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Economic Opportunities of Climate Action

Short report

For our Environment

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Economic Opportunities of Climate Action

Short report

by

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1 Introduction

In 2015, the **Paris Climate Agreement** has created a new framework for fighting climate change. The world is set to become greenhouse gas-neutral by the middle of the 21st century. Global warming should be kept below two degrees Celsius or even limited to no more than 1.5 degrees Celsius. At the national level, all signatory countries are required to set binding goals and to take suitable action to reach them. In 2016 Germany adopted a long-term strategy in the form of the Climate Action Plan 2050. Against the backdrop of the Paris agreement Germany aims at greenhouse gas neutrality by 2050.

The necessary international endeavours to reduce greenhouse gases lead to **new export markets** for climate-friendly goods and services. Climate change thus represents significant opportunities for the German economy.

Along with additional export potentials, the German economy can profit from climate change in other ways: additional investments, extensive innovation effects, and lower costs through increasing efficiency. A comprehensive survey of the economic impacts of ambitious climate policy looks at these opportunities in detail. Three separate publications, summarized in this paper, intensively examine such important questions as:

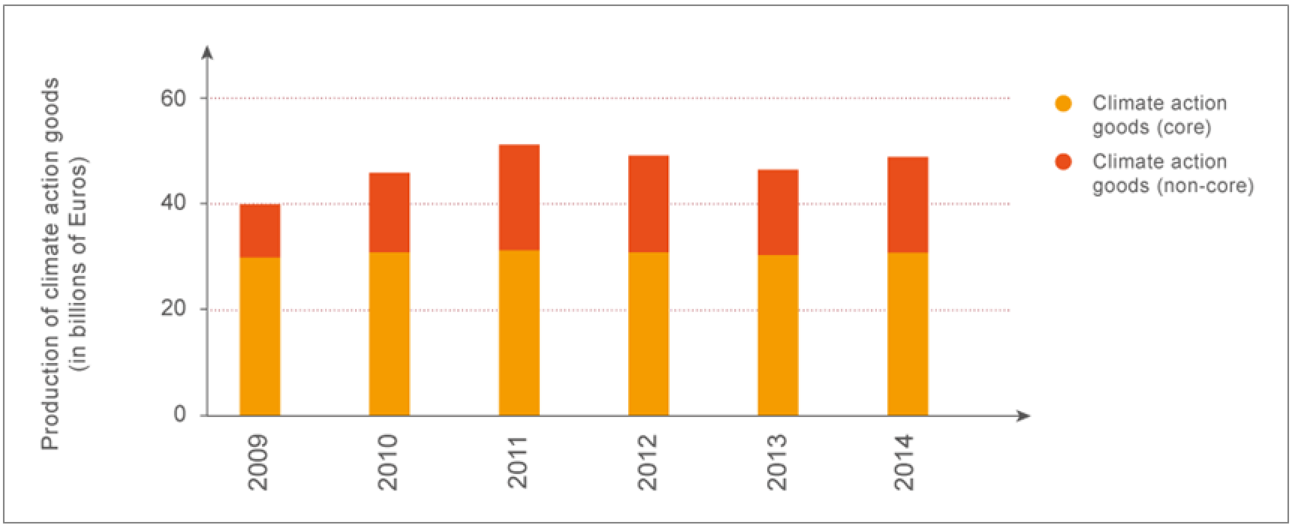
- What economic advantages has climate action already brought?
- What future potentials result from the growing global market for goods for climate action?
- What are the effects of an investment-oriented climate policy for the national economy?

2 The Status Quo

2.1 The "Climate Action Economy"

The **climate action economy** principally encompasses all economic entities, goods, and services produced for climate action endeavours. These serve to limit future climate change and consist of measures for reducing emissions and strengthening the reduction in greenhouse gases in practically all economic spheres. The current study has taken into account a broad spectrum of measures and activities for climate action. Alongside **measures taken in connection with the transformation and use of energy (core climate action)**, other **activities** are also considered **that** have contributed to the **fight against climate change** in addition to their other environmental benefits, such as air pollution controls, or those that also contribute to climate action through cross-sectional technologies, like measurement and control technologies **(non-core climate action).**

Figure 1: On the specific sales production of climate action goods



Source: own calculations, DIW

To be able to state how large the climate action economy in Germany is, various approaches exist, which have been pursued in parallel in this study. A conservative estimate is based upon an evaluation of production statistics for a comparatively narrowly-defined list of (potential) climate action products, i.e. products that, given their function, could be used to protect the climate. This list (NIW/destatis) was created on behalf of the Federal Environment Agency by the Lower Saxony Institute for Economic Research (NIW) in cooperation with the German Federal Statistical Office.[1] **According to the list, the turnover of climate action products in the core climate action fields was worth nearly 33bn Euros in 2014.** Of that total, goods for efficient energy use accounted for 18bn Euros, and renewable energy facilities around 13bn Euros. Compared to the year 2009, turnover of climate action products grew by around 3bn Euros; this represents for the period 2009 to 2014 **an annual average growth rate of 2 percent.** However, this growth did not progress consistently during the whole period. Following the collapse in production following the 2008 global financial crisis, the period up to 2011 witnessed a dynamic growth in turnover (annual average: 11,5 percent). After that, production actually decreased slightly (annual average: -3.9 percent between 2011 and 2014).

The course of production of climate goods was heavily influenced by the **particular development of photovoltaics** as part of the category "renewable energy facilities": the value of production of PV cells and inverters reached its pinnacle in Germany in 2010, and declined sharply thereafter. The production of PV cells declined dramatically in 2012 and 2013 – not least of all due to the collapse in prices – with this product group most recently registering a production value only one-fifth of that for 2010. As a result, the share of renewable energy facilities accounted for by PV cells fell from 20 percent in 2010 to its most recent value of 4 percent. On the other hand, wind energy facilities gained in importance over the same period; their production now accounts for the largest share of renewable energy facilities production.

Calculated as part of the production of all industrial goods in Germany, the **share of climate action products** (core and non-core) **in 2014 stood at 3.6 percent** (core areas 2.4 percent, non-core areas 1.1 percent). That share has – not least of all due to the particular developments in PV cell prod-

1 For this project, the DIW Berlin also analysed – for the first time for Germany –the production of climate action goods based on the Combined List of Environmental Goods der OECD (CLEG) for the years 2009-2014. Results of the analysis are documented in the final report (Abschlussbericht).

uct described above – slightly decreased in relation to 2009 (3.8 percent), but has recently begun to increase again.

Services are not included in the lists of products. As with other types of services, it is difficult to capture them statistically. For this reason, official statistics can only provide a first point of departure for assessing the importance of climate action services. According to these statistics, **the service sectors of the climate action economy** play, compared to the production of goods, **a smaller but not meaningless role**. In 2013, climate action-related **turnover** in the "provision of freelance, scientific, and technical services" (especially architectural and engineering firms) and "provision of other economic services" was **around 2.8bn Euros**. This sum was 6.5 percent of turnover in all sectors with climate action related production. The service sectors are strongly oriented towards the domestic climate action market. Only around 22 percent of climate action-related turnover in both service sectors was gained via foreign trade. The climate action market within the services sectors contracted particularly strongly from 2011 to 2013, both in relation to the other sectors and to the other markets for environmental goods; the foreign market expanded, although less strongly than for the other sectors.

