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Towards the Green Economy – economic effects of the transition to a more efficient world

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Impressum

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1 INTRODUCTION

The challenges of climate change led to the claim to decarbonize economic activities. Ten years ago, the Stern Report (2006) and AR4 of the IPCC (2007) showed that the seeming dichotomy between economic growth and climate protection can be bridged and that climate change mitigation is an economic opportunity and contributes to growth. The same holds true for many environmental challenges, and the overall goal is the transition to a Green Economy, exhibiting Green Growth and providing for Green Jobs (UNEP 2011, OECD 2011, ILO 2012).

Resource efficiency is one important pillar of a greener economy. It comprises energy efficiency and contributes to climate change mitigation, and (raw) material efficiency; thus contributing to the protection of water, soil, landscape and biodiversity as well. While efficiency partly autonomously increases due to price pressures, technological change and innovation, barriers such as long pay-back times etc. exist. Additional incentives are needed for a better internalization of the respective external effects, which are pollution, emissions, destruction of wildlife and landscapes etc. Policies for the increase of resource efficiency therefore include price instruments such as fees on the use of certain raw materials as inputs and soft loans to home owners. Additionally, information instruments, standards and labels are used.

The objective of this contribution is to show the economic effects of selected resource efficiency policies on an aggregate and a sector specific level. A special focus lies on employment effects from the transition to a more resource efficient economy. The remainder of this contribution is organized as follows. The next section introduces the modeling approach and two scenarios, a baseline scenario and the development with more resource efficiency. The scenario assumptions are discussed in detail. Section 3 gives results and section 4 concludes.

The research results presented in the following are part of a larger research project on the economic effects of the transition to a green economy. Other scenarios include all aspects of the German Energiewende, e-mobility, organic farming, noise reduction on railroads and land-use targets. The full report will be made publicly available by the end of the year (in German), e-mobility is described in Ulrich&Lehr (2016).

2 THE MODELING APPROACH

2.1 THE ENVIRONMENTAL ECONOMIC MODEL PANTA RHEI

The analysis is based upon simulation results obtained with the macroeconometric model PANTA RHEI. PANTA RHEI has a macroeconometric simulation and forecasting model at its core, which consistently describes the annual inter-industry flows between the 59 sec-

tors, their contributions to personal consumption, government, equipment investment, construction, inventory investment, exports as well as prices, wages, output, imports, employment, labor compensation, profits, taxes, etc. for each sector as well as for the total economy.

In the behavioral equations decision routines are modeled that are not explicitly based on optimization behavior of agents, but are founded on bounded rationality. The parameters in all equations in PANTA RHEI are estimated econometrically from time series data. Producer prices are the result of mark-up calculations of firms. Output decisions do not stem from an optimization process but follow observable historic developments, including observed inefficiencies. Employment is determined from the production volume and the real wage rate in each sector, which in return depends on labor productivities and prices.

To examine the economic effects of additional efficiency measures in Germany our analysis applies PANTA RHEI to two scenarios: a business as usual scenario and a scenario with increased resource efficiency. Both scenarios are implemented in the macroeconometric model PANTA RHEI. The respective differences in economic indicators, such as employment, GDP etc. can then be attributed to the effort for increased efficiency in the scenario, since all other factors are held equal. Changes in volumes and prices are fully accounted for. The simulation model runs until 2030.

2.2 TOWARDS A MORE EFFICIENT WORLD – THE SCENARIO

2.2.1 THE RELEVANCE OF MORE EFFICIENCY

Resource efficiency is more than mere energy efficiency, although energy is an important part of the resources used in the German economy. 67% of all resource imports satisfy the energy needs with natural gas, oil products and hard coal. Even domestic resources are 20% energy. But resource efficiency with a focus on material inputs goes beyond this and needs to address more and different players, to be successful.

