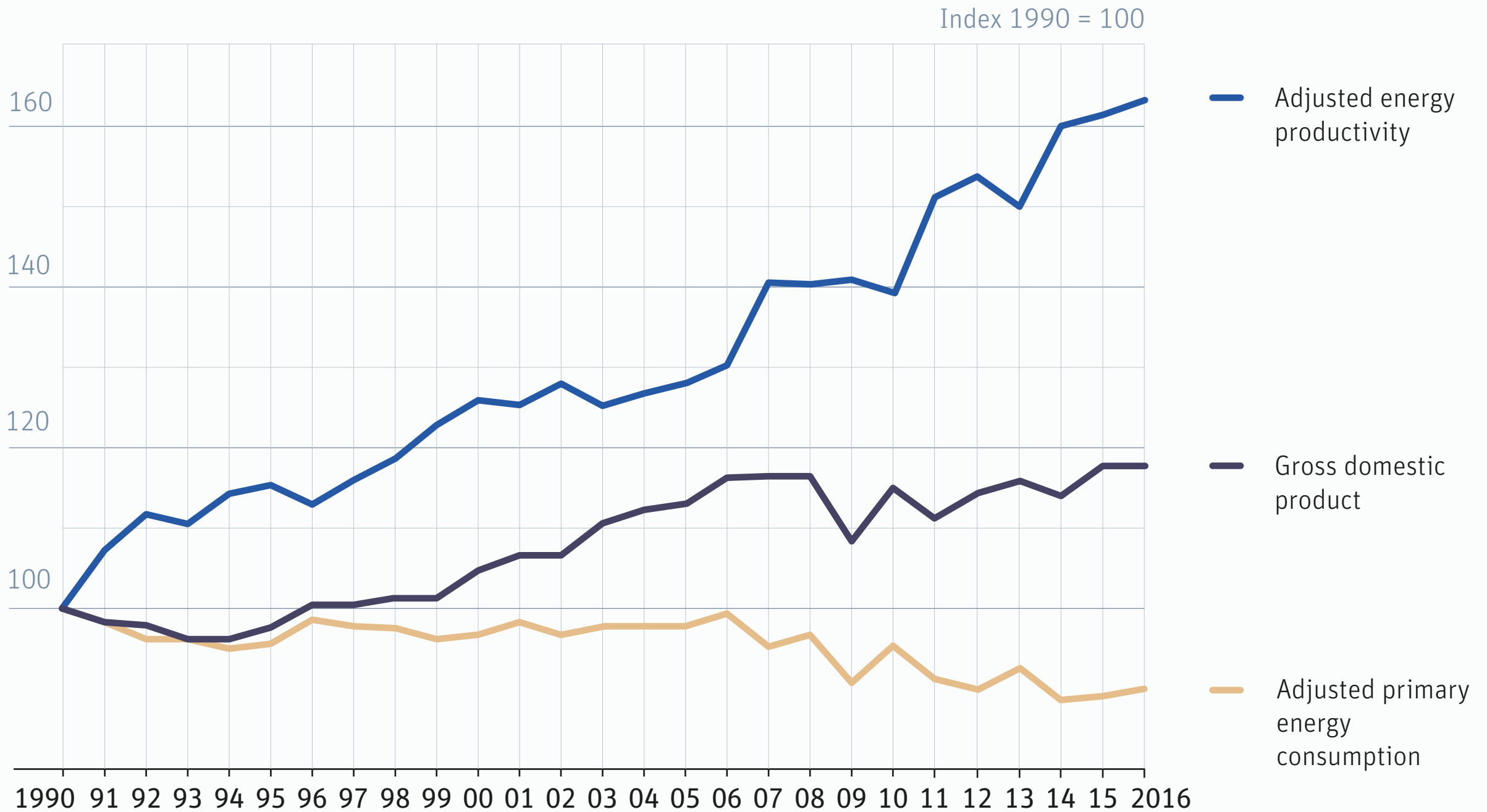


Germany is getting more value from less energy

Energy consumption is shrinking though power generation is up thanks to efficiency