2.2 Climate action as a factor for employment

The employment due to the provision of **climate action services** was estimated at about **480.000 people** for the year 2012. Of these employees, about 40 percent work to provides services to other companies. Also in construction and manufacturing, many employees provide services which benefit climate action (estimated at 56 and 51 thousands respectively), as well as in transportation and utilities.

Consistent with these estimates is the calculation of employment generated by the demand for capital goods used for climate action. This calculation captures also indirect employment effects in other sectors and branches. Overall, it is estimated that **530.000 people** are employed in Germany due to the demand for products used for climate action. In total, the number of employees due to climate action is about 1 million people. If the loss of jobs due to a reduction of energy generated from fossil fuels is taken into account, the net employment effect due to the energy transition in Germany is still positive.

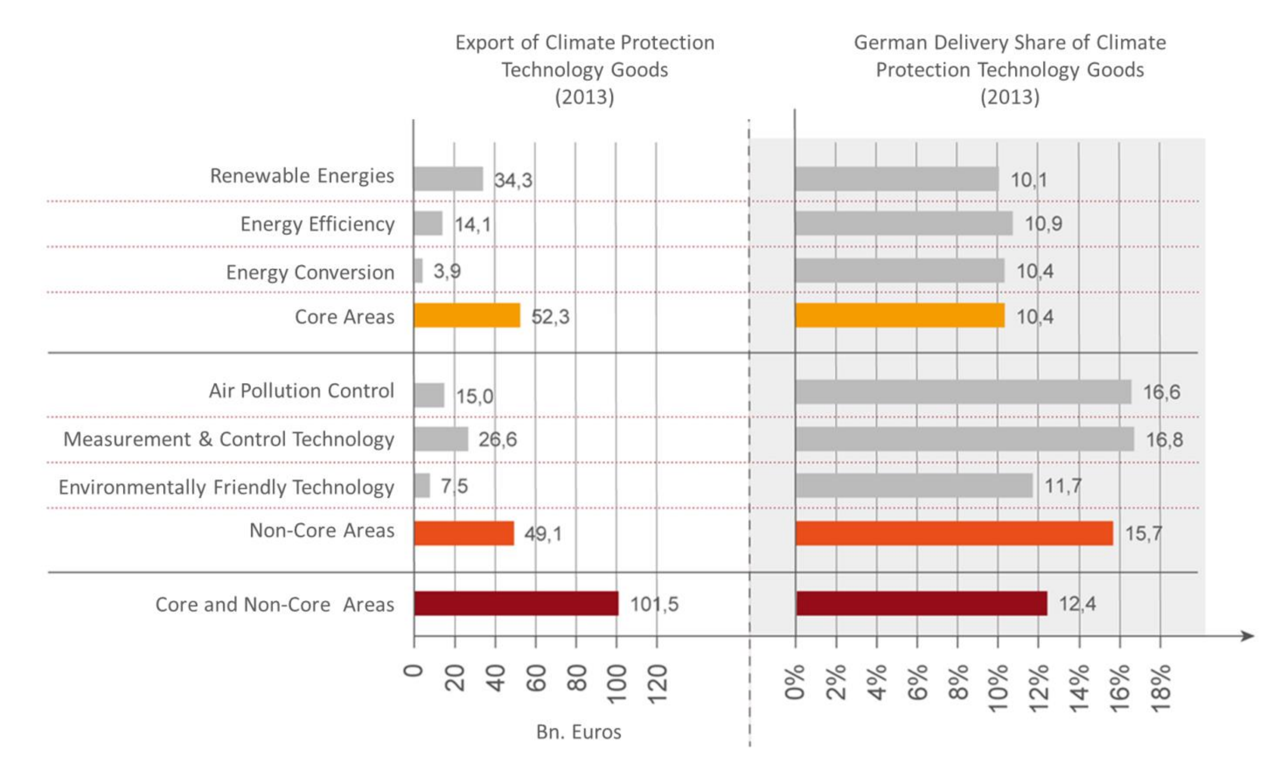
2.3 Climate action technologies as export goods

In order to estimate the exports of goods used for climate action, a new category of goods was introduced and referred to as „climate action technology goods", for which two production lists of goods were combined (see final report). Exports of these climate action technologies amounted to **around 100bn Euros** in 2013, **9.4 percent of all German commodity exports**. Most significant were goods for renewable energy facilities and for measurement and control technology; also very important were products for air pollution control and efficient energy use. German exporters possess – measured against their delivery shares relative to other countries' imports – a particularly strong market position for air control pollution products (16.6 percent) and for measurement and control technology (16.8 percent).

From **2009 to 2013**, **exports rose by 36.5 percent**. The **most important sales markets** for German exporters of climate action technologies are the **EU member states, the non-EU OECD member states, and the BRICS countries**. German delivery shares to the EU countries are especially high, followed by the BRICS countries.

The economic effects of climate action in Germany extend much further than the figures on sales, employment, and exports by the German climate action economy suggest. Germany's climate action policy led to significant cost decreases in a variety of sectors, promoted innovation, stimulated material and resource productivity, and strengthened security of supply.

Figure 2: Exports of climate action technologies by climate action field



Source: COMTRADE and calculations of DIW

2.4 Cost savings via climate action

Germany's climate action policy has led to notable efforts for increasing **energy efficiency**, but exact figures for resulting cost savings are difficult to estimate. A rough estimate can be gained by calculating what it would cost to produce currently available goods and services at rate of energy input from the year 1995, and to compare that with present day energy costs. The resulting figure shows that savings attained using energy consumption at 2013 levels compared to 1995 levels were in excess of **10bn Euros in industry alone.** This amount can be used for refinancing of efficiency measures. Using the same method, savings for **private households** reached a total of **over 13bn Euros** relative to 1995. For comparison and orientation: Private households spend more than 120bn Euros on energy annually. For **commerce, trade, and services,** this estimate is somewhat more difficult. Calculating savings using **industrial energy prices**, **savings of 9bn Euros** are reached.

In addition to the cost savings attained through increased energy efficiency, climate action contributes a diversity of other cost savings. Reduced environmental costs are especially worth of mentioning here. In total, the decrease of greenhouse gas emissions between 1991 and 2014 reduced the **environmental costs** of climate change by about **18,7bn Euros**.

The **build-up of renewable energies** prevented **environmental damages in the approximate total sum of 11.6bn Euros** in 2014 – **based solely on** the environmental costs of **greenhouse gases**, other costs associated with damage to the environment not even included. The **increase in energy efficiency led to overall cost savings** (related to greenhouse gases) **of nearly 15bn Euros** between 1995 and 2013 (5.8bn Euros in industry, 4.7bn Euros in commerce, trade, and services, and 4.3bn Euros in the household sector). A **further 5.8bn Euros in reduced costs from environmental damages from reduced methane gas emissions** can be added to that figure.

