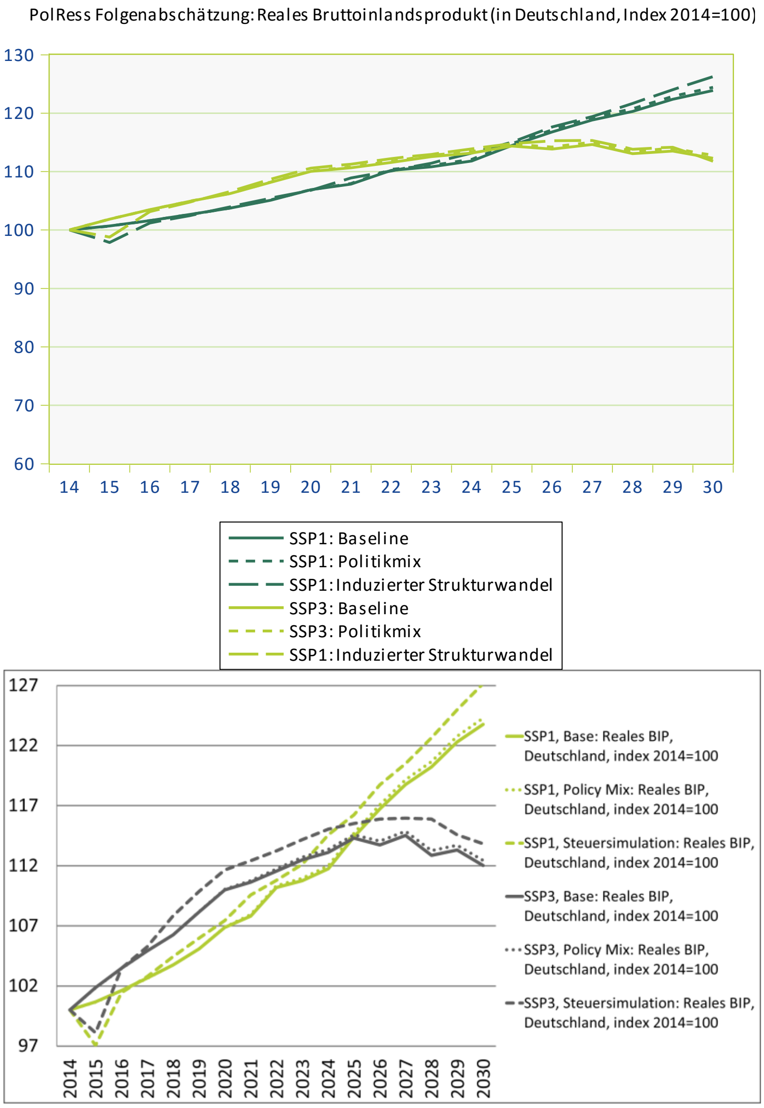

Figure 1: Effects on economic performance (GDP in Germany; Index: 2014 = 100)

The policy scenario Policy Mix does basically not differ from the baseline scenarios regarding the economic performance; only at the end of the simulation period there are negligible advantages in regard to the GDP, if the Policy Mix was implemented. In contrast, however, in both baselines the simulated commodity tax leads to a short-term damping of the economic performance, only to contribute to a significantly increased economic performance starting from 2016 or 2017, as is the case in policy mix scenario.

Assessing the effects of both policy scenarios on the production values of different industries, a slightly dampening effect on the mining industry and the extraction of stones and earths can be registered; by contrast, there are positive effects on paper, etc., glass, etc. and the construction industry. In comparison, a distinct structural shift is caused by the commodity tax: Deviations of 30% up to 40% can be expected in material intensive industries, which are opposed by an additional growth in industries with low material inputs. In total, losses in material intensive industries are more than compensated.

Employment and Income

The amount of hours worked in Germany is used as an indicator to assess the employment effects of both policy scenarios. Virtually no effects can be recorded in both baselines for the Policy Mix, the curves run parallel. By contrast, the simulated commodity tax causes a noticeable increasing employment in comparison to both baseline scenarios. According to this, the amount of hours worked increases by 5-6%.

