

FACTS

The most important data on
renewable energy in Germany.
Clear and concise.

as of 04/2015



RENEWABLE
ENERGIES
AGENCY

	2014	Sector scenario 2020
Investment in energy plants	€ 18.8 bn	€ 235 bn¹
Share of electricity consumption	27.8%	47%
Share of heat consumption	9.9%	25%
Share of fuel consumption	5.4%	22%
Share of final energy consumption (2013)	12.3%	28%
GHG savings (CO ₂ eq.)	148 m t ²	287 m t
Employment – number of jobs (2013)	371,400	min. 500,000
Fossil fuel imports savings (2013)	€ 9.1 bn	€ 50 bn
Prevented environmental damage (2013)	€ 11.0 bn	€ 12.3 bn

¹ Cumulative total investment 2010-2020

² Corresponds to around 95% of GHG emissions in the transport sector

Renewable energy is one of the most important growth factors in Germany. Every year it has an added value of around 17 bn euro across Germany. 11 bn euro of this is in local communities.

Since 2005, the share of electricity consumption from renewable energy has almost trebled.

Renewable energy boosts revenue and employment



Investment

in setting up plants using renewable energy in Germany in 2014

Wind power	€ 12,300 m
Bioenergy	€ 2,400 m
Solar energy	€ 3,100 m
Geo/aerothermal heat	€ 1,000 m
Hydropower	€ 100 m

Total € 18,800 m

Revenue

from power plant operation in 2014

Wind power	€ 1,700 m
Bioenergy	€ 9,700 m
Solar energy	€ 1,600 m
Geo/aerothermal heat	€ 900 m
Hydropower	€ 300 m

Total € 14,800 m

Employment



Annual export revenue from the production of power plants and components (2013): approx. € 10 bn

According to a study commissioned by the Federal Ministry for Economic Affairs and Energy, 261,500 jobs resulted from the effects of the Renewable Energy Law.

With more than 371,000 jobs, the renewable energy sector is on course to catch up with the chemicals industry (around 434,000 jobs).



Germany depends on energy imports

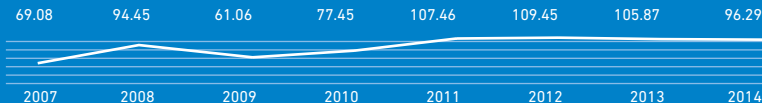
Import shares

Uranium	100%
Oil	98%
Natural gas	87%
Coal	87%

Savings on fossil fuel imports in Germany due to renewable energy

2011	€ 7.1 bn
2012	€ 10.0 bn
2013	€ 9.1 bn

Crude oil price development



Data: average annual price in US \$ per barrel for OPEC basket

Financing renewable energy is continuously becoming more favorable. Between 2006-2014, the costs for the installation of turnkey photovoltaic power plants (up to 10 kWp) fell by 68%.

Import costs in Germany for importing fossil fuels reached 78 bn euro in 2014. This amounts to around 911 bn euro since the start of the millennium.

Renewable energy is cheap – worldwide



Global investment volume in renewable energy (bn US \$)



Modern technology is gaining ground

The use of modern renewable energy has risen constantly in recent years to around 10% of global final energy consumption. Another 9% comes from traditional renewable energy sources such as hydropower and conventional wood combustion.

Ambitious renewable energy expansion targets worldwide are creating large export markets, e.g.:

EU 2013:	15.0%	2020:	20% (final energy use)
China 2013:	9.2%	2020:	15% (final energy use)
France 2013:	13.7%	2020:	23% (final energy use)

Example – wind power: 2014 was a record year for the sector with more than 51,000 MW of new power generators installed, 5,800 MW of which in Germany.

Renewable energy technology from Germany is an important export market with a turnover of around 10 bn euro. The growth of the market has boosted technological development, which has reduced the costs for electricity, heat and fuels from renewable energy worldwide.

Renewables contributed 22.1% to global electricity production in 2013; 16.4% came from hydropower.