2.5 Climate action and material and resource productivity

Pro-active climate policies can also drive innovation in material and resource productivity. The use of secondary instead of primary raw materials has a significant potential for CO_2 savings. For example, the Federal Association of German Steel Recycling and Disposal Companies estimates **emissions savings in Germany resulting from the use of steel scrap at more than 24m tons of CO_2 to date**. That equals **material savings** of **1.5 tons ore and 0.5 tonnes of fuel per tonne of steel scrap**. There are also large synergy effects in cement production. Annual global **cement production** levels are at nearly 3bn tonnes, responsible for roughly 5 percent of CO_2 emissions. **A new process** for producing cement can **halve CO_2 emissions** while using considerably less energy. **Parallel** to that, **the need for limestone can be reduced by up to two-thirds**.

2.6 Climate action and innovation

Ambitious climate action requires advances and innovation in a wide variety of economic sectors. The German government therefore applies a number of instruments and measures designed to drive innovation in climate action. For example, **research funding** not only supports new technologies and processes aimed at sustainability, but is also intended to strengthen the competitiveness of German businesses on the global market (Staatssekretärsausschuss 2015). **In 2013 alone, around 300 million Euros were used within the framework of the 6th Energy Research Programme** for research on renewable energies (BMUB 2015). The Renewable Energy Act and yearly reductions to the feed-in remuneration have contributed further to innovations in the energy sector. Indicators of this are the numerous new discoveries and the increase in patent applications in Germany in the area of renewable energies since 2005 (Maier et al. 2014).). Worldwide, the number of patents introduced per year increased about fivefold between 1991 and 2012. **Germany has taken a pioneering role in international comparisons** when it comes to the number of **patent applications relating to climate action**: **nearly 50 percent of all applications in Europe** (Rudyk et al. 2015). In general, innovation and research in Germany are focused on renewable energies and energy efficiency (including electric vehicles).

Between 1991 and 2012, the number of patents for climate action technologies registered in Germany grew about 3.5 fold and thus by a significant larger proportion than the total number of patents and the number of environmental patents, which both grew about 2.5 fold. The registration of **renewable energies** and **energy transformation** even increased tenfold (Gehrke et al. 2015). Between 2005 and 2012 the number of patents at the German Patentamt grew particularly dynamically to 2000 registrations annually.

Reliable climate politics with a long-term perspective can help to **avoid stranded investments** and thereby reduces financial risks. It also facilitates strategic management of enterprises reducing costs and stimulating private investments.

2.7 Reduced import dependency and increased supply security

Germany, as a resource-poor country, is forced to import a significant share of its resource inputs, which includes risks posed by delivery failures and by dependence on strongly fluctuating import prices. These risks can be countered by reducing energy usage, but especially by strongly increasing the diversity of energy suppliers. Decreased import volumes resulting from the build-up of renewable energies amounts to an average of 10bn Euros, and energy efficiency measures have led to a relative fall in imports of up to 26bn Euros compared to a scenario without energy efficiency measures. Decreases in imports from the build-up in renewable energies can be traced back roughly equally to the power and heating sectors (3.84 and 3.99bn Euros) and, to a much smaller degree, to transport.

Due to the reduction in energy consumption and the growth of renewable energies, **supply security** in Germany has **greatly increased**. Between 2000 and 2013, a corresponding diversity indicator taking import independence and country stability into account increased by about 10 percent, despite worsening risks in multiple source countries for that time period.

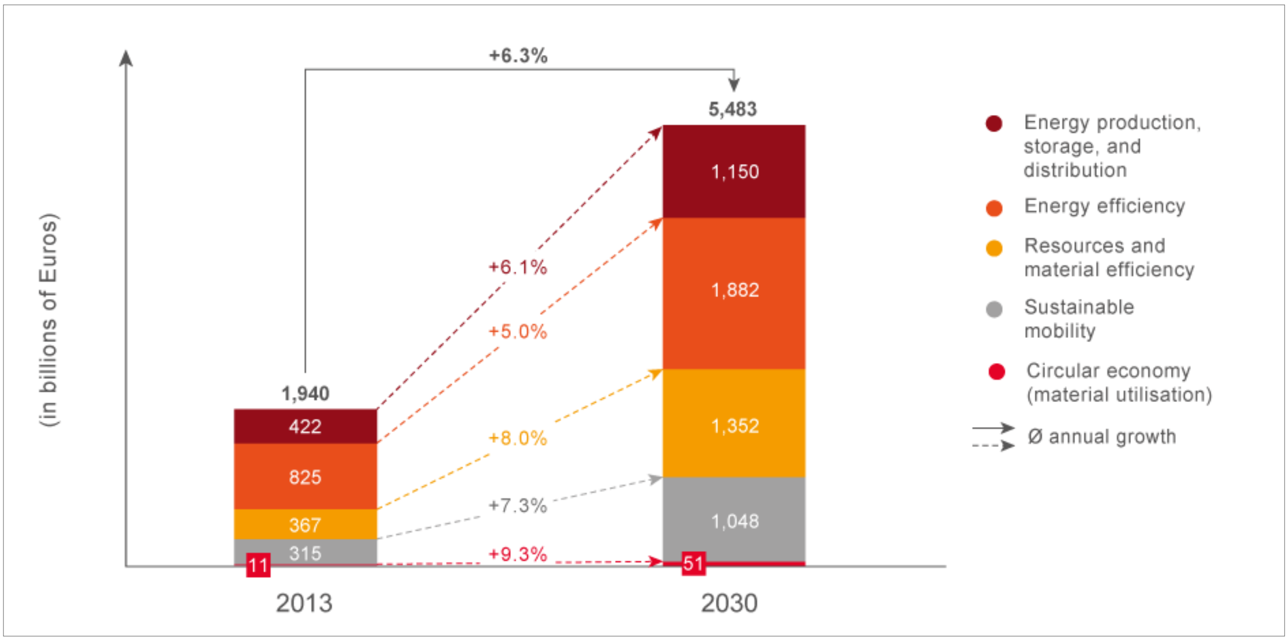
3 The growing global markets for climate action products and services

According to the Paris Climate Agreement of December 2015, states are meant to submit climate action plans every five years from 2020, which must be as ambitious as possible. Producers and providers of climate action products worldwide could profit from this development. This applies especially to German producers, who are traditionally strong in exports.

3.1 Growth of global markets for climate action

Using a special market model, two forecast scenarios for the development of global market volumes for the five climate action lead markets energy production, storage and distribution, energy efficiency, resource and material efficiency, sustainable mobility, and circular economy were produced. A conservative BAU scenario ("business as usual") comprises resolutions at national and international levels that are already in the implementation phase and those that are very likely to be implemented. Additional efforts for climate action are not taken into account. This is compared with a 2° scenario. Within this scenario, reductions in energy consumption and CO_2 emissions, and the production of energy from renewable sources are the primary drivers for achieving the 2° goal. Even the BAU scenario projects significant market growth.