Additional resource efficiency addresses in the following four of the more pressing issues regarding resource efficiency in Germany. The scenario is by no means comprehensive. With regard to energy efficiency, an increase in efficiency in buildings – residential and non-residential - is a very important building bloc, because the targets set by the European Commission and the German government will not be reached under the current policy framework. The existing soft loan systems are improved and increased so that efficiency measures, especially in the building stock, are encouraged. Increased activity in the construction sector, however, is at conflict with the target of the doubling of resource efficiency, because construction material is the one largest contribution to domestic resource extraction. A price instrument is suggested to lower efficiency of construction materials' use. The fourth sector is industry, where resource efficiency is promoted by information instruments.

The following economic channels respond to the scenario: Investment in buildings and in more efficient equipment in industry increase final demand for the respective goods. Additional demand has positive effects on employment in the respective sectors. Higher investment can trigger higher prices from an increase in depreciation of higher imports and lead to long term negative effects. Positive budget effects come from saving of energy and

material inputs for industrial producers and households as well. However, economic sectors who produce these inputs suffer losses in turnover. Long-term savings lower imports and improve overall economic balance. In the case of Germany, however, critics see the economic balance already tilted towards exports so that this improvement is not met with general approval.

2.2.2 DETAILS OF THE SCENARIO

The scenario assumes a mix of economic instruments tailored to the respective sector addressed. For residential and non-residential buildings, soft loans were the most successful instrument in the past, the main obstacle being the user-investor dilemma. For low income households, efficient appliances are directly subsidized. Also subsidized directly is investment in efficient appliances in public buildings.

In the industry sector, energy efficiency is economically efficient, but particularly SMEs have neither time nor money to be fully informed about their potentials. Thus, a program supporting energy consultants is suggested.

Resource efficiency can be induced by increasing the price of the resource, with a tax, a duty or a tariff. The scenario contains a tax on construction material. Tax revenues are used for recultivation.

The German government aims at a 20% improvement of the energy demands of buildings by 2020. To reach this target and to comply with European targets, the Ministry of Economics and Social Affairs has developed a strategy which includes soft loans and a doubling of the annual rate of additionally insulated buildings. Since 2001, energy demand per square meter decreased by 2.6% per year, however, this leads to an disproportionate smaller reduction of total energy demand in buildings, because total residential area rose.

The German KfW Bank offers different lines for soft loans for efficiency improvements in residential and non-residential buildings. The volumes were 2 to 6 billion Euro in different years since 2005, for instance, in 2012 a total volume 3.8 billion Euro was granted. Total investment in efficient buildings which was supported by these loans was 5.4 billion Euro. This amount exceeds the costs of the program, i.e. the difference to market interest rates, administration costs, information costs by a factor of 6.

In the model, two different aspects of the support lead to effects: firstly, only the additional investment necessary for additional efficiency is leading to, for instance, additional employment or value added. Secondly, energy savings and the reduction of energy expenditure hinge on autonomous investment and additional investment in “more efficiency”.

For the future, the support for owners who improve their buildings’ efficiency will be doubled.