Renewable energy with high levels of potential expansion



The renewable energy mix in Germany in 2020:

Electricity:	41% ¹ to 47% ³
Heat:	18% ¹ to 25% ²
Fuels:	12% ¹ to 22% ²

The renewable power mix in Germany in 2030:

Onshore wind energy	18% ¹ to 25% ³
Offshore wind energy	16% ¹ to 12% ³
Bioenergy	10% ¹ to 15% ³
Photovoltaics	10% ¹ to 22% ³
Hydropower	4% ¹ to 6% ³
Geothermal energy	1% ^{1,3}

Total renewable energy electricity **60%¹ to 79%³**

¹ DLR long term scenario 2012, scenario 2011 A
² AEE/BEE sector scenario 2009
³ BEE electricity scenario 2012

The official expansion forecasts for electricity from renewable energy have been exceeded regularly to date. This could be the case again in 2020. This is good news for the economy and for consumers.

Renewable energy is efficient in all application areas: electricity, heating and transport.

**100% renewable electricity
provision is possible**

100%

100% electricity from renewable energy is not a utopian dream. Leading institutions all agree on this. Studies conducted by the Federal Environment Agency (UBA), the German Advisory Council on the Environment (SRU) and the German Aeronautics and Space Research Centre (DLR) have shown that electricity provision wholly from renewable energy sources is a realistic aim. Various scenarios have been drawn up on the issue.

Electricity generation in Germany in 2050:

	DLR scenario 2011 A ¹	SRU scenario 1a ²	UBA 2010 ³
Onshore wind power	23%	13%	32%
Offshore wind power	22%	55%	33%
Bioenergy	10%	12%	2% ⁴
Photovoltaics	11%	15%	20%
Hydropower	4%	5%	4%
Geothermal energy	3%	-	9%
Imports	11%	-	-

¹ 84% electricity from renewable energy (RE); ² 100% electricity from renewable energy,

³ Regional network scenario simulation 100% electricity from RE, ⁴ waste biomass only

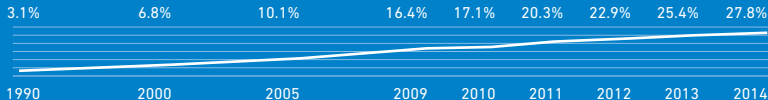
Growth potential is not restricted to the electricity sector. According to results from the German Advisory Council on Global Change (WBGU), renewable energy has the potential to supply the world with energy.

If renewable energy was expanded, sufficient levels could be harnessed to cover global energy demand as early as the middle of this century.

Feed-in remuneration guarantees efficient development



Share of renewable energy of gross German electricity consumption



Feed-in remuneration ensures:

- strong expansion of renewable energy
- Security of investment
- Development of a strong export industry that is a technological leader
- More competition on the energy market due to new mid-sized players
- Promotion of all electricity generating technologies

Decreasing remuneration

- accelerates innovation towards ever more affordable electricity from RE at calculable costs.

Quota/certification systems are inefficient:

- Lack of investment and planning security due to heavily fluctuating certificate prices
- E. g. wind power in GB and Italy shows: quota system leads to higher costs
- No mid-sized market players

The German Renewable Energy Sources Act (EEG) with feed-in priority and remuneration has proven to be very successful since the law was enacted in 2000. Renewable energy technology has become significantly less expensive since that time and is becoming ever cheaper.

At least 98 states and provinces have introduced feed-in remuneration.

Renewable energy does not drive up prices



Technology has become massively cheaper

There has been a huge drop in the price of renewable energy technology worldwide this decade. In 2014, the costs for solar modules were around 75% lower than at the end of 2009. Other sources of renewable energy have become significantly cheaper too.

Renewable energy receives considerably less support than nuclear power, coal, etc.

Conventional energy sources receive much greater state support than renewable energy, not just in Germany, but worldwide. According to IEA data, annual subsidies for fossil fuels alone amounted to around 550 bn \$ in 2013 – more than four times the amount for renewables.

Long-term state funding for renewable energy in Germany (1970-2014) was

c. 102 bn euro

By comparison:

- State support for hard coal (1970-2014)
- State support for lignite (1970-2014)
- State support for nuclear energy (1970-2014)

c. 327 bn euro

c. 95 bn euro

c. 219 bn euro

Source:
Green Budget Germany

Rising fuel prices and a lack of competition on the energy market are responsible for electricity price increases. Consumers in Germany have not benefited from falling electricity prices on the power exchange, for example.

Renewable technology is also a sensible solution for isolated, off-grid and small electricity systems such as islands, which have been supplied by diesel generators to date.

Renewable energy can supply electricity round the clock



Regenerative combined power plants

can connect and control wind, solar and biomass energy power generators as well as other power plants and accumulators. This allows electricity to be generated from renewable energy in a reliable manner that meets demand.