Figure 3: Global market volumes for the BAU scenario

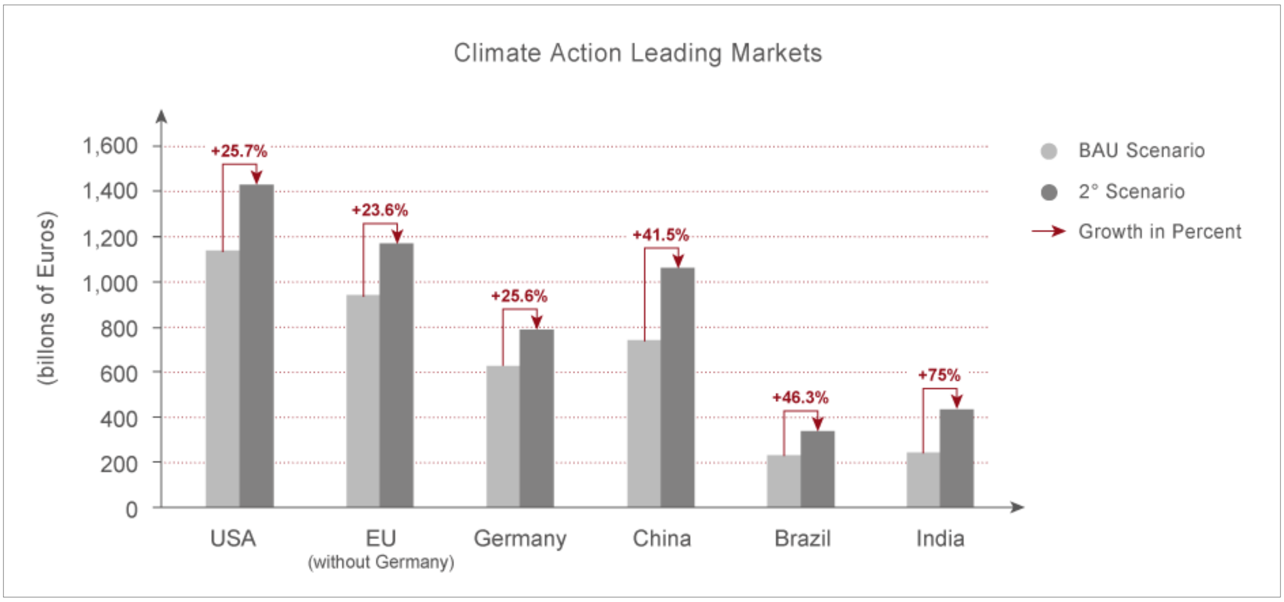


Source: own illustration, Roland Berger

Average annual growth in all five lead markets for climate action is 6.3 percent, at around 5.5 trillion Euros. The circular economy shows the highest growth, although from a very low starting point. Even the energy efficiency market, already a very important global market at a market volume of 825bn Euros in 2013, shows further average annual growth of 5 percent to 2030.

Assuming that the **2° goal** is attained, the global market for climate action would have to grow even more strongly: projected **additional growth of 37 percent**. The overall market value would then be around 7.5 trillion Euros. Market growth will impact individual countries in very different ways. Whereas industrial nations like the USA or Germany will each achieve additional investments of around 25 percent, China, Brazil, and India will witness even higher growth. The current development status of each country and the varying existing distribution and installation of climate action technologies play a role here.

Figure 4: Differences in climate action lead market volumes between the BAU scenario and the 2° scenario in selected countries (2030)



Source: own illustration, Roland Berger

3.2 Export opportunities of climate action

Significant opportunities for the export of climate action technologies are connected with this global market growth. Using a world trade model, these opportunities could be determined more precisely. Various preliminary considerations were important here: How future demand for German exports will develop does not solely depend on global market growth. The future share of demand in destination countries that is imported from abroad is also important to consider (development of import quotas).

The development of import quotas will likely be influenced by two opposing trends:

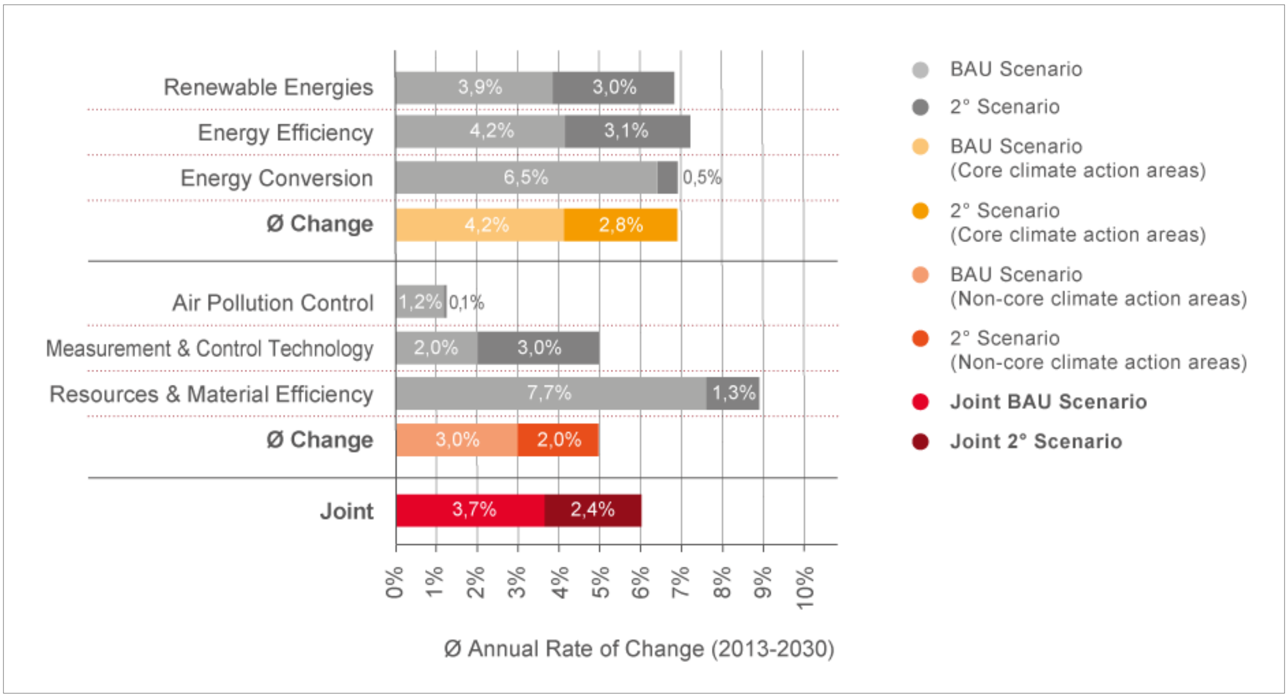
- Import quotas are increasing with globalization.
- Import quotas will be subdued by the build-up of national production capacities for climate action technologies in other countries; especially given an intensified global climate action policy.

The German **delivery share** of other countries' imports of climate action technologies will likely decrease if their national production capacities are built up and if these countries compete more strongly in third markets. If Germany took a leading role in an intensified global climate action, however, losses of delivery shares could be countered by improved competitiveness.