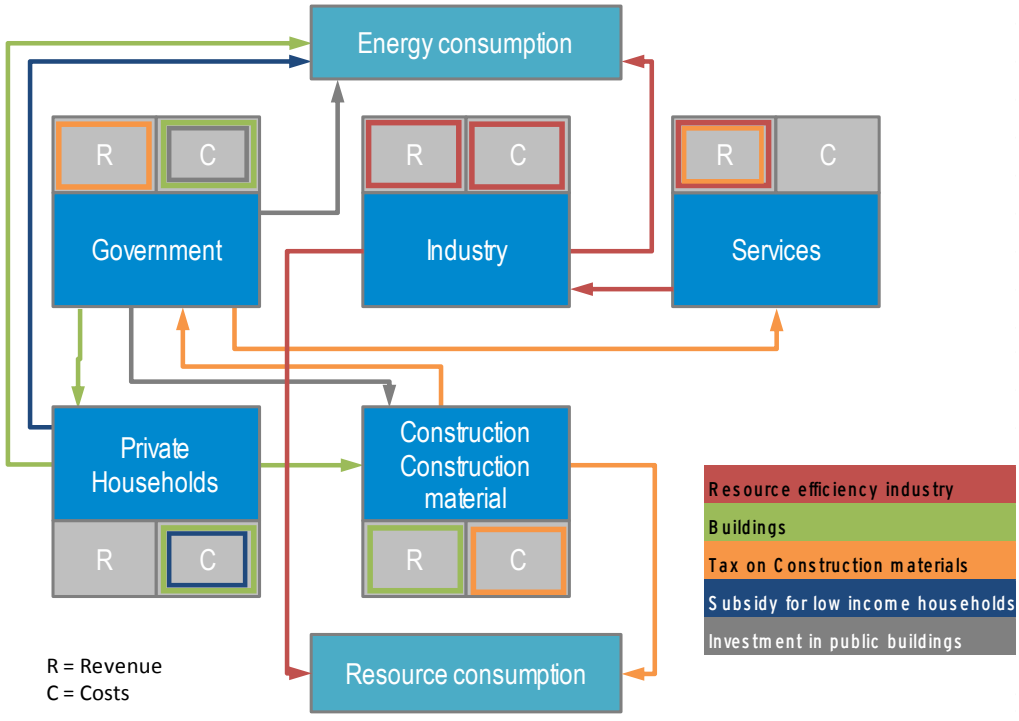
Industry and trades demand one third of all energy demanded in Germany. Correspondingly, these sectors should contribute to the energy efficiency targets. However, between 2002 and 2013, industry and trade reduced energy intensity by less than 1% (0.3% per year), regardless of the large energy saving potential that is reported in the literature. Therefore, the scenario taps into efficiency potential in the cross-cutting technologies in industry and sets sector specific, additional equipment investment and savings effects by 2030. The additional investment amounts to 1.3 billion (2017) to 0.9 billion (2020) per

year. Annual savings of final energy add up to more than 200 PJ by 2020. Energy efficiency measures are incentivized by additional activities from energy consultants. Energy efficiency consulting currently is mandatory for certain tax and surcharge exemptions. 4000 firms are active in energy consulting today, most of them are SMEs. They employ 8-12 thousand people currently. In the model, we shift the input coefficient from energy to services to be able to account for this additional investment in consulting and its assumed results.

To smoothen distributional effects, the scenario further assumes a subsidy for low income households for efficient electrical appliances. Households save up to 10% of their electricity bill, or 1% of total electricity consumption. Energy efficiency is also subsidized in the public sector, e.g. with the transition to efficient lighting.

But resource efficiency does not stop with energy. To decrease domestic resource extraction, a tax on building materials is introduced. Minerals used in construction are taxed with 2€/ton. The tax is assumed to increase to 4.8 €/ton by the year 2020. The tax revenues are used for recultivation, although the recultivation of former gravel pits is mainly in the responsibility of the company digging. New concepts for recultivation under ecological aspects can be supported with a share of the tax revenues. Further, revenues can be used to support efficiency consultants. Figure 1 gives an overview of the scenario.