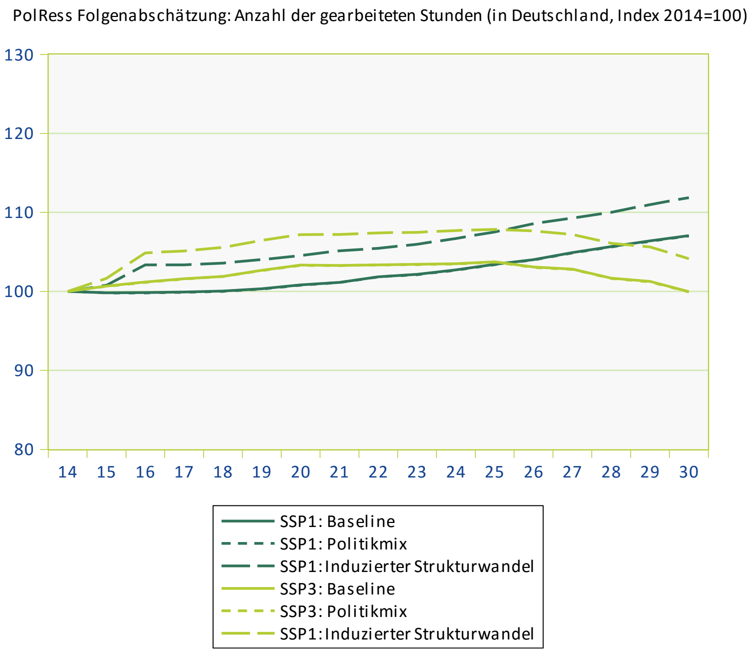

Figure 2: Employment effects in Germany (Index: 2014=100)

Investments

The situation is different regarding investment activities. In both baseline scenarios a decrease of investments is expected, this is especially pronounced in SSP3[1]. This decrease would be moderated in the policy scenario Policy Mix as compared to the scenario of an induced structural change. As compared to the respective baselines, the policy mix leads to an increase of gross investments in assets of up to 1,5% until 2030. In comparison, for the induced structural change only a small deviation of ca. 0,1-0,2% can be observed.

Figure 6 Impacts on Gross Investments

[1] [1] The SSP-scenarios assume a convergence-hypothesis. A relatively strong growth in developing and industrialized countries will therefore tend to lead to a reduction of international income disparities. In order to trace this characteristic of the SSP-scenarios in GINFORS, the investment demand in Germany was lowered and the German import quota were raised in the baseline calibration (and others).

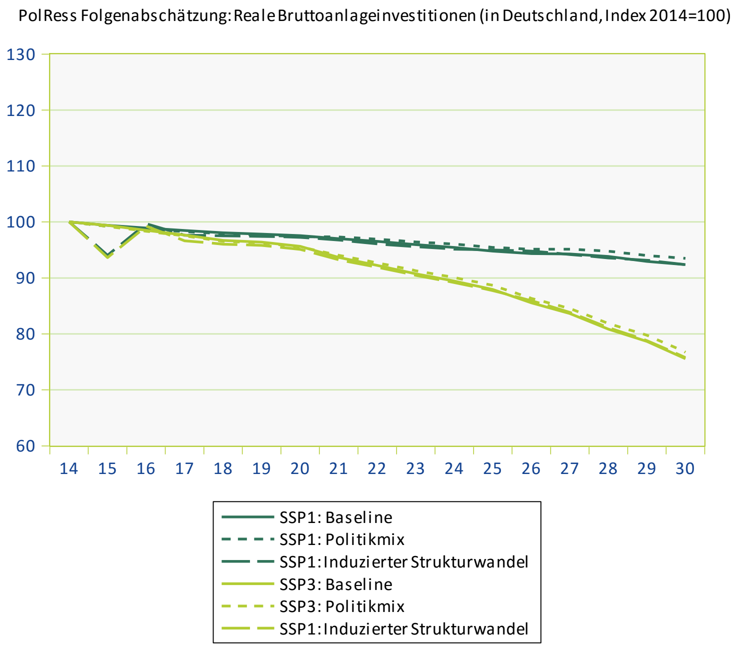

Figure 3: Gross capital expenditure in Germany (Index: 2014 = 100)

