Fifth “Energy Transition” Monitoring Report

The Energy of the Future

2015 Reporting Year – Summary
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Central messages from the Fifth Monitoring Report

Renewables are Germany’s number-one source of electricity. With a share of 31.6% in gross electricity consumption, almost one kilowatt hour of electricity in three was derived from renewable sources in 2015.

After the record low of the previous year, primary energy consumption crept up slightly by 0.9% to 13,293 petajoules. Economic growth and colder weather conditions contributed to this increase. The central measures of the National Action Plan on Energy Efficiency adopted in 2014 are implemented by now, or have been introduced and are starting to work.

Having risen 1.3% from 2005 levels, the development of final energy consumption in the transport sector continued to run counter to the goals of the Energy Concept. The aim is to cut final energy consumption by 10% by 2020 compared with figures for 2005. Further efforts are required.

Greenhouse gas emissions increased slightly in 2015 and have dropped by an estimated 27.2% in total compared with 1990 levels. The aim is to reduce greenhouse gas emissions by at least 40% from 1990 levels by the year 2020. In light of this, the consistent implementation of the 2020 Climate Action Programme is of central importance.

The 2050 Climate Action Plan contains fundamental principles and provides orientation for delivery on the global goals set out in the Paris Agreement. For the first time, it defines target corridors for emissions reduction in individual sectors by 2030. These will undergo a comprehensive impact assessment and then be discussed with the social partners. If necessary, adjustments can be made to the sectoral targets in 2018.

The supply of electricity in Germany is secure. Demand for energy in Germany is always met, guaranteeing a high level of supply security. By international standards Germany is also at the forefront, with supply quality consistently at a very high level.

In 2015, electricity prices for household customers fell slightly by an average of 1.4% on the previous year. A slight increase in electricity prices was recorded in 2016. For industrial customers not covered by special compensation arrangements, electricity prices fell by 2.1% in 2015.

In 2015, energy costs from the use of imported primary fossil fuels were down on the previous year, falling from around €77 billion to roughly €55 billion. This was mainly a result of the low prices on the global commodity markets, which fell again significantly in 2015.
1 Monitoring the energy transition

The Energy for the Future monitoring process tracks progress towards goals and checks the implementation of measures to transition the energy system with a view to establishing a secure, economic and environmentally-friendly energy supply, so that adjustments can be made if necessary.

The focus is on three tasks:

Overview: The monitoring process provides a fact-based overview of the current status of progress with regard to implementation of the energy reforms. It condenses the reams of statistical information on energy that have been collected into selected indicators.

Evaluation: Based on the status quo, the annual monitoring reports analyse to what extent targets set out in the Federal Government’s Energy Concept are being met and what effect the measures are having. In areas where the targets are likely to be missed, consolidated progress reports, which are produced every three years, propose measures on the basis of the multi-year data then available in order to remove barriers and reach the targets.

Outlook: The monitoring process also looks ahead to the likely development of key indicators. The progress reports capture and visualise reliable trends to this end.

The Fifth Monitoring Report documents the status of the energy transition in 2015. At the heart of the monitoring process for the energy transition is the annual monitoring report, which provides new facts and figures about the energy transition.

A commission of independent energy experts oversees the monitoring process. Working on a scientific basis, the commission of experts comments on the Federal Government’s monitoring and progress reports. Prof. Dr. Andreas Löschel (University of Münster) is the chair of the commission. Other members are Prof. Dr. Georg Erdmann (Technical University of Berlin), Prof. Dr. Frithjof Staiß (Centre for Solar and Hydrogen Research) and Dr. Hans-Joachim Ziesing (Working Group on Energy Balances).

In addition, the Federal Government has also been reporting on current greenhouse gas emission trends since 2015 in annual climate reports. The report provides information on the state of implementation of measures defined in the 2020 Climate Action Programme, current trends and the effects of emission reduction.
2 Objectives of the energy transition and monitoring indicators

By pursuing the energy transition, Germany is heading towards a future with a secure, economic and environmentally-friendly energy supply. The orientation for the energy transition – and thus the basis for its monitoring – is provided by the Federal Government’s Energy Concept, further decisions by the Bundestag, and European rules. The triple objective of security of supply, affordability and environmental compatibility remains the guiding principle for Germany’s energy policy.

The Monitoring Report studies the quantitative targets and the other goals and policies affecting the energy transition.

<table>
<thead>
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<th>Table: Quantitative targets of the energy transition and status quo (2015)</th>
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<td>2015</td>
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<td><strong>Greenhouse gas emissions</strong></td>
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<td>Greenhouse gas emissions (compared with 1990)</td>
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<td><strong>Renewable energy</strong></td>
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<td>Share of gross final energy consumption</td>
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<td>Share of gross electricity consumption</td>
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<td><strong>Share of heat consumption</strong></td>
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<td><strong>Share in transport sector</strong></td>
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<td><strong>Efficiency and consumption</strong></td>
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<td>Primary energy consumption (compared with 2008)</td>
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<td>Gross electricity consumption (compared with 2008)</td>
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<td>Primary energy consumption in buildings (compared with 2008)</td>
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<td>Heat consumption in buildings (compared with 2008)</td>
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<td>Final energy consumption: transport (compared with 2005)</td>
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Source: In-house figures from the Federal Ministry for Economic Affairs and Energy, December 2016

* Provisional figure for 2015
**EU goal. Target set by Directive 2009/28/EC.
The monitoring process for the energy transition is based on publicly available, verifiable data. It is undertaken using selected indicators which visualise progress made in the energy transition over time. The data used can be found at www.bmwi.de.

A points system is used to assess the progress made in terms of the quantitative targets of the energy transition. Firstly, the development of the indicators since 2008 is extrapolated on a linear basis. On the basis of percentage deviations of the extrapolated figures from the target figures in 2020, points are awarded as follows for this report: 5 points if, according to the extrapolation, the target is met or the deviation is less than 10%; 4 points if the deviation is between 10 and 20%; 3 points if the deviation is between 20 and 40%; 2 points if the calculated deviation is between 40 and 60%; and 1 point if the deviation from the target exceeds 60%.