Figure 1: Economic



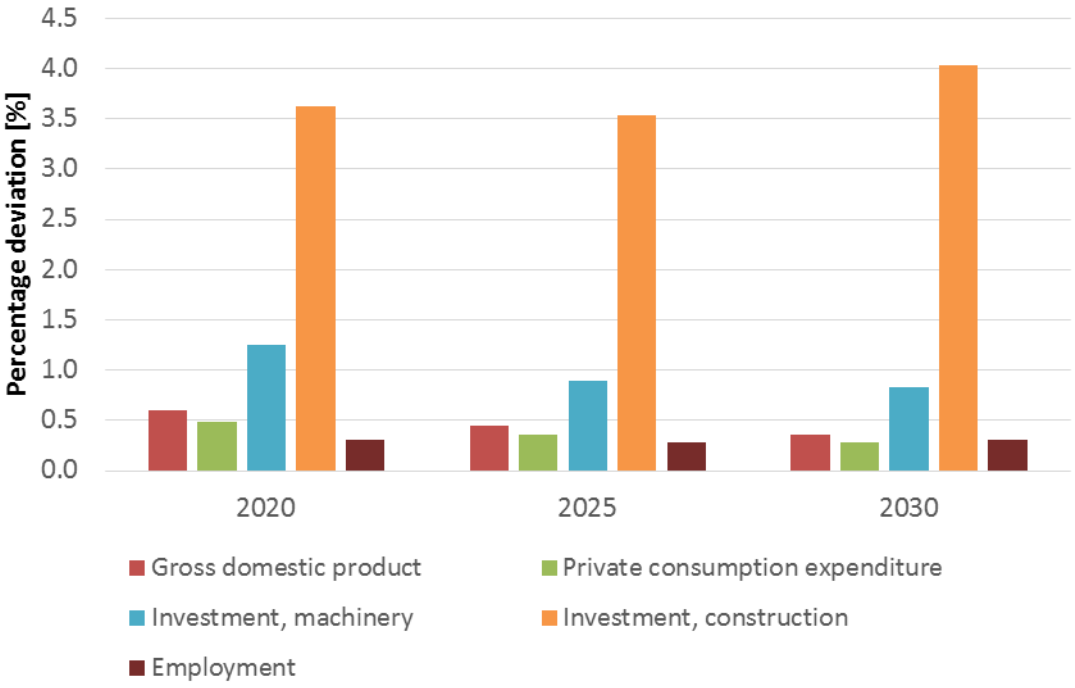
Source: Own compilation.

3 RESULTS

3.1 MACRO RESULTS

The scenario comparison between the reference scenario and the scenario with additional efficiency efforts allows statements about the advantages of the transformation toward a more efficient world based on the changes of macroeconomic variables. Overall economy, employment and sustainability are used in the following as indicators of an advantageous development of a scenario compared to the reference. Figure 2 shows the difference between the reference scenario and the scenario for the pathway towards a more efficient world based on the percentage deviation of various indicators. The advantageous overall economic development is reflected in the increase in GDP. 2020 is it 0.6% higher than in the reference case, 2030 by 0.4%. The scenario affects in its various specific aspects the construction sector: renovation gets new momentum in both the residential buildings as well as non-residential such as universities, office buildings or hospitals. This is reflected in the increase in investment in construction activities from private funds and revenues from the new tax. The latter leads per se to a slight decline in construction investment, but the positive effects outweigh by far and lead to a four percent plus in construction spending. This also affects employment in the construction industry (cf. below on sectoral impacts). Investment in equipment shows an increase of around one percent, which is primarily due to the investment in efficiency goods. Final consumption expenditure of households follow the higher income from additional employment. During the observation period employment is on average 100,000 higher than in the reference case. The revenue from the building materials tax additionally collected provide a positive impulse to the financial balance of the state, although additional governmental expenditure is foreseen, such as supporting the refurbishment of public buildings, the support of consulting services for increased material and energy efficiency as well as the support of recultivation of gravel pits.

Figure 2: Percentage change in GDP, consumption, investment and jobs – scenario compared to reference case