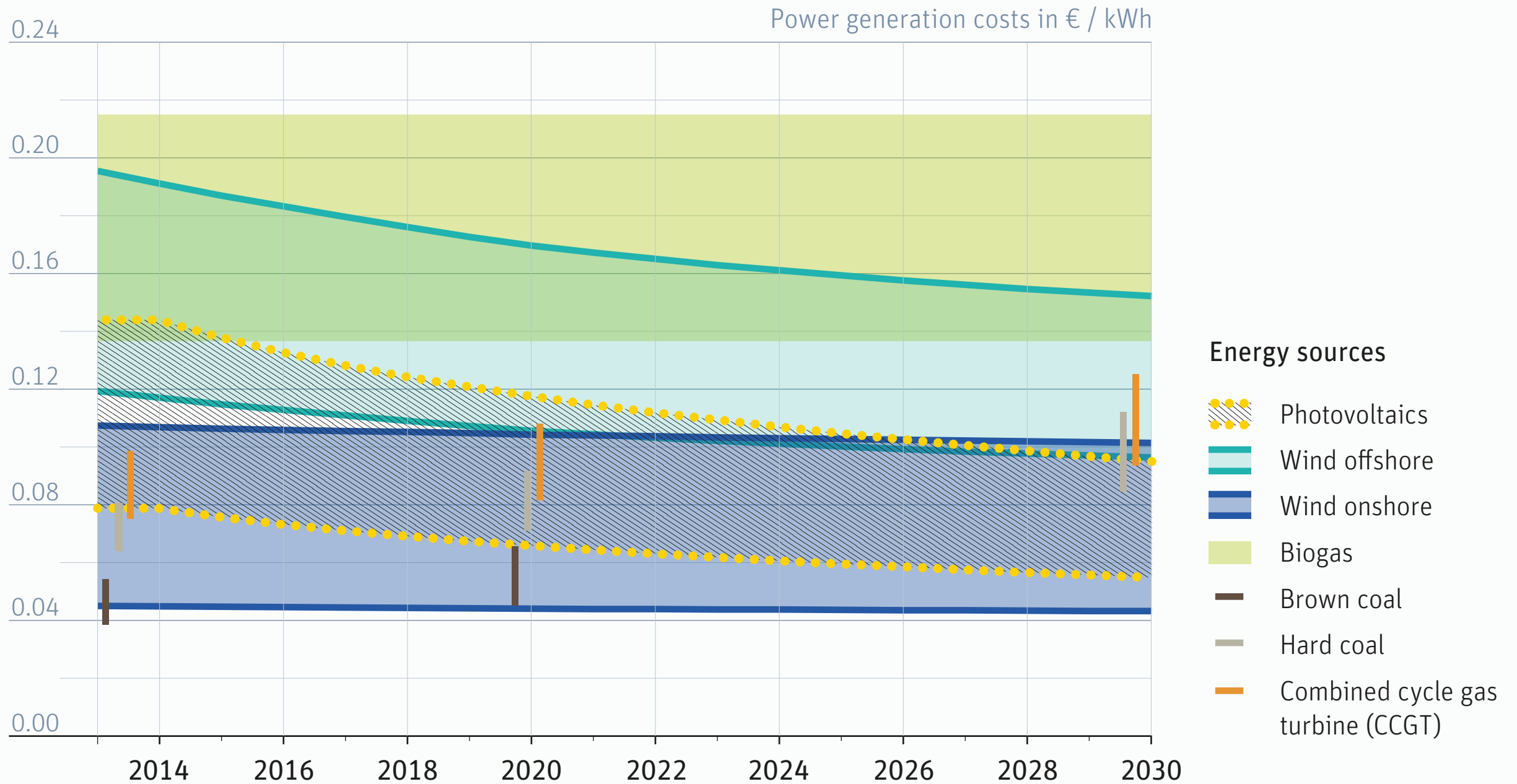
Source: Federal Statistical Office (Destatis); Working Group on Energy Balances (AGEB)