The evaluation scheme applied here cannot replace complex, model-based forecasts. But this system offers the advantage of a comparatively simple and comprehensible depiction of the current status of key energy transition indicators at a glance.

The future impact of measures which are currently being implemented is not reflected in this assessment of whether targets are met. They may yet have an impact, and the actual development can deviate in response to political and economic influences.

Table: Targets and policies affecting the energy transition

<table>
<thead>
<tr>
<th>Security of supply</th>
<th>Covering Germany’s energy needs at all times.</th>
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<tbody>
<tr>
<td>Nuclear energy phase-out</td>
<td>Switching off the last nuclear power plants at the end of 2022.</td>
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<tr>
<td>Affordability, competitiveness</td>
<td>Maintaining affordability of energy and ensuring Germany’s competitiveness.</td>
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<td>Grid expansion</td>
<td>Expanding and modernising grids to meet demand.</td>
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<td>Sector coupling, digitisation</td>
<td>Unlocking the potential of efficient sector coupling and digitisation for a successful energy transition.</td>
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<tr>
<td>Europe and internationally</td>
<td>Establishing a reliable European and international framework for more climate change mitigation, renewables and energy efficiency.</td>
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<tr>
<td>Research, innovation</td>
<td>Fostering forward-looking innovations for the restructuring of the energy supply.</td>
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<tr>
<td>Investment, growth, employment</td>
<td>Retaining and creating jobs in Germany and laying the foundations for sustainable prosperity and quality of life.</td>
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</table>

Source: In-house data from the Federal Ministry for Economic Affairs and Energy, December 2016
Where do we stand?

The share of renewables in total energy consumption is rising steadily. In 2015, the gross final energy delivered by renewable sources amounted to 377.5 TWh, thereby covering 14.9% of total gross final energy consumption. This is an increase of 1.3 percentage points on the previous year.

The share of renewables in gross final energy consumption has increased by roughly 6 percentage points in total since 2008. This dynamic development was primarily driven by the strong increase in renewable generation in the electricity sector. In contrast, the increase in renewables in the heating sector was less pronounced, and the share of renewables in the transport sector has been falling since 2006. A gap of around 3.1 percentage points must be closed to reach the 18% target by 2020. This can only be achieved by continuing the ambitious expansion of renewables in the electricity and heating sectors, and by stepping up efforts significantly in the transport sector.

Almost every third kilowatt hour of electricity consumed in 2015 came from a renewable energy source. Total gross electricity consumption, i.e. domestic electricity production plus electricity imports minus electricity exports, stood at 593.8 TWh in 2015. Providing around 187.3 TWh, renewable energy was able to significantly consolidate its leading position in the electricity sector, achieving a 31.6% share in gross electricity consumption. The share of renewables in the electricity supply has therefore increased by 4.3 percentage points from the previous year.

The trend in the development of renewable heat is positive. In 2015, renewables covered 13.2% (roughly 157.8 billion kWh) of heat consumed – up from 12.5% in 2014.

2015 saw a decline in the consumption of energy derived from renewables in the transport sector. At 33.8 TWh, renewables accounted for around 5.2% of total final energy consumption, down slightly on the previous year. The share of biofuels in total final energy consumption stood at 4.6% in 2015, and the renewable share of the electricity consumption of electric vehicles at 0.6%.

The EEG surcharge fell from 6.24 ct/kWh in 2014 to 6.17 ct/kWh in 2015. It will rise again to 6.35 and 6.88 ct/kWh, respectively, in 2016 and 2017. The EEG surcharge has inherited a large cost burden from the past, specifically payment for existing installations with high feed-in tariffs which cannot be altered due to the principle of the protection of legitimate expectations and the protection of vested interests. Falling prices for electricity on the exchange also reduce the sales revenues of these existing installations, increasing their need for support. In addition to the lower
**Diagram:** Meeting the target for renewable energy in gross final energy consumption

**2020 target**  Renewable energy to cover 18% of gross final energy consumption

**Status 2015**  14.9%

**Share of gross final energy consumption in %**

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<td>11.8</td>
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**Trend**  ● ● ● ● ●


**Diagram:** Meeting the target for renewable energy in gross electricity consumption

**2020 target**  Renewable energy to provide at least 35% of gross electricity consumption

**Status 2015**  31.6%

**Share of gross electricity consumption in %**

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<td>16.3</td>
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**Trend**  ● ● ● ● ●

**Measures**  Renewable Energy Sources Act

The Renewable Energy Sources Act 2017 introduces a paradigm shift in renewables support towards more competition and greater cost efficiency. The Renewable Energy Sources Act 2017 marks the end of a period of technology support characterised by politically defined funding amounts. By largely changing the system of funding to one based on competitive auctions, the Act makes the further expansion of renewables cost-efficient. In addition, the expansion of onshore wind will temporarily be adapted locally in areas with the highest grid congestion.

The share of renewables in the heating and cooling sectors must continue to increase steadily to deliver on the goal of the Renewable Energies Heat Act in 2020. The entire building stock in Germany is to be virtually climate-neutral by 2050. As the Energy Efficiency Strategy for Buildings has demonstrated, this will only be possible if serious progress is made by combining efficiency and the use of renewables for heating and cooling.

The Twelfth Act to Amend the Federal Pollution Control Act set the course to reach the 10% target for the transport sector set out in Directive 2009/28/EC. In line with applicable legal requirements, the greenhouse gas reduction commitment (greenhouse gas quota) will increase from the current rate of 3.5% to 4% starting in 2017 and to 6% from 2020 onwards. Further to this, the share of electricity in the transport sector will also increase as the better drive efficiency of electric motors in road and rail transport and the growing share of renewables in the power grid will also be taken into consideration in the future.