Foreign Trade

Again, the policy scenario Policy Mix has a small positive impact on foreign trade compared to the baselines. Hence, the competitiveness would not be compromised in this scenario. The simulated commodity tax, however, causes a slight dampening of the foreign trade in the policy scenario „Induced Structural Change". This effect can be traced back to cost-induced price increases. Export goods are not subject to an independent taxation, but commodity taxes paid for advance service inputs tend to result in price increases for the production of export goods.

The commodity tax also shows a slightly dampening effect on imports, which can be explained with higher prices of imported goods, which can also be taxed in the policy approach, as far as they are part of material intensive commodity groups.

Environmental Impacts

The described and analyzed policy scenario of an induced structural change would have positive effects on the further reduction of CO2-emissions. In 2030, the emissions would be approximately 8-9% below the respective reference values of the baseline scenarios.

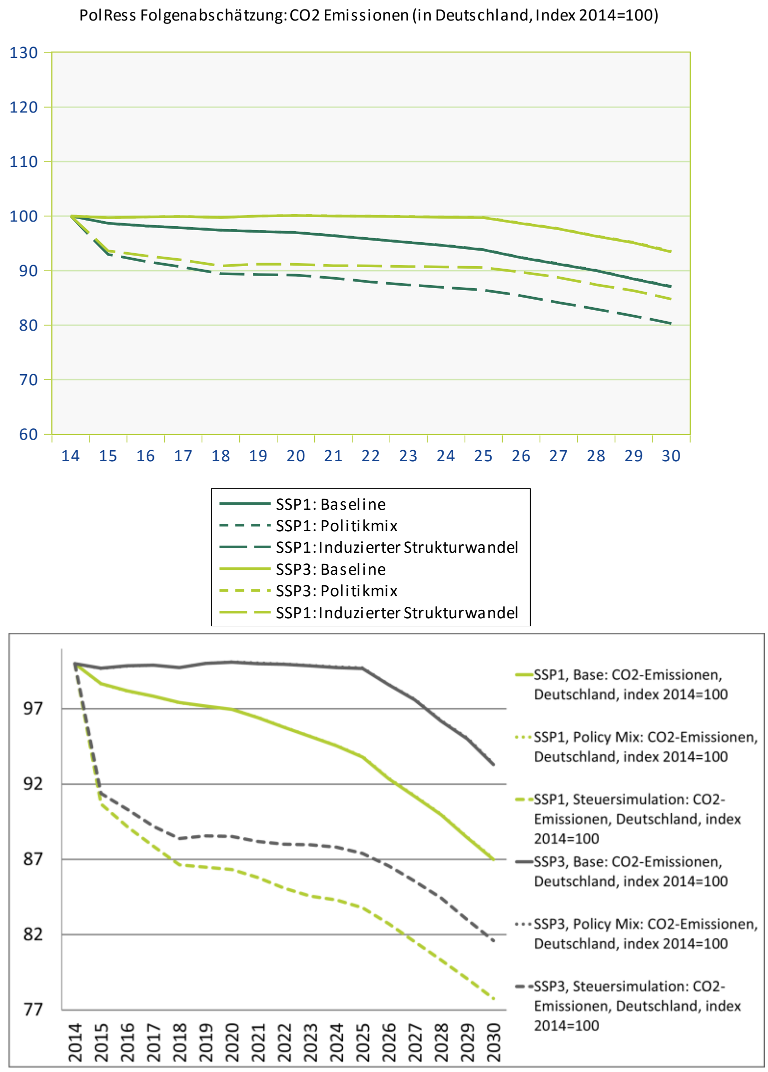

Figure 4: Environmental effects: CO2 emissions in Germany (Index: 2014 = 100)