Renewables are becoming competitive

Forecast of power generation cost in Germany up to 2030

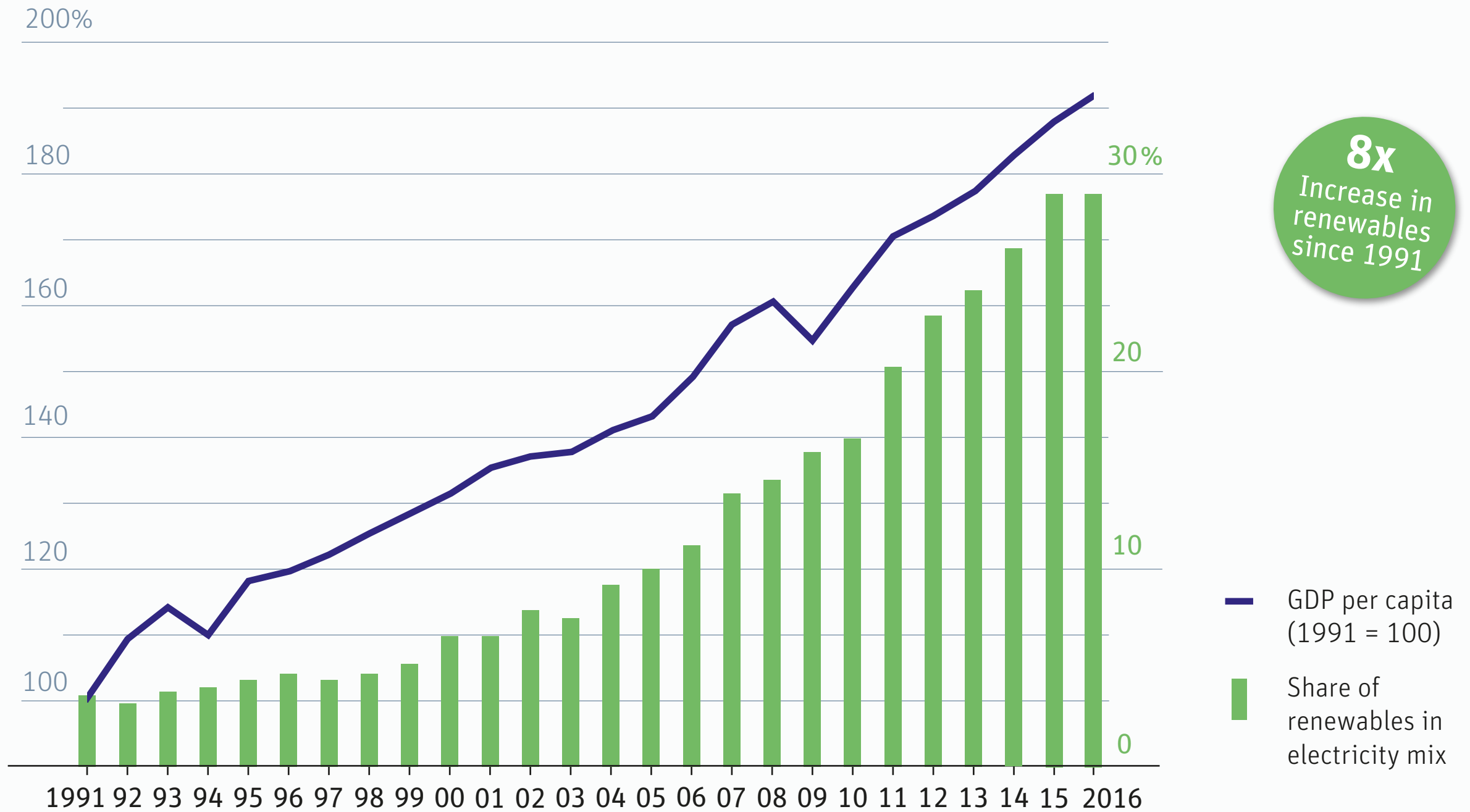
Source: Fraunhofer ISE



Renewables do not hurt Germany's economy

Gross Domestic Product and share of renewables in power generation from 1991-2016