What are the next steps?

The energy transition in the electricity sector involves the continued development and enhancement of the entire system. The priority now is to adapt the entire energy supply system to an increasing share of renewable energy while safeguarding cost efficiency. The laws adopted on 8 July 2016 have laid the cornerstones for this:

- By switching to a competitive bidding system, the Renewable Energy Sources Act 2017 seeks to guarantee compliance with the deployment corridors for renewable energy, whilst ensuring the cost-efficient further expansion and development of renewables. In doing so, the Act makes renewables fit for the electricity market.
- The new Electricity Market Act creates an electricity market 2.0, which is ready for growing shares of renewables.
- The Act on the Digitisation of the Energy Transition signals the start of a modern infrastructure to successfully interlink all stakeholders involved in the supply of electricity in a smart grid.
- The reforms are embedded in the European internal market, thereby establishing the energy transition across national borders also.
4 Energy consumption and energy efficiency

Where do we stand?

Primary energy consumption rose slightly in 2015 compared with the year before. In 2015, primary energy consumption stood at 13,293 PJ, and was therefore up 0.9% on 2014. Compared with the reference year, 2008, primary energy consumption in Germany had dropped by 7.6% by 2015.

Between 2008 and 2015, final energy productivity increased by 1.3% on average each year, which falls short of the target of an annual increase of 2.1%. To reach this target, final energy productivity must increase by an average of 3.3% per year through to 2020.
Gross electricity consumption increased slightly in 2015. Gross electricity consumption refers to the total quantity of electricity consumed in Germany. It stood at 594 TWh in 2015, and had therefore increased by 0.3% on the previous year.

Between 2008 and 2015, gross electricity consumption declined by around 4%. This is equivalent to an average annual reduction of roughly 0.6%. To achieve the 10% reduction target by 2020, electricity consumption must fall by a further 37 TWh, translating to an annual reduction of around 1.3%.

What are the next steps?

The principle of “Efficiency First” is a central pillar for the Federal Government, as this is the only way to adequately limit demand and develop renewables in a resource-friendly, environmentally compatible manner.

With the National Action Plan on Energy Efficiency (NAPE), the Federal Government has launched a comprehensive strategy to deliver on the energy consumption goal. NAPE defines immediate actions and farther-reaching work processes in order to meet the national efficiency and climate goals. It also makes a significant contribution to the 2020 Climate Action Programme, which focuses on reaching the 2020 climate change goal.

Diagram: Meeting the target for reduction in primary energy consumption

| 2020 target | 20% reduction in primary energy consumption (compared with 2008) |
| Status 2015 | -7.6% |

Petajoules


**Trend**

*● ● ● ● ●*

**Measure**

National Action Plan on Energy Efficiency
The most important action areas of energy efficiency policy are to:

- Step up energy efficiency in the buildings sector
- Establish energy efficiency as a business model and a model for generating returns on investment
- Increase personal responsibility for energy efficiency

For these action areas, the NAPE defines cross-cutting measures designed to reduce energy consumption on the demand side.

**NAPE monitoring will be expanded in the further course of the monitoring process.** The NAPE measures were implemented in 2015 and 2016 and are starting to work. It is worth noting that measures typically do not deliver maximum effects at the start, as implementation structures must first be established and awareness of the measures raised among the target groups.

**A broad-based campaign to boost energy efficiency was also launched in May 2016.** The aim of the mobilisation and awareness-raising campaign "Germany Makes it Efficient" is to bring about a change in the mindset towards the more efficient use of energy and raise public awareness of possible ways to increase energy efficiency. The campaign is geared to private households, business enterprises and public institutions alike, and involves all the stakeholders.

**The Federal Government is currently working on further-reaching approaches to greater energy efficiency.** To this end, the Federal Ministry for Economic Affairs and Energy published the Green Paper on Energy Efficiency in August 2016. The Green Paper launched a consultative process which will form the basis for the development of a medium- to long-term Federal Government strategy to reduce energy consumption.

The central measures in the area of energy efficiency specifically include:

- National Action Plan on Energy Efficiency
- Updated CO2 Building Modernisation Programme (KfW funding programmes for energy-efficient construction and retrofitting)
- Energy Efficiency Incentive Programme
- Continued development of the Market Incentive Programme for Renewable Energy in the Heating Market (MAP)
- National Efficiency Label for old heating systems
- Promotion of heating optimisation using high-efficiency pumps and hydraulic balancing
- Updated “Production Facilities and Processes” KfW efficiency programme
- Energy Efficiency Networks Initiative
- Mandatory energy audits for non-SMEs
- Programme to Promote High-efficiency Cross-cutting Technologies
- Waste Heat Prevention Campaign
- Programme to Promote Energy-efficiency and Climate-friendly Production Processes
- Competitive tendering scheme for electrical energy efficiency (STEP up!)
- Promotion of energy conservation contracting
- Refinement of the SME Energy Transition and Climate Action Initiative
- Energy Management Systems funding programme
- Energy Savings Meters pilot programme
- National Top Runner Initiative
- Energy advice for municipalities and non-profit organisations
- Green Paper on Energy Efficiency
- “Germany Makes it Efficient” mobilisation and awareness-raising campaign
- Energy and Climate Action Campaign of the German Hotel and Catering Association (DEHOGA)
Where do we stand?

Final energy consumption in buildings, hereinafter also referred to as heating energy demand, rose in 2015. Heating energy demand stood at roughly 3,069 PJ in 2015, up by 4.3% on the previous year. This increase is largely due to the relatively cold weather at the start of 2015, which increased the demand for heating.

The demand for heating energy has dropped by 11.1% since 2008. This means that heating energy demand fell annually by around 1.7% during this period. To reach the target of cutting heating energy demand by 20% by 2020 compared to the 2008 baseline, heating energy demand would need to decrease annually by an average of 2.1% in the next few years.