Regarding the utilization of materials the following picture can be expected:

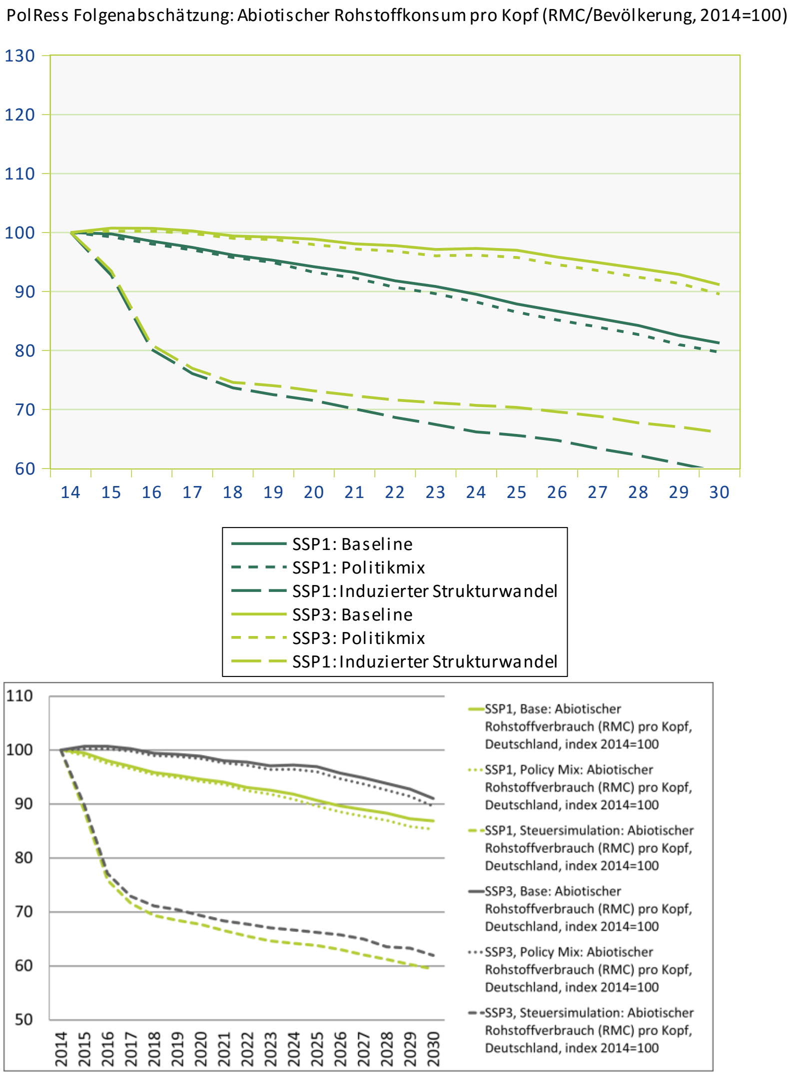

Figure 5: Abiotic resource consumption (RMC) per capita (Index: 2014 = 100)

In both baseline scenarios slightly decreasing per capita values can be projected for the German abiotic raw material usage (RMC). In average only a reduction of ca. 1% p.a. is simulated. In the policy scenario "Policy Mix" further, but relatively small reductions of the RMC per capita can be expected in both simulation versions.

The simulation of the structural change induces a considerable decrease of domestically used extractions, through which the per capita RMC can be reduced lastingly. In 2030, the amount of materials (recorded in raw material equivalents) consumed in Germany would lie about one third below the reference value of the baseline scenarios. However, the long-term target of limiting the per capita consumption to 10 t $TMC_{abiotic}$ until 2050 would also hardly be achievable even in this policy scenario. As explained in section 2 the material input would have to be reduced by 70%.

Both presented policy scenarios mainly affect Germany. Accordingly, there are no comprehensive effects on the global utilization of materials that are expected. The model results indicate that the globally used extractions of primary raw materials could be reduced on average by -300 to -340 billion t per year, if a commodity tax was implemented.