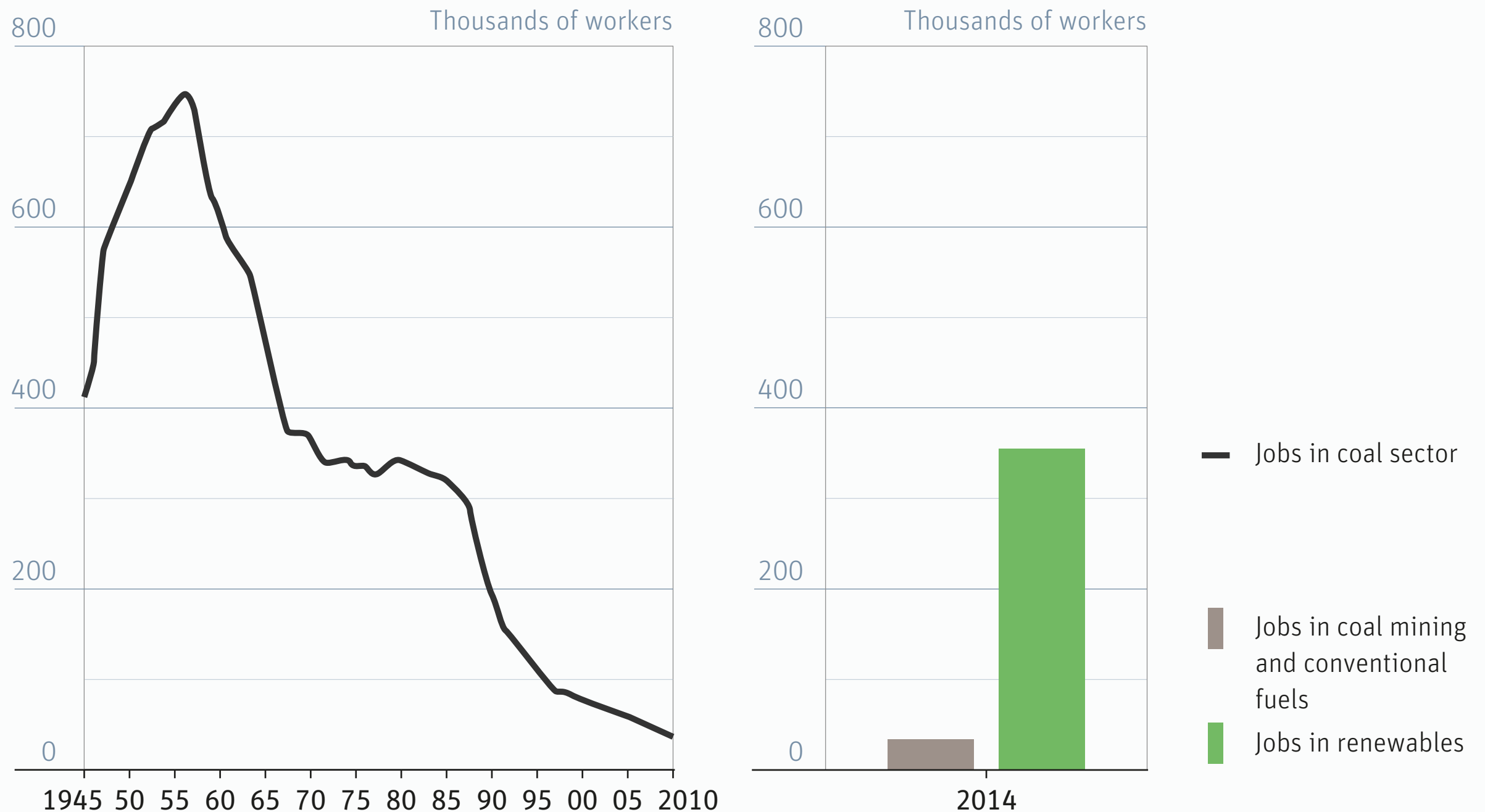
Source: AGEB Annual Report 2016



Renewables create more jobs than coal power does

Employment in Germany in