Primary energy consumption of buildings was 4.2% higher in 2015 than in the year before. Primary energy consumption has already decreased by roughly 16% since 2008. This is equivalent to an average annual reduction of 2.4%. This is a clear indication that Germany is on the right track to reducing primary energy consumption.
### Diagram: Meeting the target for heating energy demand

<table>
<thead>
<tr>
<th>Year</th>
<th>Heating Energy Demand (Petrojoules)</th>
</tr>
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<tbody>
<tr>
<td>2008</td>
<td>3,451</td>
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<tr>
<td>2009</td>
<td>3,319</td>
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<tr>
<td>2010</td>
<td>3,619</td>
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<tr>
<td>2011</td>
<td>3,144</td>
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<td>2012</td>
<td>3,230</td>
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<td>2013</td>
<td>3,418</td>
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<td>2014</td>
<td>2,942</td>
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<tr>
<td>2015</td>
<td>3,069</td>
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<td>2018</td>
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<td>2019</td>
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</tr>
<tr>
<td>2020</td>
<td>2,761</td>
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</table>

**Target:** -20% by 2020

**Status 2015:** -11.1%

### What are the next steps?

In November 2015, the Federal Cabinet adopted a strategy for the energy transition in the buildings sector with the **Efficiency Strategy for Buildings**. Containing both new measures and proposals for the development of existing measures, this strategy shows how the goal of a virtually climate-neutral building stock by 2050 can be achieved by combining greater energy efficiency with the increased use of renewable energy.


**Central measures in the buildings sector specifically include:**

- Individual Renovation Roadmap
- "Energy-efficient Buildings 2050 – Innovative Projects for a Virtually Climate-neutral Building Stock in 2050" funding initiative
- "Solar Construction/Energy-efficient Cities” funding initiative
- Promotion of heating optimisation using high-efficiency pumps and hydraulic balancing
- Updated CO₂ Building Modernisation Programme – KfW funding
- Energy advice for municipalities and non-profit organisations
Where do we stand?

Final energy consumption in the transport sector increased slightly in 2015. Taking all modes of transport together, final energy consumption in the transport sector stood at 2,619 PJ in 2015, up 0.1% on the previous year. The transport sector therefore accounts for roughly 30% of total final energy consumption in Germany.

Final energy consumption in the transport sector has increased by a total of 1.3 percentage points compared against the baseline year, 2005. Final energy consumption in the transport sector has therefore increased annually by around 0.1% on average since 2005, and even by 2.3% annually since 2010. In light of this development additional efforts are urgently needed, including on the short-term, to reach the target: to cut final energy consumption by 10% by 2020, it would need to be reduced by a total of 12.5% compared with 2005 levels over the next five years, and by an average of 2.5% per year.

The number of electric drive vehicles is increasing rapidly, but the market share is still small. Around 42,000 battery-powered 3-wheel-plus vehicles were registered in 2015, around 11,000 of which were externally chargeable hybrid electric vehicles. Overall, the number of 3-wheel-plus vehicles increased by almost 50% on the previous year. However their market share remained at less than 1% of new passenger car registrations. In addition to 3-wheel-plus electric drive vehicles, increasing numbers of two-wheel electric vehicles, such as pedelecs und e-bikes, can be seen on German roads. Their market share rose to around 13% in 2015 (Institute for Transportation Design/Institute for Energy and Environmental Research 2015, German Bike Association).
What are the next steps?

A reversal of the trend in the transport sector resulting from significantly lower energy consumption is and will remain a long-term project. Overall final energy consumption in transport runs contrary to the goals of the Energy Concept. So far, efficiency improvements have been unable to offset the growing energy consumption in the transport sector resulting from the significant increase in the volume of traffic. With the Mobility and Fuel Strategy and the 2020 Climate Action Programme, the Federal Government therefore established a mix of support, advice, funding and an enhanced regulatory framework as early as 2014 designed to further reduce final energy consumption in the transport sector. In addition, the focus is already on the use of technical innovations resulting from R&D funding and associated programmes to take the innovations to market, as well as the potential of digital solutions.

Central measures in the transport sector specifically include:

- Consumption/efficiency/climate change mitigation: Continued development of the 2013 Mobility and Fuel Strategy, new World Harmonised Light Vehicle Test Procedure (WLTP), Strategy for Automated and Connected Driving, ambitious further development of European legislation limiting the CO₂ emissions of road vehicles post-2020
- Electric mobility: Electric Mobility Market Incentive Package, “Local Electric Mobility” or “Renewable and Mobile” funding programmes
- Alternative fuels: Round Table on Gas-based Mobility, “Taskforce for LNG in Heavy-duty Vehicles” or the “H₂ Mobility” project, implementation of the EU Directive on the Deployment of Alternative Fuels Infrastructure
- Move to environmentally friendly modes of transport: Continued high level of investment in the rail infrastructure, the 2020 National Cycling Plan, and the 2030 Federal Transport Infrastructure Plan

Diagram: Meeting the target for final energy consumption in the transport sector

<table>
<thead>
<tr>
<th>2020 target</th>
<th>10% reduction in final energy consumption (compared with 2005)</th>
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<tbody>
<tr>
<td>Status 2015</td>
<td>1.3%</td>
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Petajoules

Greenhouse gas emissions and environmental impacts

Where do we stand?

According to initial estimates of the Federal Environmental Agency for 2015, total greenhouse gas emissions in Germany have fallen by more than 27%, or a total of 340 million tonnes of CO₂ equivalent, since 1990. This is 0.7% more than the previous year. Following the significant drop in emissions in 2014, greenhouse gas emissions are still well below 2013 levels despite the increase.

Emissions in the energy sector fell slightly compared with the previous year. In contrast, households and transport had significantly higher emissions than the year before. At roughly 4%, private households accounted for the biggest increase on the previous year, as more energy was needed for heating due to the colder weather conditions. Another increase was also registered in the transport sector where greenhouse gas emissions rose by over 2% on the previous year, thereby pushing emissions above 1990 levels for the transport sector, albeit only marginally.

