Key Facts about the Energy Transition in Germany
The second phase: Interconnected and digital

Renewable energy in Germany is a success story. In 2018, wind, solar, biomass, hydro and geothermal energy reached a market share of 37.8% in power consumption. Further increases are in the making. This is a huge opportunity for the modernization of Germany’s economy. The transformation of the energy system plays a vital role as a driver of progress, innovation and jobs. After the progress in the power sector, efforts will now have to concentrate on the heating and transport sectors and on reducing overall greenhouse gas emissions.

Quantitative targets of the energy transition:

<table>
<thead>
<tr>
<th>Energy efficiency</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
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<tbody>
<tr>
<td>Greenhouse gas emissions (from 1990)</td>
<td>-40%</td>
<td>-55%</td>
<td>-70%</td>
<td>-80% to -95%</td>
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<tr>
<td>Primary energy consumption (from 2008)</td>
<td>-20%</td>
<td></td>
<td></td>
<td>-50%</td>
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<tr>
<td>Electricity consumption (from 2008)</td>
<td>-10%</td>
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<td></td>
<td>-25%</td>
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<tr>
<td>Energy demand in buildings (from 2008)</td>
<td></td>
<td></td>
<td></td>
<td>-80%</td>
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<tr>
<td>Heat demand in buildings (from 2008)</td>
<td>-20%</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Energy consumption in transport (from 2005)</td>
<td>-10%</td>
<td></td>
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<td>-40%</td>
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<table>
<thead>
<tr>
<th>Renewable energy</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
<td>RE share in final energy consumption</td>
<td>18%</td>
<td>30%</td>
<td>45%</td>
<td>60%</td>
</tr>
<tr>
<td>RE share in electricity consumption</td>
<td>35%</td>
<td>65%</td>
<td></td>
<td>&gt;80%</td>
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<tr>
<td>RE share in heating</td>
<td>14%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE share in transport</td>
<td>10%</td>
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After the first phase of the energy transition, which focused on expanding renewable energies and establishing them as a technically and economically viable option, sector coupling and digitalization will shape the second phase. Transforming the energy system requires the three sectors power, heat and transport to be interconnected. Using electricity from renewable sources to heat drinking water and to fuel electric cars gives the power sector more flexibility to integrate solar and wind. On the other hand, it provides heating and transport with low carbon alternatives to fossil fuels. Digitalization can make the matching of energy supply and demand more efficient and helps shaving the peak load.

**Energy efficiency – Twin pillar of the energy transition**

Switching from fossil fuels to renewable energy and reducing energy consumption need to go hand in hand. Efficiency reduces costs and the environmental impacts caused by the energy system. Therefore, Germany set itself ambitious targets. By 2020, energy consumption is to decrease by 20% from 2008 levels, and by 50% until 2050.

Germany’s energy efficiency policy relies on a broad range of instruments: financial incentives, efficiency standards as well as information and consulting. Financial incentives are given by low-interest loans or investment grants. External effects, such as environmental impacts of energy consumption, are partly internalized into energy prices through an energy use tax. The Energy Saving Ordinance (EnEV) sets minimum requirements for efficient energy use in new buildings and for large-scale renovations of existing buildings. EU-wide provisions on energy labeling of products ensure transparency and provide incentives for more efficient products. Requirements to ecodesign set binding minimum standards for the environmentally friendly design of energy-related products.

Energy efficiency is also seen as a lucrative business model. In 2017, the market for energy efficiency services in the European Union reached €26.7 bn. It is expected to reach a market volume of €49.5 bn by 2025. Digitalization will expand the market by an additional €13.6 bn, according to an analysis by Roland Berger consulting.

**Lowest energy consumption since 1970s**

Primary energy consumption in Germany dropped by 5% to 12,900 PJ (3,583 bn kWh) in 2018, the lowest level since the early 1970s. Price increases, mild weather and energy efficiency improvements played a key role. From 2017 to 2018, significant achievements were reached in curbing energy consumption from mineral oil (-5.6%), natural gas (-7.3%), hard coal (-11.2%) and lignite (-1.9%). On the other hand, energy production from renewable energy increased by 1.1%.
Renewable energy – extending market leadership

Further rise in renewable power generation, progress needed in heat and transport

In 2018, the renewable share in German power consumption rose by 1.8 percentage points to 37.8%. It was even higher when it comes to power production. Wind, solar, biomass and hydro power generated as much electricity as hard coal and lignite combined for the first time. The rise of clean energy was mainly due to the installation of new solar power plants and a sunny year. The number of sunshine hours was about 30% higher than average. Photovoltaics (PV) contributed 46.2 bn kWh (+6.8 bn kWh) to clean electricity generation. This resulted in an on-year rise in renewable power generation by 12.4 bn kwh to a new record of 228.7 bn kWh in 2018. On the other hand, hydro power generation decreased to
16.9 bn kWh (-3.3 bn kWh) due to a hot and dry summer. Onshore wind power production reached 93.9 bn kWh (+4.6 bn kWh), offshore wind power 19.4 bn kWh (+1.7 bn kWh). Power production from biomass rose slightly by 1 bn kWh to 52 bn kWh.