renewable and conventional energy sectors

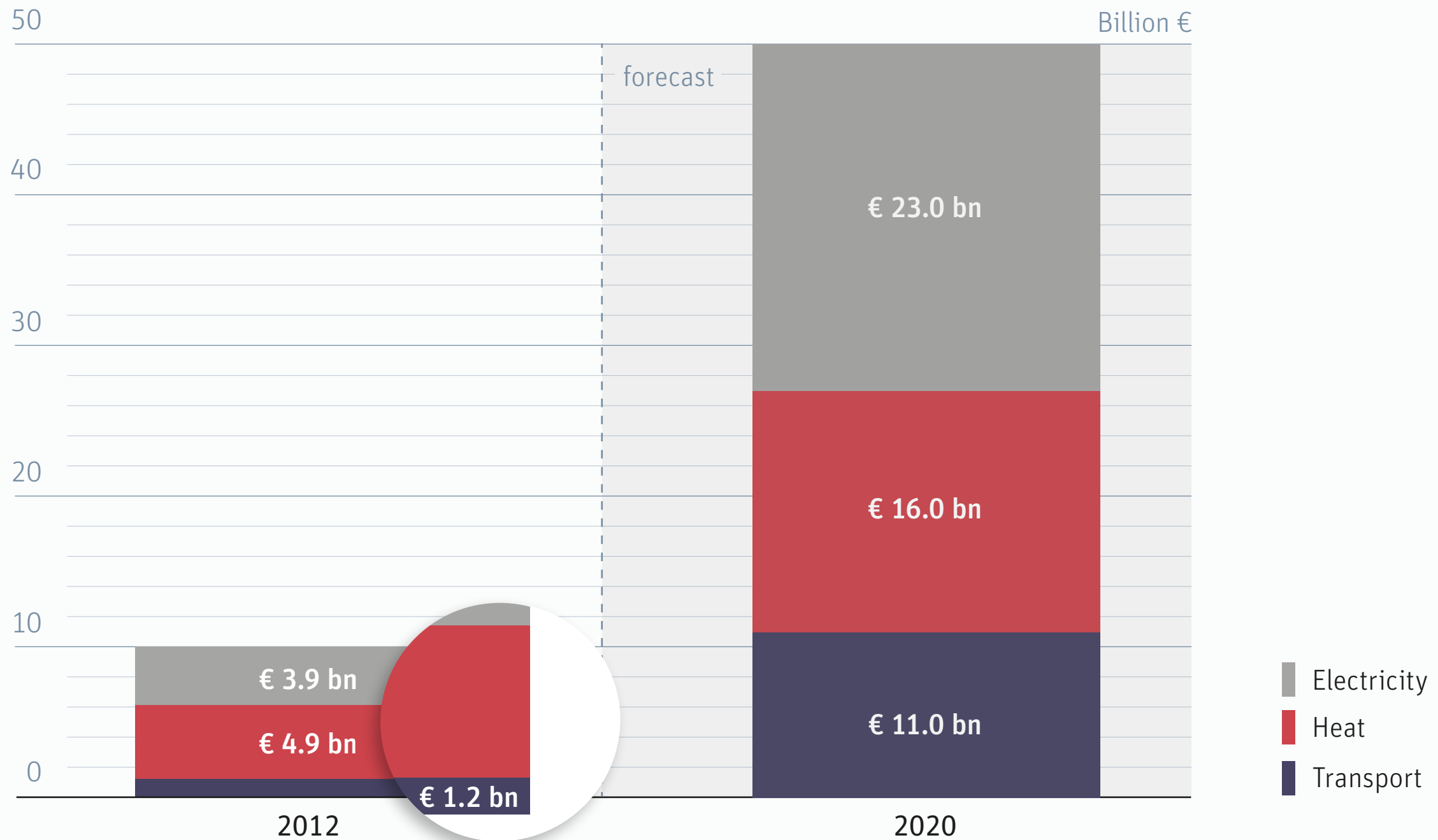
Source: DLR, DIW, GRS, Kohlenstatistik.de. Renewables data from 2014.