Weather conditions, low commodity prices and a high electricity export surplus have a major bearing on the climate footprint for 2015. Colder weather conditions compared with the previous year, and a resulting increase in the need for heating energy, coupled with lower fuel prices caused greenhouse gas emissions to creep up slightly in 2015. A high electricity export surplus with a still high proportion of coal-derived electricity, and therefore emissions with a high carbon intensity, also prevented a more significant decline in GHG emissions in the electricity sector despite the continued expansion of renewable energy.

The replacement of fossil fuels with renewables is a key factor in reaching climate goals. Total emissions of around 160 million tonnes of CO₂ equivalent were avoided in 2015 benchmarked against a reference system without renewables and with the same demand for energy. The electricity sector accounted for approx. 120 million tonnes. Through the use of renewables, the heating sector avoided 34 million tonnes of CO₂ equivalent and the transport sector reduced its emissions by around 4.4 million tonnes.
The 21st session of the Conference of the Parties to the
United Nations Framework Convention on Climate
Change (COP21) signed on to a new agreement on cli-
mate change in Paris on 12 December, 2015. The Paris
Agreement and the accompanying decisions establish an
ambitious climate policy regime with the following cli-
mate change mitigation milestones:

- All 197 Parties – developed countries, emerging mar-
  kets and developing countries alike – have made a firm
  commitment to action, and not just industrialised
  countries as in the past.

- The Parties commit, inter alia, to progressively more
  ambitious measures to keep global temperature
  increase to well below 2°C compared with pre-indus-
  trial levels. Efforts should be pursued to limit the tem-
  perature increase to 1.5°C.

- To monitor progress towards this long-term goal, a
  global review process (“ambition mechanism”) will
  take place every first years, starting in 2018. The
  nationally determined contributions must be updated
  every five years from 2025 onwards.

- Developed countries will support developing countries
  annually with emissions reduction and adaptation
  efforts through technology development and transfer,
  capacity building measures and financial aid. The
  pledge made in 2009 to mobilise US$100 billion a year
  for climate finance by 2020 will be extended through
to 2025.

The Paris Agreement entered into force in November
2016: with ratification by the European Union and other
member states, including Germany, more than 55 coun-
tries responsible for more than 55% of global greenhouse
emissions had ratified the treaty by 5 October 2016.
Please refer to Chapter 12 for information on the imple-
mentation of climate change mitigation goals at Euro-
pean level.

---

**Diagram:** Meeting the target for greenhouse gas emissions in Germany

<table>
<thead>
<tr>
<th>2020 target</th>
<th>Reduction in greenhouse gas emissions of at least 40% (compared with 1990)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status 2015</td>
<td>-27.2%*</td>
</tr>
</tbody>
</table>

**Mt CO$_2$ equivalent**

<table>
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<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>value</td>
<td>1,248</td>
<td>1,124</td>
<td>1,078</td>
<td>1,036</td>
<td>999</td>
<td>941</td>
<td>908</td>
<td>749</td>
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</tbody>
</table>

**Target:** at least -40% by 2020

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*Provisional figures for 2015

**Trend**

**Measure** 2020 Climate Action Programme
Effective climate change mitigation is not possible without a sustainable energy policy. The transition to the age of renewables, coupled with greater efficiency in the conversion and use of energy, protects our natural resources and creates the framework for economic and social development both in Germany and worldwide. The burning of conventional fuels, such as coal, oil and natural gas, negatively impacts both the climate and the environment.

What are the next steps?

The 2020 Climate Action Programme is the central instrument to close, by 2020, the climate change mitigation gap identified in the 2013 projection report. The Action Programme is designed to contribute between 62 and 78 million tonnes of CO₂ equivalent towards closing the climate mitigation gap. This aggregate contribution is based on individual contributions from more than 100 individual measures. At this stage, roughly 70% of the measures adopted in the Action Programme have already been fully implemented, and work has already commenced on the implementation of the remaining measures.

2016 Climate Action Report: Expert assessments of the effect of measures in the Action Programme to reduce emissions carry a degree of uncertainty, particularly in the early or initial phase of implementation. However, according to this assessment the contribution is lower than the “snapshot” contribution of roughly 60 million tonnes of CO₂ equivalent estimated in the current projection report under ambitious, textbook implementation conditions. Despite these uncertainties, the goal can still be achieved. The Federal Government therefore reaffirms the need for consistent implementation of the agreed measures in order to actually meet the reduction targets it adopted for the measures in the 2020 Climate Action Programme. Further to this, the Federal Government will continue to oversee the implementation of the measures on an ongoing basis. On the basis of the projections and estimates due to be updated next year (including the 2017 Projection Report, 2017 Climate Action Report with updated quantification) and the reduction targets set out for the individual action areas in the Action Programme, the Federal Government will be able to make specific adjustments if necessary – also as part of the implementation of the 2050 Climate Action Plan.

The 2050 Climate Action Plan provides important orientation for the post-2020 period. The Federal Government adopted this Climate Action Plan on 14 November 2016. The 2050 Climate Action Plan aims to spell out in concrete terms Germany’s current 2050 climate change goal and the agreed intermediate goals in light of the Paris Agreement and back these goals with measures based on comprehensive impact assessments. In particular, it sets concrete milestones and strategic measures for the GHG intermediate goal for 2030, also taking impact and cost analyses into account.
8 Power plants and security of supply

Where do we stand?

The supply of electricity in Germany is secure. Demand for electricity in Germany is covered at all times, guaranteeing a high degree of supply security.

The installed renewable capacity has increased significantly once more. The net nominal capacity of power generation installations connected to the German grid increased by roughly 60 GW in total between 2008 and 2015. The nominal capacity of power generation installations based on renewables amounted to 98 GW in 2015, up 8.4% on the previous year. The share of nominal capacity from renewables therefore increased to roughly 48% of total power plant capacity.