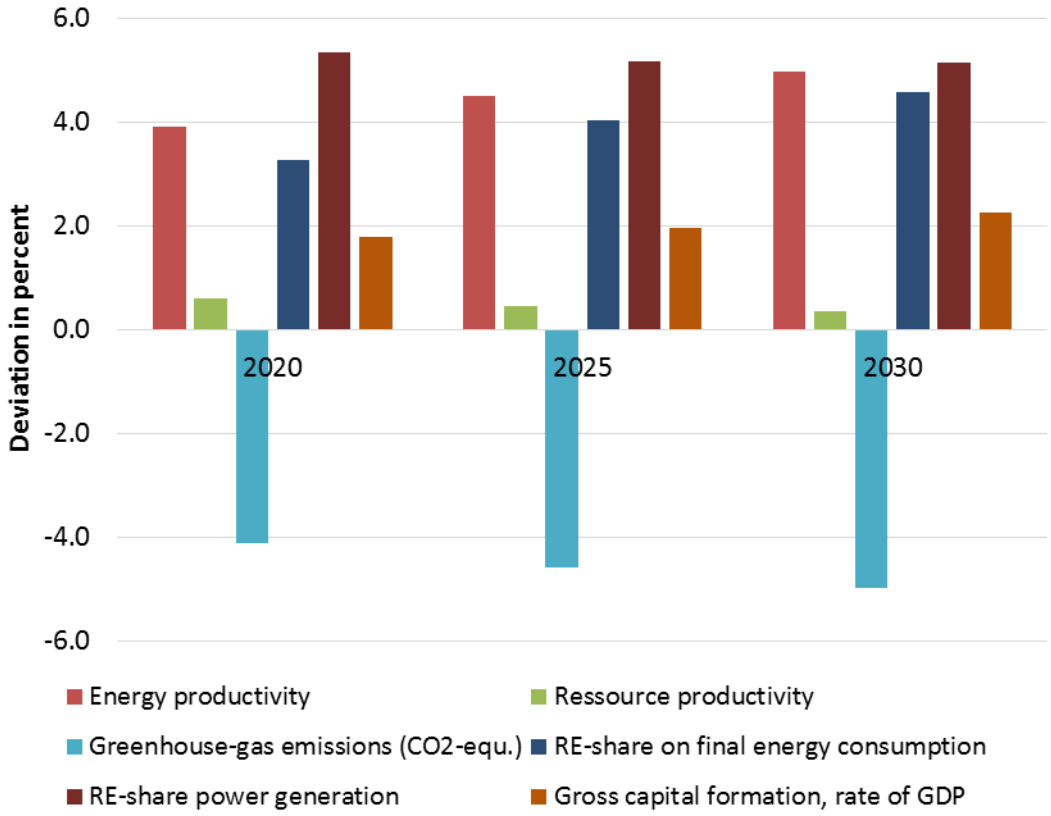
Own results.

3.2 SUSTAINABLITY INDICATORS

How about sustainability? While focusing on economic effects and net employment effects, one driver of the transition to a green economy is the contribution to a more sustainable world. Germany's sustainability concept includes resource protection as one important item. The indicators here are: energy productivity, primary energy use and resource productivity (UBA 2016). The reader might note a slight dominance of energy also in this catalogue. Table 3 shows for the years 2020, 2025 and 2030, the percentage deviations of the indicator from the reference case. Energy productivity is defined as the ratio of price-adjusted GDP and primary energy consumption. The indicator has 1990 = 100 as a base and is larger than 100, if either more GDP is generated per energy consumption compared to 1990, or less energy is used for the same GDP as 1990. In the efficiency scenario, it is consistently higher than in the reference case. In the year 2020 for example, the indicator is195.35, meaning almost twice as efficient as 1990 in the reference, but 202.97 already in the scenario.

The scenario also improves most sustainability indicators not directly related to resource protection, such as CO2 emission, share of renewable energy in electricity generation, share of renewables in final energy demand and the ratio of investment to GDP.

Figure 3: Percentage change of sustainability indicators in the scenario compared to the reference case



Own results.