Taking such developments into account, an increase in global demand as in the BAU scenario could lead to an **increase in German exports** of climate action technologies in real terms of **3.7 percent per year**. With accelerated climate action (**2° scenario**), this would be **6.1 percent** (Figure 5).

In the scenario with ambitious climate action (achieving the 2° goal), the goods structure of German exports shifts more strongly towards technologies for using renewable energies and for increasing energy efficiency than under BAU conditions. Most export goods for climate action are delivered by the sectors electrical equipment, computing devices, electronic and optical instruments, and mechanical engineering.

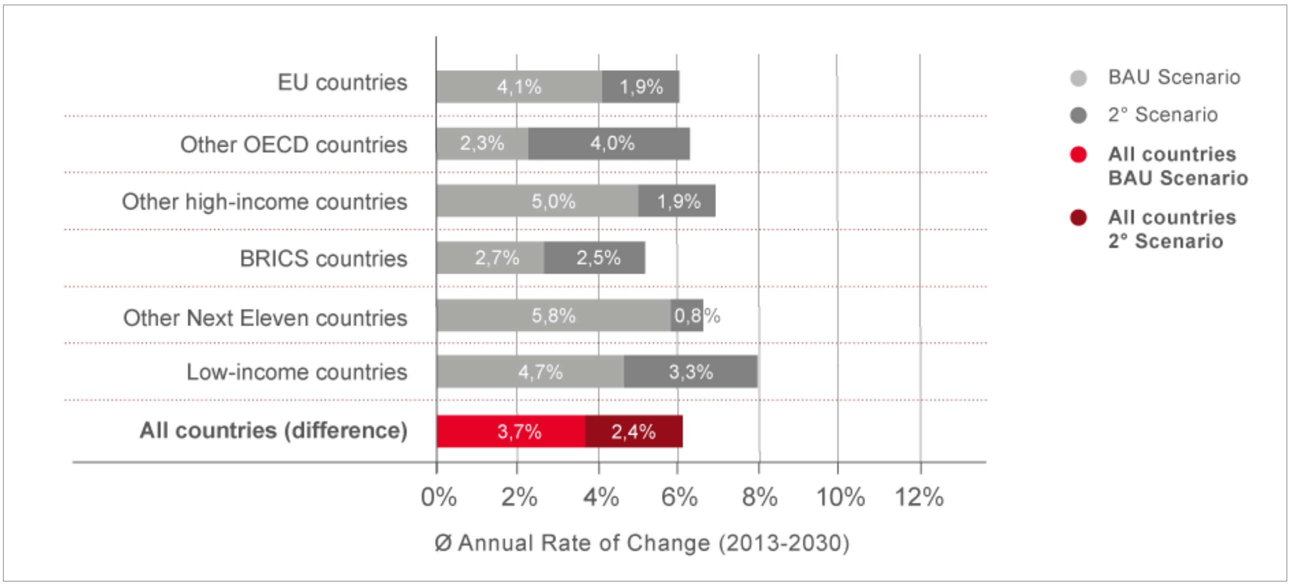
Figure 5: Development of German climate action technology exports by climate action sector



Source: own illustration, DIW

Relatively speaking, exports increase primarily for low-income countries, while they increase at below-average rates in the EU and BRICS countries (Figure 6).

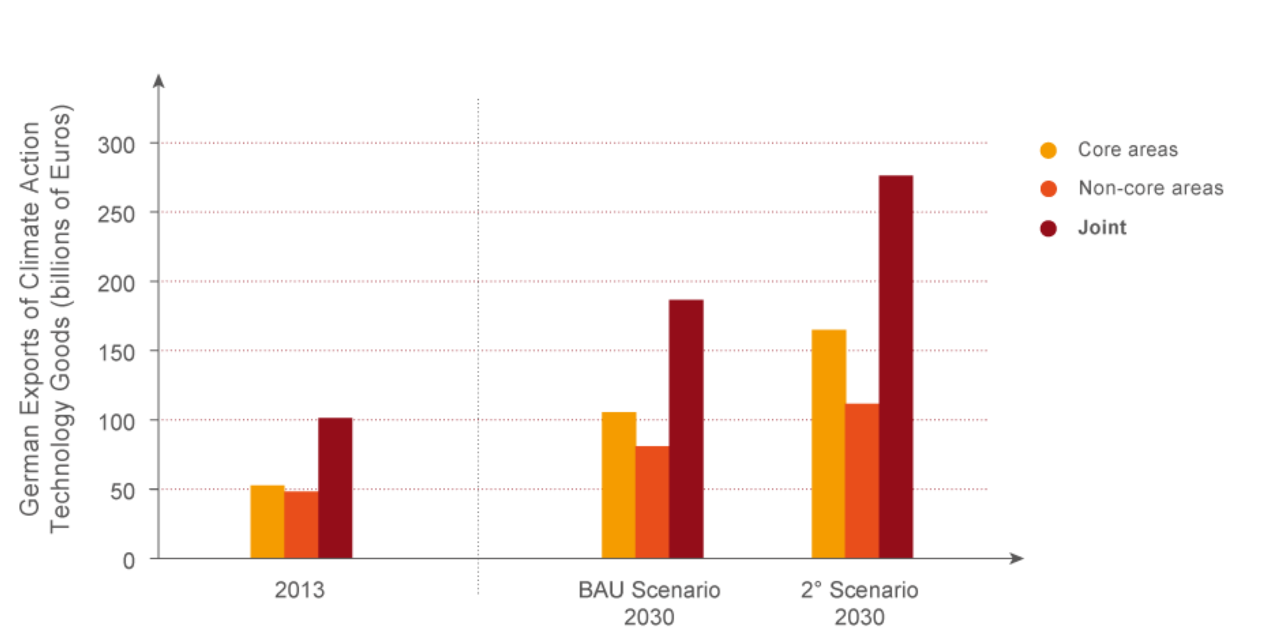
Figure 6: Development of German climate action technology exports by country groups



Source: own illustration, DIW

In absolute numbers, exports grow from 101bn Euros for core and non-core climate action technologies to 187bn Euros in the BAU scenario and 277bn Euros in the 2° scenario (Figure 7).

Figure 7: German exports of climate action technologies in the BAU and 2° scenarios



Source: own calculations, DIW

3.3 Overall economic effects of increased exports given globally ambitious climate action

To estimate the overall economic effects of larger exports for the scenario with ambitious global climate action the economic model PANTA RHEI was used. The use of this model ensures that supply chains and feedbacks within the economy are taken into account. For both the BAU scenario and the 2° scenario additional exports were used as input to the model. Differences between the two scenarios in terms of gross domestic product (GDP) and employment can then be attributed to the additional exports (ceteris paribus method). Due to a larger external demand, domestic production increases. The larger production results in larger employment and a larger demand for input goods. The demand for additional inputs, in turn, results in additional growth of domestic GDP or larger imports.