The total capacity of conventional power plants increased in 2015 compared with the previous year. There were changes in the relevant capacity provided by nuclear energy, coal and natural gas in 2015. Overall, the decommissioning of the nuclear power plant in Grafenrheinfeld is overcompensated by additional capacity from coal.

Combined heat and power (CHP) plays a special role in conventional electricity generation and local heating supply. In 2015 CHP electricity generation amounted to 105.5 TWh.

Despite growing demands on the grids, grid quality in Germany continues to remain very high – another factor contributing to security of supply. The “System Average Interruption Duration Index” (SAIDI), which is representative of
the average outage duration per connected final user, stood at 12.70 minutes in 2015 compared with 12.28 minutes the year before. The slight increase is primarily attributable to weather conditions such as storms and heat waves. Compared with other countries, Germany still also ranks among the best in this regard.

What are the next steps?

In the coming years, 13% of lignite capacity will be put on security standby. Under the new Electricity Market Act, lignite-fired power plant units with a capacity of 2.7 GW will gradually go off-line. Before being shut down permanently, the plants will first be transferred to a security standby reserve for a period of four years; this reserve can be called upon as a very last resort to help secure the electricity supply in the case of emergencies. The security standby reserve should deliver emission reductions of 12.5 million tonnes of CO₂ through to 2020. This reduction is an important contribution to reaching Germany’s 2020 climate goal.

Security of supply is also considered and established in a European context. The German electricity market is closely connected to the electricity markets of its “electricity neighbours”, by which is meant its geographical neighbours as well as Norway and Sweden. By taking advantage of smoothing effects across a large area, particularly in the event of peak loads and the feed-in of renewable energy, security of supply can be achieved at a lower cost in the European internal market.

The phase-out of nuclear energy for electricity production comes with several challenges. These include securing the funds for the nuclear phase-out. At its core, the Draft Act on the Redistribution of Responsibility for Nuclear Waste Management centres on clearly dividing responsibility for implementation and financing between the government and the nuclear plant operators. Operators of nuclear plants will continue to be responsible for the management and reserve-backed financing of plant decommissioning and dismantling, and for the correct packaging of radioactive waste.

Central measures in the area of security of supply and power plants specifically include:

- Electricity Market Act
- Amended Combined Heat and Power Act (December 2015)
- Draft Act on the Redistribution of Responsibility for Nuclear Waste Management
- Commission for the storage of high-level radioactive wastes (final repository commission)
- Establishment of a central market master data register
9 Affordable energy and a level playing field

Where do we stand?

The energy expenses of private households fell in 2015. A sample four-person household spent around €4,207 on energy in 2015, 3.7% less than the previous year. Affordable energy still remains a challenge, however, for certain groups of households. This is particularly true of relatively low-income households.

For the first time in over a decade, electricity prices for household customers fell in 2015, by 1.4% on average. A slight increase in electricity prices of 2.4% on average is registered in 2016. Electricity prices fell in 2015 by 2.1% for industrial customers not covered by special compensation arrangements. Even though electricity prices dropped for many German industrial and commercial customers in 2015, electricity prices remained above the EU average.

The reform of the Renewable Energy Sources Act in 2014 has made an impact. It was possible to curb the cost dynamics associated with the increase in the EEG surcharge in 2015, even though the surcharge did increase again in 2016 and 2017.

Total industry spending on energy fell in 2015 and was at its lowest level since 2011. Energy is an important cost factor for industry and thereby has a bearing on the ability of industry to compete with other countries. Industry spent
approx. €37 billion in total on energy in 2015, roughly 3.7% less than in 2014. This drop was registered even though consumption increased by 1.2%. The significantly lower prices on the global commodity markets were the main reason for this development.

The costs for the provision of primary energy dropped significantly by 20.2% in year-on-year terms in 2015 to €90 billion. This is primarily attributable to the sharp decline in import prices for fossil fuels. Energy costs fell from approx. €81 billion to approx. €57 billion as a result of the consumption of imported fuels

What are the next steps?

Special compensation arrangements are essential to maintaining Germany’s position as a centre of industry and are in the interests of the economy as a whole. For the Federal Government it is clear that the competitiveness of German industry must not be put at risk. The objective is still to avoid production moving offshore to countries with lower environmental standards and/or levies on energy (“carbon leakage”) and to secure closed value chains and industrial jobs in Germany on the long term.

Carbon leakage rules help reconcile the competitiveness of German industry with climate change mitigation requirements. For businesses whose products compete in a particular international environment, the aim is to limit the cost burden of CO₂ reduction so that carbon leakage is avoided, thereby ensuring the local economy remains strong. At the same time, appropriate regulations are needed for global climate change mitigation also, as greenhouse gas emissions are limited and not shifted elsewhere.

Central measures in the area of affordable energy for private households and industry specifically include:

- The Revision of the Renewable Energy Sources Act 2014 helped slow down the cost dynamics of the EEG surcharge. Following this, the Renewable Energy Sources Act 2017 adopted in July 2016 strengthens the principle of the economic, cost-effective and environmentally compatible implementation of the energy transition by marking the transition to competitive auction systems, inter alia (see Chapter 3).
- Ordinance on the transparent itemisation of state-imposed or regulated price components in the basic supply of electricity and gas.
- Other measures: The efficient use of energy and energy conservation will be the basis for falling energy expenditure in future. To this end, the Federal Government launched the National Action Plan on Energy Efficiency (NAPE) and the “Germany Makes it Efficient” awareness-raising campaign.

Central measures in establishing a level playing field specifically include:

- Special equalisation scheme in the Renewable Energy Sources Act
- Reductions in the CHP surcharge
- Electricity price compensation
- Relief under the Energy Tax Act and Electricity Tax Act
- CO₂ allowance price and free allocation, in some cases, in the EU emissions trading system
10 Grid infrastructure

Where do we stand?