Renewable energy offsets expenses for fossil fuel imports

Benefits of renewables in energy use, Germany

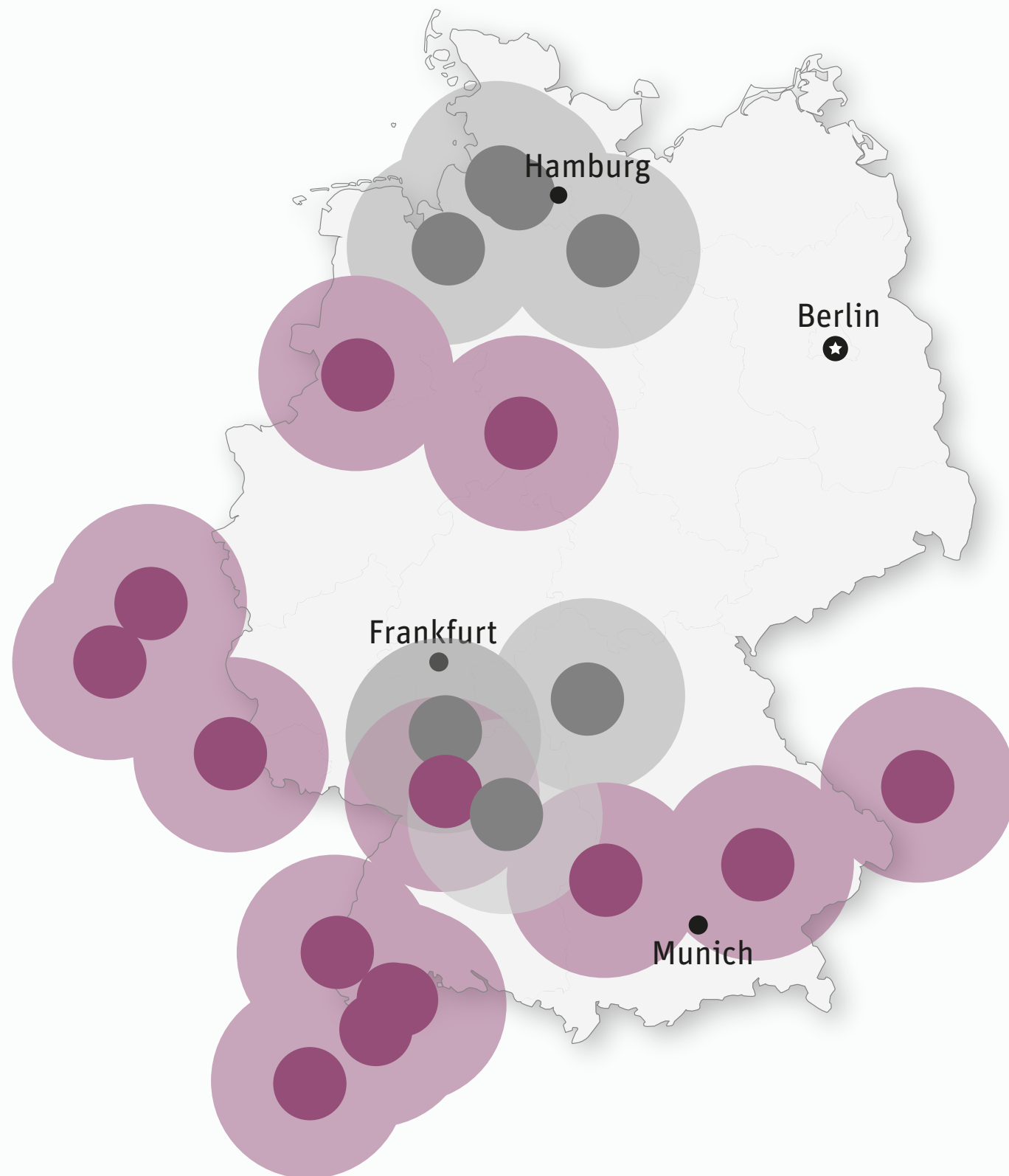
Source: AEE



Recognizing the danger of nuclear power

30/80 km radius around nuclear reactors in Germany and nearby reactors of neighbouring countries

Source: <http://opendata.zeit.de/atomreaktoren>

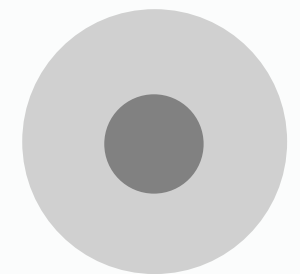
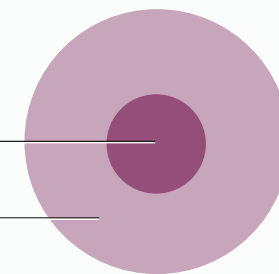