**Germany's power mix in 2018**

At 226 billion kilowatt hours, renewables supplied a third of Germany's gross electricity production and became the most important energy carrier for electricity generation. The share of renewables in power consumption reached 38 percent.

The installed renewable power capacity increased by 6.6 GW in 2018. After recording an all-time high in net addition in 2017 (+8.2 GW), another 3.2 GW new wind power capacity was added in 2018 (2.3 GW onshore, 1 GW offshore). By end 2018, 59 GW had been installed in total. Solar power capacity rose by 2.9 GW, compared to only 1.7 GW in 2017. By the end of 2018, total solar power capacity reached 45.3 GW. In the biomass sector, 419 MW in new capacity was added.

Meanwhile, in the heat and transport sectors, more progress is need to reach Germany's ambitious goals. In 2018, renewable energy installations remained at 170.9 bn kWh or 13.9%
in heating and cooling (2017: 13.4%). In transport, the renewable share rose from 5.2% to 5.6%.

## Share of renewable energy in Germany's final energy consumption 1990–2018

**Multiple benefits**

**Effective climate protection**

The use of Renewable Energies avoided 184 million tons (mt) of greenhouse gas (GHG) emissions (CO₂-eq.) in 2018, compared to 178 mt of saved emissions in 2017. Renewable power generation contributed 141 mt of GHG savings, 35 mt were attributable to heating and cooling. Due to the use of renewables in the transport sector, above all biofuels, GHG emissions of 8 mt were avoided.
Investments strengthen the economy
The successful expansion of renewable power production goes hand in hand with investment in renewable capacities. Investment in wind, solar, biomass, hydro and geothermal power in Germany amounted to €188.7 bn within the past ten years. 2018. With the upcoming coal phase out, investments are expected to increase in the coming years.

Globally, investment in renewable energy were down 8% in 2018. According to Bloomberg New Energy Finance (BNEF), investments totaled $332.1 bn. Europe, in contrast, leaped by 27% to $74.5 bn, mainly due to offshore wind projects. The three leading countries for renewable energy were China ($100.1 bn), the United States ($64.2 bn) and Japan ($27.2 bn).

Driver of innovation
The massive cost reduction in solar and wind power generation is one indicator of the innovative potential in the renewable energy sector. In good locations in Germany, wind power and PV already have lower costs than new coal or natural gas power plants. In 2018, the generation costs of onshore wind power ranged from 3.99 to 8.23 €Cents/kWh, depending on sites, according to research by Fraunhofer ISE. For photovoltaics, the range is from 3.71 to 11.54 €Cents/kWh.

Job engine
Suppliers of chemicals, glass, steel, copper and electronics highly benefit from the growing demand for renewable technologies made in Germany. Wind power producers are now among the most important customers of the steel industry. The energy transition creates jobs in manufacturing, in the services industries and for the installation and operation of plants in many parts of the country. This includes remote areas which have been in need of a bright economic outlook for decades.

After three years of dropping numbers, employment in Germany’s renewables industry has picked up again. Nowadays, approximately 340,000 persons are employed in the renewable energy sector in Germany. Almost half of these are now to be found in the wind power sector (160,200). Biomass follows with 105,600 jobs, while employment in the solar industry is at 45,200.

Public participation
With renewable Energy, every citizen can be a plant operator. Energy cooperatives give people the opportunity to invest in citizen-owned wind energy systems or citizen-owned solar energy plants – even with minor payments, starting with €500. According to a survey by the market research institute trend:research, 42 percent of all renewable power capacity installed in Germany lies in the hands of private individuals and farmers.
The way ahead

Power production from wind and solar energy will dominate the energy system of the future. In the course of a year, wind and solar roughly complement each other. However, integrating fluctuating power production into the energy system is a key challenge for the years to come. Biomass, hydro power, storage systems and load management can fill the gaps or reduce energy demand in times of low wind and solar power production. Furthermore, cogeneration plants will have to work more flexibly and adjust their power production according to the needs of the energy transition.

Expanding wind and solar power production will also lead to higher volumes of power in times of low demand. The coupling of all three sectors - power, heat and transport - is a crucial flexibility option. Excess power can be used in heating technologies like heat pumps.
and district heating networks. In the transport sector, power can be used directly in electric cars or indirectly by converting it into hydrogen, methane or liquid fuels.

**Sector coupling for an integrated energy transition: power, heat and gas**

Entering the next phase of the energy transition, there is a growing need for coordination within the power system. A well-developed and intelligent electricity grid is an important companion to an increase in the production of electricity from renewable energy sources. With a “smart grid”, electricity consumers can, for example, manage their devices in a manner that they primarily operate when electricity prices are low. The overarching goal is to match electricity demand and supply in the best possible way. Electricity consumers are rewarded for a more thoughtful use of energy. Infrastructure for digitalization has to be expanded and business cases for data-based transactions need to be further developed.
This factsheet was prepared by:

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