Combined power plant 2 sets a new trend

The Combined Power Plant 2 project shows the contribution that renewable energy can make to security of supply. Important renewable energy services were tested, for example during bottlenecks in the electricity grid.

Using excess renewable energy

Various providers in Germany have already shown that excess electricity from renewable energy can be stored, for example by developing battery systems and converting electricity into hydrogen using electrolysis. A link up with the heating and transport sectors also makes sense.

Reliable energy provision from renewable energy sources is possible at all times and in all locations. Projects such as hybrid and combined power plants have proved this.

Research and development is being undertaken into solutions for the energy system of tomorrow, e.g. on new energy storage solutions.



Expanding the use of renewable energy quickly

Renewable energy is widely supported by the general public. According to a survey conducted by tns infratest in autumn 2014, 92% of Germans regarded expanding the use of renewable energy sources as important, very important or extremely important.

Sustainability and climate protection as the most important benefits

Intergenerational fairness plays a major role in German thinking about the benefits of renewable energy. 75% of those surveyed said that renewable energy will contribute to ensuring the future for coming generations. Climate protection had a similarly high priority.

Renewable energy welcome in the neighbourhood

According to this survey, 65% of the population thought renewable energy plants in their neighbourhood were good or very good. People who know renewable energy from their own environments show above average approval rates. Or put differently: The acceptance of renewable energy rises with familiarity.

Source: AEE/tns infratest

A large relative majority of Germans want to speed up the expansion of renewable energy usage. According to a survey conducted by the Federation of German Consumer Organisations in mid-2013, 45% regarded the expansion of renewable energy as being too slow. Only 18% of those surveyed thought the rate of expansion was too fast.

Surveys have shown: It is not renewable energy sources that have an acceptance problem, but coal and nuclear power.

Renewable energy is a communal growth package



Municipal added value effects of selected renewable energies (for 2012)

Electricity:	Wind power	€ 3,081 m
	Photovoltaics	€ 4,428 m
	Bioenergy ¹	€ 1,002 m
	Hydropower	€ 71 m
Heat:	Bioenergy ¹	€ 302 m
	Heat pumps	€ 279 m
	Solar heat	€ 212 m
	Local heat networks	€ 188 m
	Deep geothermal energy	€ 50 m
Transport:	Biofuels	€ 710 m

¹ without wood fuels

Source: Greenpeace/IÖW 2013

Municipal added value includes tax payments to the local community as well as the income of those employed in the community and the profits of companies based in the area. The more chain links of an added value chain that are located in a community, the higher the added value effects that can be attained.

Everyone can join in: Across Germany there are around 1,000 energy cooperatives that characterise the decentralised nature of the energy transition.



Wind power performance in Germany in 2014

Total capacity installed	40,456 MW
Newly installed capacity (net addition)	5,796 MW
Electricity produced	56.0 bn kWh
Share of gross electricity consumption	9.1%
Greenhouse gas savings	40.5 m t CO ₂ eq.
Investment in new systems	€ 12.3 bn
Revenue from power plant operation	€ 1.7 bn
Employment – number of jobs (2013)	137,800

International wind energy market 2014

Export quota of German manufacturers	67%
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Sector aims for Germany

Employment 2020	approx. 160,000
Share of electricity consumption 2020	25%
CO ₂ savings 2020	120m t/a
Investment 2010-2020	€ 66.9 bn

Wind energy contributes the biggest share in Germany to electricity production from renewable sources. On the global stage, the German wind industry is among the leaders in terms of market share and technology.

In addition to new locations, the replacement of old wind turbines with a lesser number of new, more modern systems – a process known as repowering – has great potential. Around 6,000 of the nearly 25,000 German wind turbines are older than 15 years and could be replaced.



Hydropower performance in Germany in 2014

Total capacity installed	5,595 MW ¹
Electricity produced	20.5 bn kWh
Share of electricity consumption	3.3%
Greenhouse gas savings	16.7 m t CO ₂ eq.
Investment in new systems	€ 100 m
Revenue from power plant operation	€ 300 m
Employment - number of jobs (2013)	13,100

Sector aims for Germany

Investment 2010 to 2020 € 4.2 bn

International hydropower market

Export quota of German manufacturers > 80%

¹ Incl. pumped-storage power plants with natural water inflow

With a share of more than 16%, hydropower is the most significant renewable energy source for electricity generation worldwide. The technology involved is sophisticated and has been in use for more than 100 years. Its greatest advantages are its constant availability, high level of efficiency and the ability to store energy.