The grid expansion measures that have been agreed must be implemented without delay. At around 35%, the share of projects under the Energy Line Expansion Act that had been implemented by the end of the third quarter 2016 is still too low. However, around half of all energy line expansion projects are approved. It is also just as important to implement projects from the Federal Requirements Planning Act as quickly as possible. In this context, SuedLink and SuedOstLink – the two big extra-high voltage, direct current (EHV-DC) transmission lines – are entering the next planning phase.

The public is closely involved in the grid expansion planning process. This applies for demand assessment, federal sectoral planning and planning approval procedures. For example, transmission system operators and the Federal Network Agency make draft grid development plans available for public consultation.

The expansion of the power grids requires greater investment. Grid operators invested roughly €9.2 billion in total in German power grids in 2015. In the transmission grid, the majority of investment – amounting to €2.1 billion – was in new grid construction and grid reinforcements. Further to this, €299 million were spent on grid maintenance and repair. At the distribution grid level, grid operators invested around €3.8 billion in the expansion and €3 billion in the maintenance and repair of the infrastructure.

In terms of grid stability and quality, the reliability of the grid infrastructure in Germany remains at a very high level. The costs of ancillary services increased significantly in 2015. Compared with the previous year, the proportion of ancillary services costs attributable to congestion in the power grid almost trebled, increasing from €387 million to €1,035 million.

What are the next steps?

The Renewable Energy Sources Act 2017 helps to better align the expansion of renewable energy and the expansion of the grid. The central aim remains that of ensuring continued swift progress on the expansion of renewable energy.

Power distribution grids are increasingly responsible for new tasks. There is increased electricity feed-in from smaller and medium-sized generation facilities to the distribution grid. Over 90% of the capacity installed in renewable installations is connected to distribution grids. More and more electricity consumers are also electricity producers. Therefore investment is needed in these grids, increasingly given that they are not designed for such feed-in levels. Alongside the necessary grid expansion, the distribution grids are also to be developed into smart grids. The aim is to integrate the volumes of electricity fed into the grid in the best possible way through the use of smart grids.
Central measures for the grid infrastructure specifically include:

- Revision of the Incentive Regulation Ordinance
- Act Amending Regulations Governing the Construction of the Energy Grid
- Enhancement of the monitoring system for German grid development projects
- Refinement of the Ordinance on Agreements Concerning Interruptible Loads
- Act on the Digitisation of the Energy Transition
11 Integrated development of the energy system

Where do we stand?

The economically efficient integration of the electricity, heating and transport sectors contributes increasingly to decarbonisation, greater efficiency and a more flexible energy system. Renewable electricity is becoming the most important source of energy. After tapping existing efficiency potential and using renewables directly in the heating and transport sector, remaining energy needs will increasingly be covered by renewable electricity (sector coupling).

Digitisation links the energy sector with modern information and communication technology. With new, customer-friendly business models, digitisation creates new potential for efficiency improvements and for the integration of renewable energy. Data protection and data security are a high priority in this regard.

What are the next steps?

The integrated development of the energy system will drive forward interaction between the energy, transport and construction sectors as well as industry. Electricity generation is a key factor in the design of suitable frameworks. Forward-looking frameworks avoid technical, economic or policy lock-in effects. Alongside this, flexible infrastructures also play a central role.

The digitisation of the energy transition has begun. With the Act on the Digitisation of the Energy Transition, the Federal Government has taken an important steps towards defining the framework for digitisation in the power sector. It must now continue along this path resolutely. With its Green Paper on Energy Efficiency and the “Electricity 2030” discussion paper, the Federal Ministry for Economic Affairs and Energy has launched consultative processes that look, inter alia, at how energy efficiency can be significantly increased and how to reliably push ahead with the digitisation of the energy system to help ensure the success of the energy transition and to achieve energy policy goals.

Central measures specifically include:

- **Sector coupling**: Promotion of heat pumps, low-temperature heat networks with seasonal thermal energy storage, promotion of innovative CHP systems in the CHP Act
12 The energy transition in the European and international context
Where do we stand?

European energy policy: With regard to the goals for 2020, the EU is on target overall and among participating Member States Germany’s performance scores high.

The Paris Agreement paves the way for a global energy transition. The Paris Convention on Climate Change has laid the foundations for ambitious, global climate change mitigation. Germany is pursuing the delivery of these goals as a matter of priority.

To reach the climate goals, the EU is also continuing to rely on the EU emissions trading system as a central instrument. The greenhouse gases under the EU emissions trading system are decreasing and the 20% goal has already been reached. Due to the overabundance of allowances, the decision to backload allowances in 2015 reduced the number of allowances available for auction EU-wide by 300 million. The Federal Government has called for the further strengthening of emissions trading as a market-based instrument of climate change mitigation.

Climate change mitigation in the sectors outside the scope of the emissions trading system: Currently roughly 60% of EU-wide emissions do not fall under the emissions trading system. These include, in particular, the transport sector (excluding aviation), the buildings sector, the waste management industry, non-CO₂ emissions from agriculture and smaller industrial enterprises.

What are the next steps?

International energy policy: Germany is in favour of also developing a pioneering energy policy at international level. This involves promoting the German energy transition, and identifying and supporting partners and initiatives for the joint development of sustainable energy systems.

Effective climate change mitigation requires global effort. Global CO₂ emissions in 2014 were around 59% higher than in 1990 and have also increased on 2005 levels by around 18% (IEA 2016).

Central measures specifically include:

- **Non-ETS sector**: Effort Sharing Decision (ESD) regarding national GHG emission reduction targets for sectors outside the scope of the ETS through to 2020, EU Draft Effort Sharing Regulation (ESR) regarding national GHG reduction targets for sectors outside the scope of the ETS for the period 2021-2030, Land-use, Land-use Change and Forestry Regulation (LULUCF-Regulation).
13 Energy research and innovation
Where do we stand?