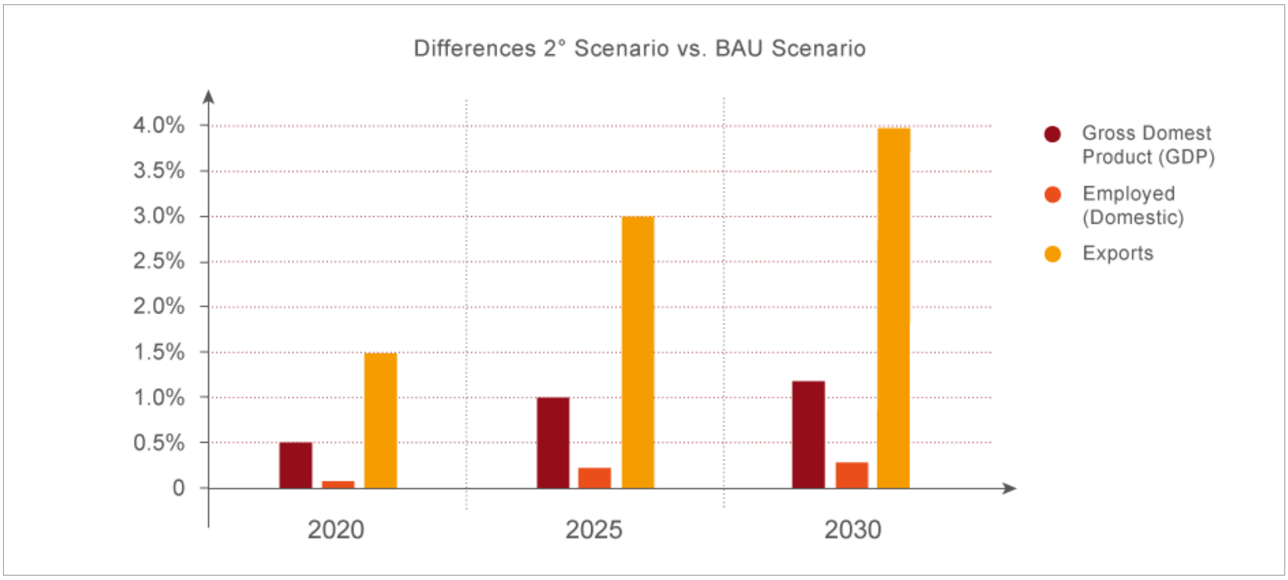
Additional exports of climate action products have a positive effect on the **GDP**, as it **is 0.5 percent higher than in the comparison scenario in 2020**, and the difference in GDP between the scenarios grows (Figure 8). In the 2° scenario, private consumption in 2020 is 0.4 percent higher than in the BAU scenario, and 1.2 percent higher in 2030, as growth positively impacts the income of private households. The high significance of consumption for the GDP is therefore supported with additional exports in the scenario. The growth of private consumption due to the additional exports in the 2° scenario until 2030 is around 1.1 percent and therefore equals the average yearly growth rate of private consumption between 1995 and 2015.

To achieve the production capacities for the additional production, there will have to be investment in equipment and buildings[2]. The sectors in which increased demand is generated by the export of climate action products will have to especially invest in new facilities and structures. In the 2°scenario, investments in equipment for 2020 are 0.6 percent higher, and in 2030 1.4 percent higher than in the BAU scenario. For construction of buildings, the difference in 2030 is at ca. 0.6 percent.

The growth rates for employment are somewhat lower: A look at the structure of the sectors exporting more climate action products shows that less labour intensive, often highly automated production processes are used. Much higher exports can be ascertained in the 2° scenario, especially for electrical equipment (additional export of 31bn Euros in comparison with the BAU scenario in 2030), for electronic instruments (+25bn Euro), and for mechanical engineering (+13bn Euros). Higher production consequently leads to disproportionally smaller employment increases. Other economic sectors that provide production inputs for these sectors will also see more demand and production (indirect employment) and also use production processes that are partially or completely automated. Nevertheless, the relative difference between the two scenarios resulting from these effects amounts to ca. 0.3 percent in 2030, which corresponds to an absolute number of around **110,000 additional positions.**

The additional exports in the 2° scenario will also benefit the state budget. State revenue is derived from, among other sources, income and property taxes, which will increase due to increased employment. In the 2° scenario, the state has additional income-tax revenues in 2030 of around 6.5bn Euros (+1.3 percent). Production and import revenues will also increase slightly, being ca. 4.6bn higher in 2030 than in the BAU scenario (+1.1 percent). Overall, the **public fiscal balance** in 2030 is **around 13bn Euros higher in the 2° scenario than in the BAU scenario.**

Figure 8: GDP, employment, and exports



Source: own calculations, GWS

[2] The national accounts distinguish between investments in equipment and buildings. The German Federal Statistical Office defines: investments in equipment include machinery and devices (including military weapon systems), factory and business equipment and vehicles. Integral components of buildings like elevators, heating systems, pipelines and the like are not included, but permanently mounted machines or components of complex fabrication plants are. Investments in buildings include construction works on residential and non-residential buildings as well as integral components of buildings like elevators, heating-, cooling- and ventilation systems, gardens and fences.

3.4 Case studies of attractive export markets

In addition to the results from economic models, the future perspectives of the climate action economy in Germany were analysed in more detail for four selected export markets. Based on a scoring model, four export markets were chosen: recycling of PV panels, infrastructure for charging and network integration of electro-mobility, Li-batteries, and re-use of industrial waste heat.

Using expert interviews with representatives of these branches, current export barriers and support options were identified. These were used to derive recommendations from the perspective of the private sector. The recommendations include an early promotion of new technologies in order to realise economies of scale and first-mover advantages, a targeted support of technologies considering target groups along the supply chain, and an enhanced promotion of cooperation between science and industry. Beyond that, private enterprises providing climate action goods and services benefit from support for establishing international private sector partnerships. Furthermore, the interviewees suggested a better inclusion of the private sector in international cooperation and an enhanced transfer of environmental policies into other countries in order to make the regulatory political framework more beneficial for export businesses.

4 Climate action policy as a strategy for overcoming weak investment

A productive capital stock is the foundation for innovation, technological progress, and having a claim to international competition. In a modern national economy, when investments are lacking for a longer period of time, economic success is threatened (Expert Commission on Strengthening Investments in Germany, 2015). Since the year 2000, the rate of investment has continuously been below the official target value set by the government, the average value for all member countries of the OECD. Since 2011, the overall rate of investment has stabilised at around 19 to 20 percent, after being below this level in most of the prior years (Alm und Meurers 2014).

The transition to a greenhouse gas neutral economy requires high investments in important fields of action. To analyse the impacts of these investments, **scenarios on future investment paths** were developed for various climate action areas. The scenarios thus took into account the lead markets “environmentally-friendly production, storage, and distribution of energy”, “energy efficiency”, and “sustainable mobility”. Areas of action were matched to those markets for which a **reference scenario** was developed to compare with an investment scenario. The reference scenario is based on the reference scenario of the energy reference prognosis (ERP-REF) (cf. Schlesinger et al. 2014). It describes a climate policy that is rather restrained. As a comparison, an **investment scenario** was developed representing particularly ambitious climate policy, i.e. a reduction in greenhouse gas emissions of 95 percent by 2050 relative to 1990.