In summary, harmful effects on the analyzed economic indicators cannot be expected in the presented modeled policy scenario „Policy Mix“, even though the individual included instruments were designed ambitiously. Nevertheless, these instruments are not sufficient to effectively and substantially reduce the material utilization in Germany. As part of the presented study only a small share of possible and only some of the qualitatively assessed ProgRess-instruments can be modeled quantitatively and can be screened regarding their effects. Resource policy address various other materials and actors as the ones considered in the policy scenario „Policy Mix“. In this respect, potentials of an incremental policy development are underestimated. Nevertheless, an ambitious designing was assumed during the respective modeling of individual instruments. Such a resource policy would definitely contribute to developing and supporting stakeholders who develop and market innovations and who support an ambitious resource policy. In the long run, actors and more demanding instruments could be established, who and which would support an ecological structural change.

Furthermore, the presented policy scenario of structural change induced by a simulated commodity tax would cause a shift of value creation from material intensive to material saving industries. Even though this is linked with short-term declines in economic performance, innovation activities, and foreign trade, such a structural change as a whole would be beneficial in terms of growth and employment. In regard to environmental impacts, a considerable decrease of material utilization and CO2-emissions can be expected from such a structural change in favor of services and knowledge-based industries. A sophisticated resource policy and climate protection go hand in hand.

However, neither of the presented policy scenarios would have a noteworthy effect on the global material utilization. In this regard further efforts would be required, for example international agreements or the support of disseminating respective policies. Germany could serve as an example that a reduction of material utilization can be realized without losses in prosperity levels or competitiveness.

7. Further Development of the Resource Strategy

An ambitious resource policy, be it to reach the objective of the Federal Government to double raw materials productivity or to limit resource consumption per capita as suggested in this paper, requires a strategy which is assertive against individual interests. Resource policy is a task that cannot be achieved with environmental political instruments alone, but needs efforts and activities of different departments, various levels and non-state actors. In order to mobilize them, to enforce and provide significance of resource-political targets in the respective fields of activities, a strategy is needed that does not distinguish itself by targets and action programs alone, but also through a process, which allows policy learning and creates new dynamics. Moreover, strategic capacities should be created, which make actors responsible for the strategy to be assertive against interests. Accordingly, the analysis and the recommendations for the further development of the resource strategy in Germany does not only address the target system and the instruments, but also the strategic process and the capacities of the strategy (Jacob, Münch et al. 2012; Jacob and Kannen 2015a; Jacob and Kannen 2015b).

Approaches for a strengthening of the strategic process would initially consist in accentuating the need for resource policies and related targets in different policy domains. In doing so, action programs of the departments, of federal states and municipalities would be possible, in which in different fields of action, such as in the area of infrastructure, agriculture, energy and construction policy, ways of implementing resource policy are concretized.

Such action programs could be complemented with reporting obligations, be it to the Federal Government or the German Bundestag, and with evaluations and therefore gain more credibility. Last but not least, resource aspects could gain more emphasis in the field of policy impact assessment. As part of the sustainability check the departments could be instructed to present which material flows would result or be reduced by new policy proposals.

Not only the individual action programs, but also the resource strategy of the Federal Government as a whole should be subject to an evidence-based evaluation, alongside with reports of the Federal Government to the German Bundestag on the process and further development of the resource efficiency program. Such an evaluation can promote policy learning on the one hand by critically assessing the undertaken measures and their effects; on the other hand an evaluation can incite a new dynamic for the strategic process. The peer reviews of the Sustainability Strategy of the years 2009 and 2013 could serve as an example (Stigson, Babu, et al. 2009; Stigson, Babu, et al. 2013). Such evaluations could supplement the periodically planned progress report of the Federal Government on the implementation of ProgRess.

Another component of further developing the process is the participation of citizens as well as organized stakeholders of the economy, civil society, and municipalities. By asking citizens directly for their ideas on designing resource preservation and utilization, further potentials for action can be tapped. The participation processes initiated by the BMUB to further develop ProgRess seems to be adequate and could be further pursued for the implementation of the strategy after evaluating experiences.