30 km evacuation radius
around Fukushima

POPULATION
ORIGINALLY AFFECTED **12%**

active

decommissioned



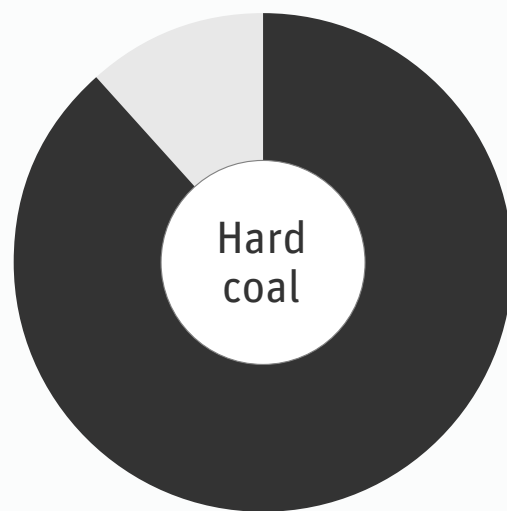
80 km evacuation radius
recommended by US for Fukushima

POPULATION
ORIGINALLY AFFECTED **51%**

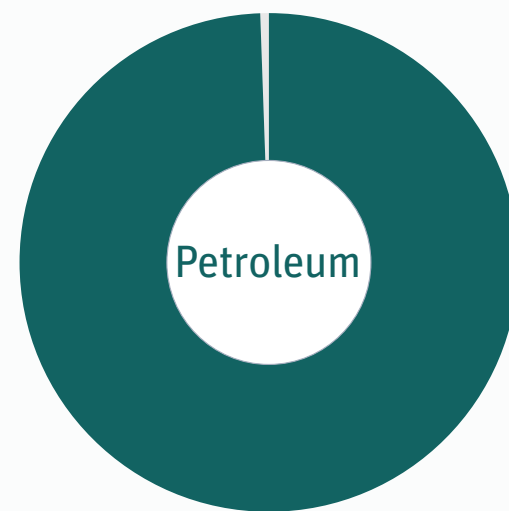
More renewables strengthen Germany's energy security