Intergenerational justice belongs to the list of relevant items for sustainable development. As a proxy, it is often measured by the ratio of gross fixed capital formation to GDP. The idea behind this indicator is that investments constitute the basis for future possible entrepreneurial trade and define the capital stock, with which future generations can produce, but also light, heat and transport. Therefore, the gross fixed capital formation, which include "buildings (residential and non-residential), equipment (machinery, vehicles, equipment) and other assets (intangible assets such as software and copyright - rights, property transfer costs, production livestock) (StaBA 2015), in different ways influence the transformation to the Green Economy. On the one hand investment in efficient systems leads to a reduction in energy and material consumption, on the other hand new construction projects lead to increased material consumption. Overall the benefits are dominant, the Federal Government claimed the share of gross fixed capital formation to gross domestic product (the investment ratio) to increase as a sustainable objective. The coalition agreement for the 18th legislative period states, that a total investment ratio is desired, which is above the average of the OECD. Around the turn of the millennium, the investment rate fell below 20%, which is three to four percentage points below the OECD average. The scenario does not close this gap, but can contribute about half a percentage point.

Raw material productivity is similarly defined as the ratio of the price-adjusted GDP to abiotic primary material used. The increase in raw material productivity takes place much more slowly and also the difference of the scenario to the reference is lower, but positive

throughout. The indicator of the greenhouse gas emissions in CO2 equivalents refers to 1990, too. Improvement is shown in a decline in the indicator, the lower GHG in comparison to 1990, the better it is for the climate. Compared to the reference indicator in the scenario is again significantly lower and the distance grows over the observation period.

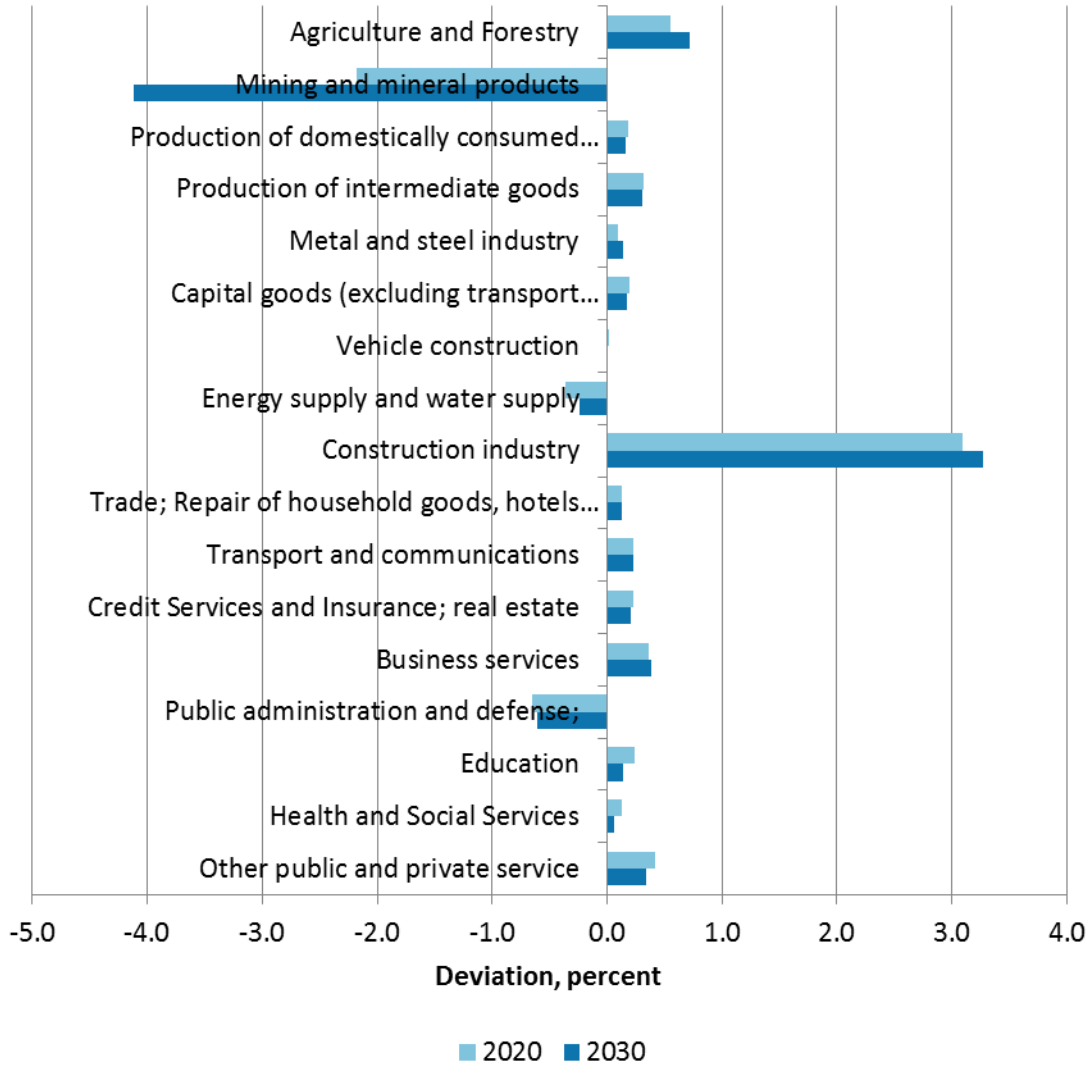
The counseling program for resource protection in the scenario mainly aims at ores. The use of construction minerals is in the scenario lower than in the reference case and the overall use of abiotic primary material goes back by more than 1.5%.