Approximately 50% of all hydroelectric plants worldwide have been built on the basis of German expertise.



Bioenergy performance in Germany in 2014

Electricity	Total capacity installed	8,791 MW
	Electricity produced (incl. biogenic waste)	49.1 bn kWh
	Share of electricity consumption	8.0%
	Greenhouse gas savings	27.5 m t CO ₂ eq.
Heat	Heat produced	113.4 bn kWh
	Share of heat consumption	8.6%
	Greenhouse gas savings	31.2 m t CO ₂ eq.
	Number of jobs in electricity and heat provision (2013)	approx. 100,800
	Investment in new electricity generation plants	€ 1.3 bn
	Investment in new heat generation plants	€ 1.1 bn
	Revenue from plant operation	€ 7.1 bn

International biogas market 2015

Export quota (forecast) 70%

Sector aims for Germany 2020

Share of electricity supply 9.1%
Share of heat supply 13.1%

Bioenergy is an all-rounder. Its greatest advantage: It is constantly available and versatile in terms of use. Biogas, wood, vegetable oil or waste material can be used to generate heat and electricity.

An estimated 360,000 heating systems and thermo-stoves powered by wood pellets were in operation in winter 2014/15 in Germany.



Biofuel performance in Germany in 2014

Biofuel usage:	3.3 m t
of which biodiesel	2.1 m t
bioethanol	1.2 m t
Share of fuel consumption	4.9%
Greenhouse gas savings	5.2 m t CO ₂ eq.
Revenue from plant operation	€ 2.6 bn
Employment - number of jobs (2013)	approx. 25,600

- Rapeseed, grain and sugar beet from domestic agriculture dominate
- Certification and monitoring of origin required by law since the start of 2011
- Mandatory GHG saving of at least 35% compared with fossil fuels, 50% from 2017
- Prohibition to use raw material from former rainforest areas

Sustainably produced biofuels are essential for an energy transition in the transport sector. Whereas market penetration of electric vehicles is proceeding slowly, biofuels can already provide a climate and environmentally friendly alternative to mineral oil today.

The yield of 1 hectare of energy plants is sufficient to produce biodiesel or bioethanol to power travel of over 23,000 km.



Solar energy performance in Germany in 2014

Photovoltaics

Total capacity installed	38,236 MWp
Newly installed capacity	1,899 MWp
Electricity produced	34.9 bn kWh
Share of gross electricity consumption	5.7%
Greenhouse gas savings	23.9 m t CO ₂ eq.
Investment in new plants	€ 2.3 bn

Solar thermal

Total capacity installed	12,900 MW
Newly installed capacity	630 MW
Heat produced	6.9 bn kWh
Greenhouse gas savings	1.8 m t CO ₂ eq.
Investment in new systems	€ 800 m

Number of jobs in the solar energy sector (2013) 68,500

Export quota of the solar sector: > 65%

The energy quantity provided by annual solar irradiation on Earth equals approximately 2,850 times the world energy demand. Its potential could be exploited using the technology that is already available today.

Around 1.5 million photovoltaic systems and more than 2 million solar thermal systems were installed in Germany in 2014.



Geothermal energy performance in Germany in 2014

Installed electricity generation capacity¹:	31 MW
Electricity produced ¹	110 m kWh
Installed heat production capacity	
Geothermal energy	4,200 MW
Aerothermal energy	3,570 MW
Thermal energy generated	10.6 bn kWh
Newly installed heat pumps	71,400
geothermal/hydrothermal heat pumps	18,500
aerothermal heat pumps ²	52,900
Greenhouse gas savings	1.1 m t CO ₂ eq.
Investment in new plants	€ 1 bn
Employment (2013)	17,300
Sector aims for Germany	
Employment 2020	25,000
Electricity and thermal capacity 2020:	16,000 MW
CO ₂ savings 2020	approx. 11 m t CO ₂
Investment in electricity 2010-2020	€ 8.7 bn
Investment in thermal energy 2010-2020	€ 26.1 bn

Every day 2.5 times more energy than we actually need worldwide rises from the Earth's interior. The potential of geothermal energy for heat and electricity generation is enormous. It is constantly available regardless of the weather or time of day.

As heat is easier to store than electricity, heat pumps can be used to profit from excess renewable energy.



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