Business investment in research and development continued to increase in 2015. In the field of publicly co-funded energy research projects alone, businesses invested around €185 million in the development of innovative energy technologies in 2015. Added to this are third-party funding payments to universities and research centres as part of collaborative projects. The total volume invested by the business community in the research and development of energy technologies is probably far higher than this. In 2015, the business community spent a total of roughly €59 billion, i.e. 4.6% more than the previous year, on research and development overall, including energy technologies (Donor’s Association for the Promotion of Sciences and Humanities in Germany, 2016).

The Federal Government also increased the budget for energy research in 2015. From 2013 to 2016, roughly €3.4 billion in total are being provided to promote the research and development of modern energy technologies. Funds in 2015 amounted to €863 million, an increase of €44 million on the previous year. In the 2015 Federal Report on Energy Research, the Federal Government provides an overview of the energy research supported in Germany.

No other country is as deeply involved in the EU Framework Programme for Research and Innovation as Germany. Within the context of the projects approved, some 16% of the funding will go to Germany.

What are the next steps?

Energy research will become even more important going forward. Medium-term financial planning makes provisions for a research volume of around €1 billion in 2019. In the European context also, Germany will push for a holistic approach geared towards the transition of the energy system.

Cross-sectoral energy research makes a central contribution to the energy transition. The focus of energy research is increasingly trained on the growing importance of the integration of the electricity, heating and transport sectors (sector coupling) and the integration of innovative technologies into the system to deliver on the goals of the energy transition. Joint research initiatives into storage systems, grids, construction and housing, hydrogen and fuel cell technology will be continued and, going forward, will potentially incorporate new activities looking into smart sector coupling within the context of the energy transition using electricity-based fuels.

Central measures in the field of energy research specifically include:

- Research and Innovation Platform and the Energy Transition Research Forum
- Copernicus projects and the “Energy Systems of the Future” Academies’ project
- “Sustainable Power Grids” research initiative and the “Energy Storage” research initiative
- National Hydrogen and Fuel Cell Technology Innovation Programme (NIP)
- Programme collaboration: Energy Transition Research Alliance at the German Federation of Industrial Research Associations (AiF)
- “Carbon2Chem” research initiative, “Renewable Resources” funding programme and the “Biomass Energy Use” funding programme

Central measures for the promotion of innovative technologies specifically include:

- WIPANO – “Knowledge and Technology Transfer via Patents and Standards”
- Promotion of stationary fuel cell heating as part of the Energy Efficiency Incentive Programme
- Hydrogen and Fuel Cell Technology Government Programme for the 2016–2026 funding period
- Renewed funding for horizontal technologies
- Strategy for Automated and Connected Driving
14 Investment, growth and jobs
Where do we stand?

2015 was another year in which billions were invested in the restructuring of the energy supply. This is particularly true of measures to improve the energy performance of buildings, to increase the amount of renewable energy, notably wind energy, and to expand the power grids.

Investment in energy retrofits for buildings has increased slightly on the year before. In 2015, €36.4 billion were invested in the existing residential building stock, following €35.7 billion in 2014. In addition, around €16.8 billion were invested in existing non-residential buildings.

Less investment is needed to build new renewable facilities. At the same time, the expansion of renewables is pushing ahead. The growth of installed renewable capacity in 2015 was on the same scale as in the previous year (see Chapter 8). This could be interpreted as an indicator of the drop in costs per installed facility.

Developments on the world energy markets continue to have a stronger impact on prices than the energy transition. Experts are of the opinion that, as a result of energy transition measures, inflation in Germany was slightly higher in 2015 than it would have been in the absence of the energy transition. This moderate impact on inflation was masked by the drop in prices for oil, gas and other fuels on the world markets. At the same time, wholesale electricity prices have continued to fall significantly. The expansion of renewable energy is one reason for this decline in prices.

Businesses in Germany lead the field in modern energy technologies and are consolidating their position. By making the energy transition an environmental and economic success, the chances are high that other countries will follow suit. This creates potential in Germany for additional value creation and employment. At the same time, capital goods to help restructure the energy supply system will be purchased from suppliers within and outside the country.

The demand for imports of fossil fuels would have been higher in the absence of renewable energy and energy efficiency efforts. According to current scenario models (Institute of Economic Structures Research (GWS), German Aeronautics and Space Research Centre (DLR), German Institute for Economic Research (DIW) 2016), the estimated dampening effect of renewables on the demand for imports of fossil fuels in 2015 is calculated at €8.8 billion net. In addition, savings are also made from the reduced consumption of energy as a result of efficiency measures, which are estimated at around €16 billion in 2015.

The energy transition is a restructuring process: employment structures change and adapt. Employment incentives deriving from renewable energy and energy efficiency go hand in hand with structural changes, which also impact jobs in other areas of the energy industry and in the remaining sectors of the economy. An estimated 117,000 people were employed in the conventional system of electricity supply in 2015, around the same level as the previous year. At this stage, renewables are an important economic factor, employing around 330,000 people in 2015. This translates to a drop of around 25,000 workers compared with 2014 (Institute of Economic Structures Research (GWS), German Aeronautics and Space Research Centre (DLR), German Institute for Economic Research (DIW), 2016).

What are the next steps?

Investment requires predictability: The Acts adopted by the Bundestag in July 2016 (Renewable Energy Sources Act 2017, Electricity Market Act, Act on the Digitisation of the Energy Transition) and the amended incentive regulations create a stable economic and legal framework for investment within the context of the energy transition.

The expansion of renewables and investment in energy efficiency have an impact on employment due to increasing demand for associated goods and services. This boosts production in the economic sectors that supply these goods and creates jobs in this area. At the same time, this spills over to the upstream sector, triggering an additional indirect impact on job-creation. However, not all sectors benefit equally from this surge in demand.