Strategic capacities describe after all institutional responsibilities, the knowledge base of resource policy, networks with support and budgets to implement the strategy. The lead in implementing ProgRess lies within the responsibilities of the BMUB. The establishment of a consultancy and steering committee consisting of particularly relevant departments, where appropriate of federal states and municipalities and public institutions at federal level, for scientific policy advice would be worth considering.

Independent of that, the Federal Government an advisory group composed of individuals from economy, civil society, and businesses could counsel the Federal Government in the implementation of the strategy and provide new impulses. Baring this in mind, the resource efficiency network should be continued and further developed. In order to win long-term acceptance and support for a sophisticated resource policy, innovators need to be identified and interests of assistants thereby mobilized (Prittwitz 1990). Particularly actors providing resource efficient technologies and services would be worth considering.

The knowledge base of resource policy is developed especially in the Federal Environmental Agency with regard to environmental aspects and VDI-ZRE and the DERA with regard to economic and business aspects of resource conservation. The BGR disposes of relevant knowledge regarding international aspects of resource extraction and utilization. It would be worth considering a competency center, which further develops the development of municipal resource conservation, identifies best practice examples, and contributes to the dissemination through consultancy.

8. Summary

- The utilization of materials has various impacts along the value-added chain on natural resources and emissions are caused. An environmental policy that starts at the causes of environmental degradation should not only address the condition of ecosystems and emissions, but also the input in the economic system.
- Not only environmental reasons argue for an improvement of resource efficiency, but also economic reasons on business and macroeconomic level. The saving potentials and innovation possibilities are not fully tapped.
- The Federal Government adopted the target of doubling raw material productivity until 2020 (in comparison to 1994) in its Sustainability Strategy. It is expected that this target cannot be reached without additional measures (such as a departure from lignite). From the perspective of a sustainable development the domestic and current level of material utilization can neither be generalized globally nor can it be accepted in the long term. Hence, in the long-term the material utilization (including used extractions) should be reduced to 10 t/capita.
- The political and legal framework of resource utilization are not only set by national environmental policy, but decisively in other policy fields and on different policy levels. Resource political considerations should therefore be emphasized more strongly and gain a greater significance in other policy fields, too (e.g. construction and living, infrastructure, industrial policy). Accordingly, the integration of resource political principles in relevant legal areas can be recommended.
- Particularly in municipalities, there are potentials for action to improve resource efficiency. As already existing consultancy services for businesses an easily accessible knowledge database for municipalities should be created, in which social and economic benefit aspects of resource efficiency on-site are highlighted (especially local value creation, working places, lower maintenance costs) and which support the exchange of best practices.
- The more efficient utilization of materials cannot be expected reclusively by a market-driven motivation to save costs. Numerous obstacles and mechanisms of market failure indicate otherwise, including the access and the availability of information, the need for innovations, or the possibility to externalize environmental costs along the value-added chain. This results in need for actions and strategic approaches of a resource policy.
- The previous resource-political instruments can and should be designed far more ambitiously in order to at least reach the self-appointed target of doubling raw material productivity.
- The resource-political strategy developed as a part of the project (policy scenario „Policy Mix“) would not have negative effects on central economic parameters.
- Another policy scenario, which assesses the effects of a comprehensive, politically induced structural change (policy scenario „Induced Structural Change“) would contribute to a substantial reduction of material utilization; linked to this is a reduction of CO2-emissions. Furthermore, the consequence would be a considerable structural change at the expense of material intensive industries and at the same time all in all positive effects on value creation, employment, household incomes and state finances.

In any case, the resource efficiency strategy ProgRess of the Federal Government needs to be further strengthened and expanded, particularly with regard to the stronger anchoring of resource-political targets in different policy field and on different policy levels. In the short-term supporters of a comprehensive resource policy should be networked and supported in order to facilitate policies that change structures in the medium- and long-term.

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