4.1 Areas of action for investment-oriented climate action

Lead Market Renewable Energies, Network, and Energy Storage: The energy sector has the largest share of greenhouse gas emissions in Germany. Given the existing reduction potentials in the energy sector from a technical and economic perspective compared to other sectors (Pfeiffer et al. 2016), disproportionately high sectoral emissions reductions are recommended here. The energy economy and especially the area of action for renewable energies is thus one of the central areas of action for ambitious climate action. At the same time increased energy production from wind and solar demands a more flexible electricity system. Feed-in of renewable energies while also guaranteeing network stability at a low voltage level represents a challenge. A prerequisite for network stability is that the frequency and voltage constantly remain within their pre-defined parameters (Agricola et al. 2014). For the action area energy storage, the build-up of energy storage technology is examined for this reason.

Lead Market Energy Efficiency: Another source of greenhouse gases is the building sector. Its share of overall German energy needs is at around 40 percent. Residential building accounts for two thirds, non-residential building for the other third (dena 2012). To reduce these emissions, the government's energy concept calls for a nearly climate-neutral buildings sector by 2050 (BMWi and BMU 2010). In the investment scenario, this approach is followed. Investments are complemented by increases in energy efficiency via the area of action of energy efficient cross-sectional and process technologies. The digital transformation is changing whole industries and sectors at different speeds and intensities. This includes increases in energy efficiency for industrial supporting and core processes. In this are aof action, the study focusses particularly on energy intensive-industries like metal production, basic materials chemistry, and synthetic polymer processing (Dorst 2016).

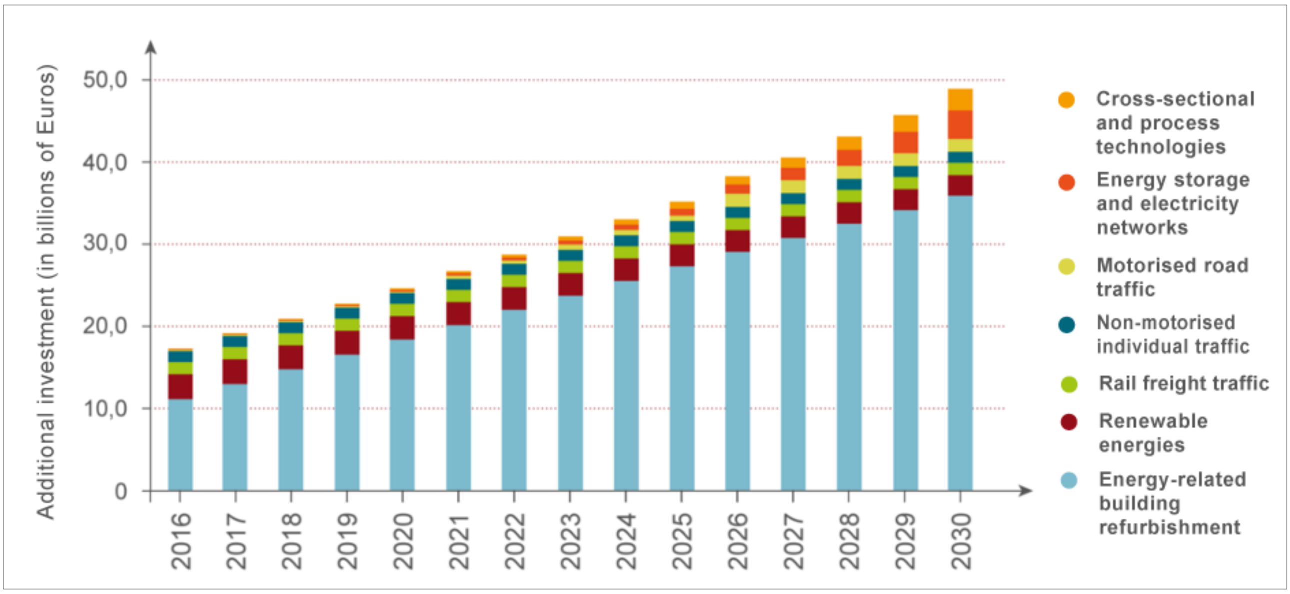
Lead Market Sustainable Mobility: The transport sector in Germany currently accounts for around 31 percent of final energy demand (Kasten et al. 2016). In a scenario with ambitious climate action that assumes a 95 percent reduction in greenhouse gas emissions by 2050, a greenhouse gas-neutral transport sector is the goal (Repenning et al. 2015). Necessary conditions for reaching this goal are the increase of efficiency in transport and the stepwise replacement of fossil fuels by alternative propulsion systems.

In the investment scenario, for the lead market "Sustainable Mobility" moving freight traffic from roads to rails, the introduction of overhead lines for goods transport, an increased use of electric passenger cars and public transport are taken into account.

4.2 Investment effects of ambitious climate action

Additional investments in specific areas of action compared to the reference scenario have been compiled in Figure 9. **The overall additional investments rise from 17.3bn Euros in 2016 to 48.9bn Euros in 2030**. The largest share by far goes to energy-related building refurbishments, followed by renewable energies and rail freight traffic.

Figure 9: Overall additional investment in the individual areas of action



Source: own illustration, adelphi

For the whole observation period, the image is shaped by investments in construction. On the one hand, there is a lot of catching up to do here, as construction investments experienced a marked reduction between 2000 and ca. 2010, and have only recently begun to recover. On the other hand, from a climate action perspective, there is a great need for further efficiency increases for both residential and non-residential buildings. Beyond that, investments in the infrastructure for electromobility, as it has been assumed for the field of action of motorised road traffic, are the foundation for the urgently needed “transport transition”.

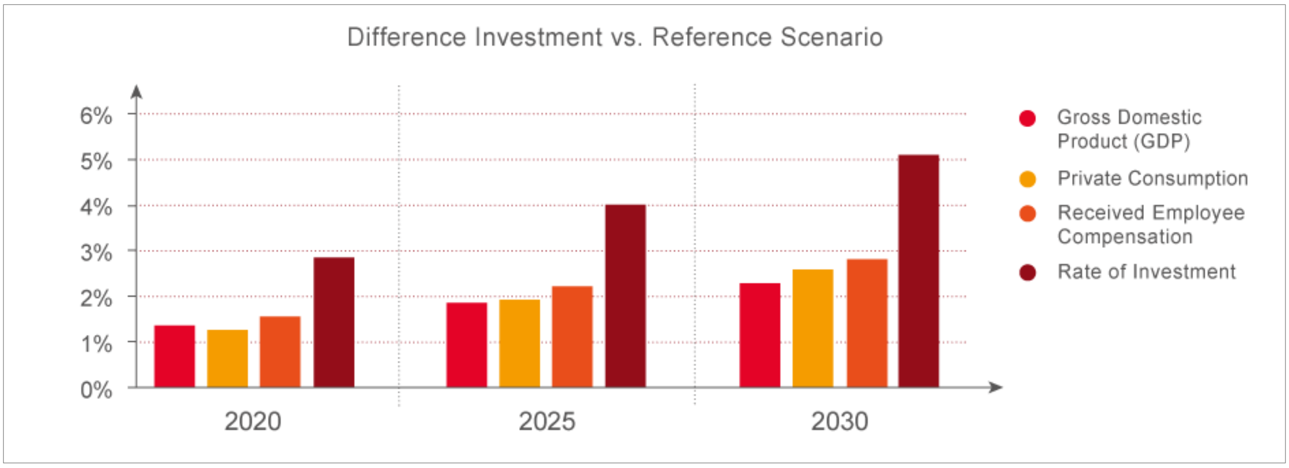
4.3 Overall economic effects of investment-oriented climate action

Investment triggers various economic effects. On the one hand it stimulates production, yet on the other, it has to be refinanced and changes relative prices in the economy. In order to take overall stock of these effects, the economic situation in a scenario with the additional (climate action) investments is compared with the situation in a reference scenario without these investments. The advantageousness of investment-oriented climate action can be derived from the difference in the overall economic indicators such as the gross domestic product and employment between the two scenarios.