Thus far, a positive picture emerges. GDP runs at a slightly higher path, the environmental indicators point in the direction of more efficient, less polluting economy and there are more people employed than in the reference. However, the question arises whether there are only winners, or if certain sectors are negatively affected, while others win.

3.3 SECTORAL RESULTS

The transformation to the Green Economy leads to a comprehensive structural change, which on the long term affects most sectors of the economy. The sectors are affected to different degrees. In a nutshell: if less energy or raw materials are used, producers of energy or raw materials face a shrinking market. This leads to a decline in employment in this field of activity, which can be offset by a re-orientation. Best examples are demand side management services and contracting by energy utilities or recycling of material as a new business opportunity. Figure 4 gives an overview of the sector specific employment changes.

Figure 4: Sectoral employment effects scenario in relative deviation from the reference



Source: Own calculations.

The largest percentage deviation is attributable to the extraction of building material, where the decrease is mainly attributable to the introduction of the construction material tax; and on construction activity. In absolute terms, the 3% increase in the construction sector stands for 55,000 employees, so that the 4% decrease with less than 2,000 employees is more than compensated. Services win and so does landscaping, which plays an important role in recultivation. The effects in the industrial sectors of the economy are positive but small.

4 CONCLUSIONS AND OUTLOOK

This contribution reports results from a larger study on the net employment effects along the pathway to a Green Economy in Germany. Next to the efficiency scenario described

above, the study explored the transport sector, organic farming and other areas. The change of economic structure, however, is the largest in the efficiency scenario.

Additional investments have invigorating impulses, price increases, or changes in relative prices can have a dampening effect. Several measures are accompanied by an increase in construction activity. The construction sector benefited from energy efficiency measures in residential and office buildings, schools and hospitals, from bike paths and improving the cycling infrastructure or the development of renewable energies. Although the sector itself already recycles much of its materials, is still responsible for a large part of the resource and material consumption in Germany. 44% of the materials used in total (domestic extraction and imports) are used in construction - in domestic extraction, this amounts to 68

The tax revenue is then used to further the transformation to a Green Economy. An essential feature of the Green Economy should be the environmental benefits. The presented scenario shows noticeable reductions in greenhouse gas emissions and resource extraction. Macroeconomic models can calculate economic effects along alternative new future paths only as good as the best bottom-up determined scenarios describe these paths. Therefore, the simulations above can only explore the opportunity space and serve as a starting point for further discussion of aspects of the transformation to a Green Economy. In conclusion it must be noted that the positive effects outweigh the negative effects. If technologies drive the transformation, Germany is well placed to develop these technologies and deliver on the global markets. Other industries such as construction and a variety of services are in demand in the greener future and to adapt to increasing demand.

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