For all relevant indicators such as gross domestic product, consumption, income from work, and the investment quota, the difference is positive and increases over time. Overall, the **rate of growth in the investment scenario is higher than in the reference scenario for the entire time period. Private consumption** also **develops** at a **higher level**, primarily attributable to higher wages and salaries (shown in Figure 10 as employee compensation). Over time, savings from reduced energy consumption also factor in, opening further consumption possibilities.

Investment as a driver in the scenario leads to a **much higher rate of investment** compared to the reference scenario. It proceeds at a higher and overall more consistent level over the years. However, this assumes stable framework conditions. **Around 220,000 additional people** would find themselves **employed** in diverse economic sectors as a result of the investments. Analogous to the export scenarios, version 2 of the population projection of the Federal Statistical Office is implemented in the model, which already contains higher migration (see chapter 3.3).

Figure 10: Scenario comparison – important indicators



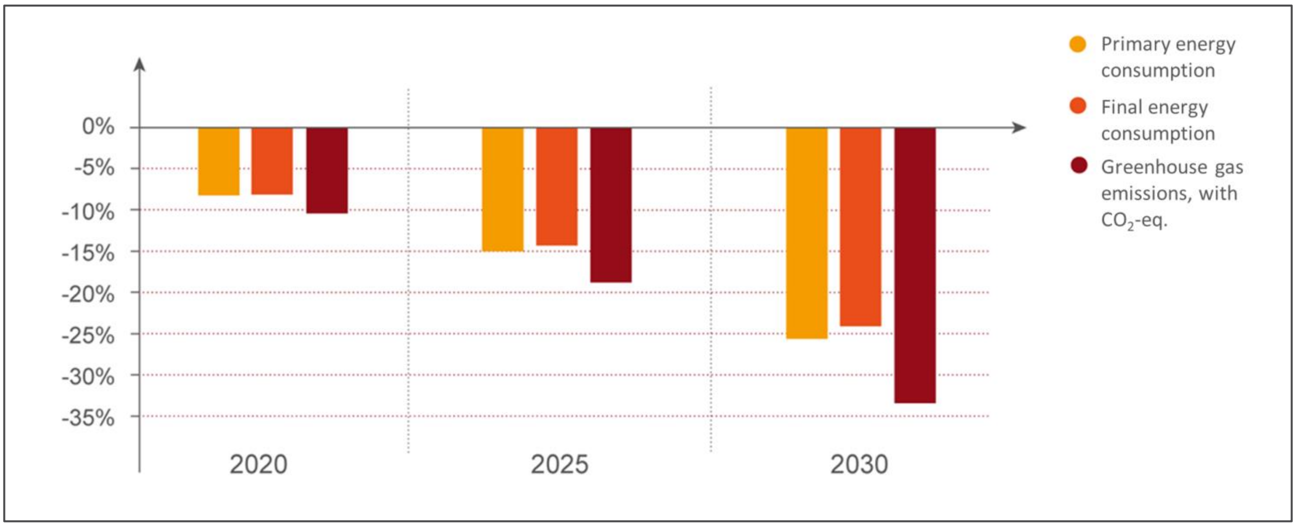
Source: own calculations, GWS

Wage and income develop positively throughout, with up to an additional 70bn Euros in income through 2030. Through taxes on the additional income and the goods sold additionally, **the state will collect an additional 22bn Euro.**

4.4 Climate action investment, energy efficiency and greenhouse gas reductions

The investment scenario also has to be measured by its environmental indicators. Relative to the reference, primary energy consumption, final energy consumption and greenhouse gas emissions are all much lower by 2030. In a scenario in which economic activity is stimulated, this activity also leads to additional emissions emitted. However, emissions reduction goals are better achieved in the investment scenario than in the reference.

Figure 11: Scenario comparison – Primary energy consumption, final energy consumption and greenhouse gas emissions, difference investment vs. reference scenario



Source: own calculations, GWS

4.5 Effects of individual measures

The investment scenario comprises impulses from various areas of action. In order to be able to identify and assign the effects in the individual areas, individual sensitivities were calculated for which the impulses relate to only one area of action.

The strongest effect on gross domestic product and employment overall is the result of investments in building refurbishment. The GDP for 2030 is nearly two percent higher than in the reference scenario, and employment is half a percent higher, despite the nearly exhausted potential for additional workers.

The investment inputs and the energy savings sparked by them also lead to clearly positive effects in all other areas of action. The **GDP is at least 0.5 percent higher in all areas of action than it is in the reference.** This difference increases over time for all areas of action. For each Euro invested, the impacts on employment are highest in the transport and buildings sectors, while impacts on growth (GDP) are highest in the cross-sectional and process technologies sector.

In the long-term, emissions reductions in the refurbishment area of action are the highest. The additional build-up of renewable energies has similarly large effects as the measures taken in transport and energy storage.

5 Conclusion

Besides the realization of environmental policy goals, climate action also has many economic benefits. Central results of the studies “The Status Quo”, “Growing World Markets for Climate Action Goods and

Services" and "Effects of Investment Oriented Climate Action Policy on the National Economy" have been presented in this report.

The sales of core climate action goods in 2014 amounted to almost 33 bn Euros based on the NIW/destatis-list. The production of climate action goods in the industry lead to the employment of 240.000 people. Exports of climate action technology had a share of 9.4% of the German commodity exports in 2013. Climate action also saves energy and prevents social costs; it increases the security of supply and investment activities and has positive effects on material and resource efficiency.

Future benefits of climate action have been captured by growing world markets and effects of a national investment-oriented climate action on the national economy. Under the assumption of the 2° goal, the German exports of climate action goods increase in real terms by 6.1% annually until 2030.

The GDP in the 2° scenario in 2030 is therefore 1% higher and the employment 110,000 people higher than in the BAU scenario. Compared to the reference scenario, a scenario with more investments nationally leads to additional investments of 49 bn Euros. These additional investments lead to a 5% higher investment rate, a 2% higher GDP and 220,000 more employees in 2030.

To fully generate these benefits, a climate action policy is needed that is strictly committed to ambitious goals. The measures that are currently enacted will not suffice to achieve this.

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