Share of imports of conventional energy sources in Germany, 2015

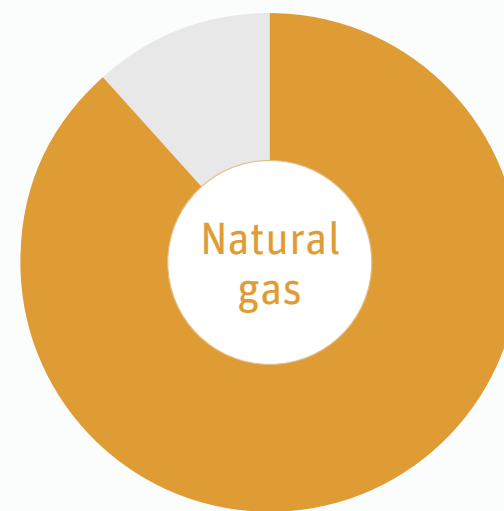
Source: BMWi



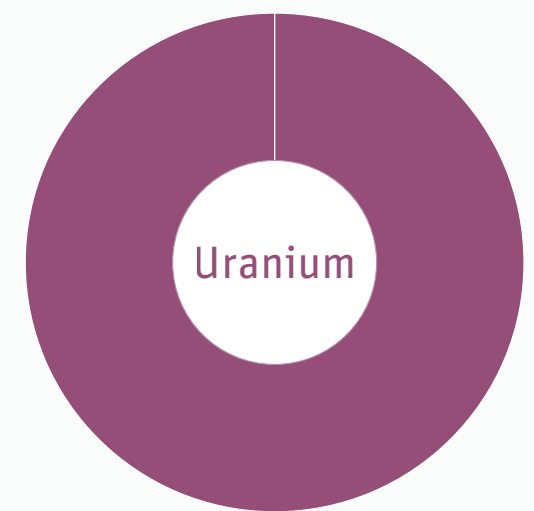
88.5%



99.5%



88.5%

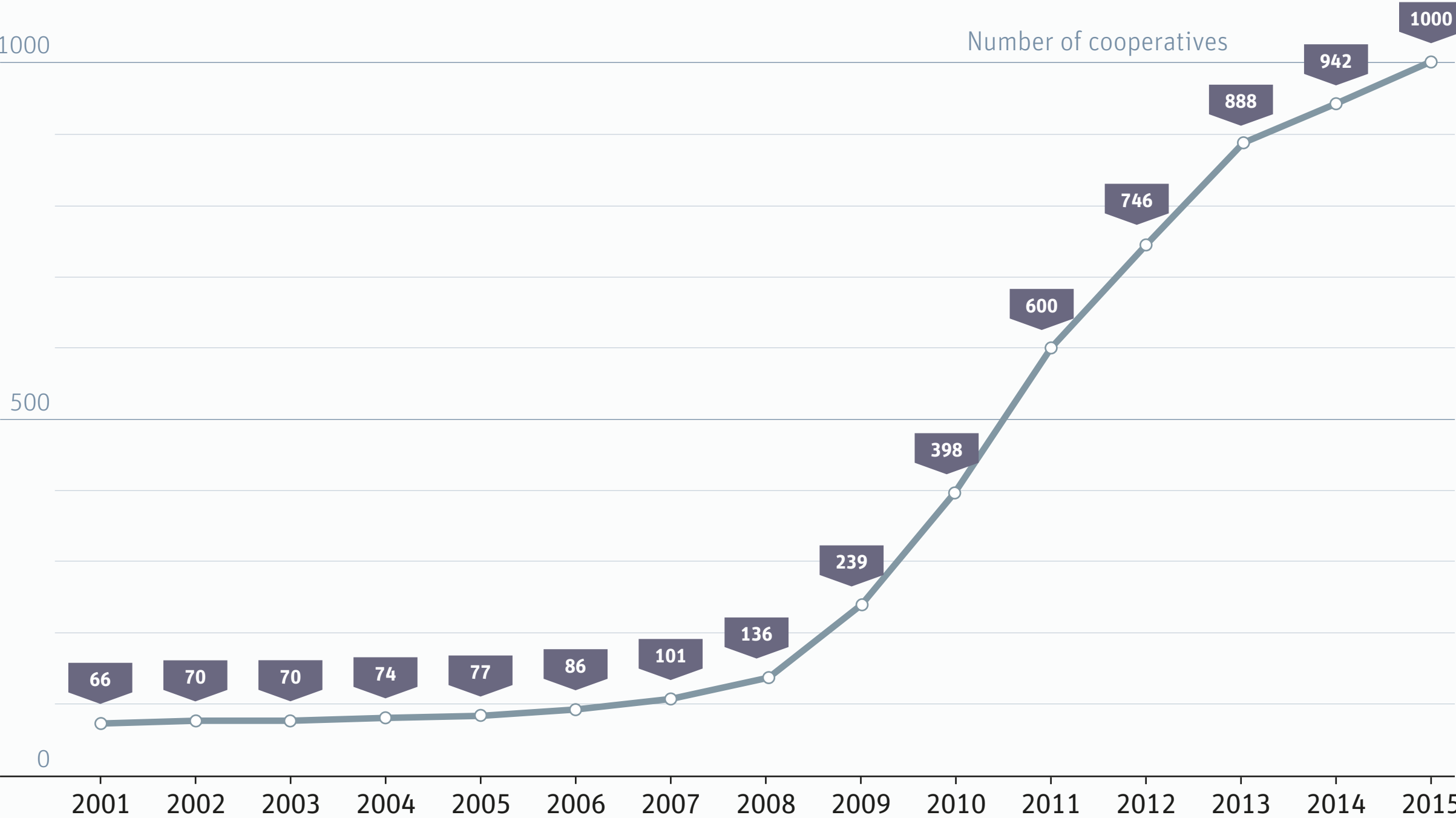


100%

Citizens form cooperatives to drive the energy transition

Number of energy cooperatives in Germany, 2001-2015

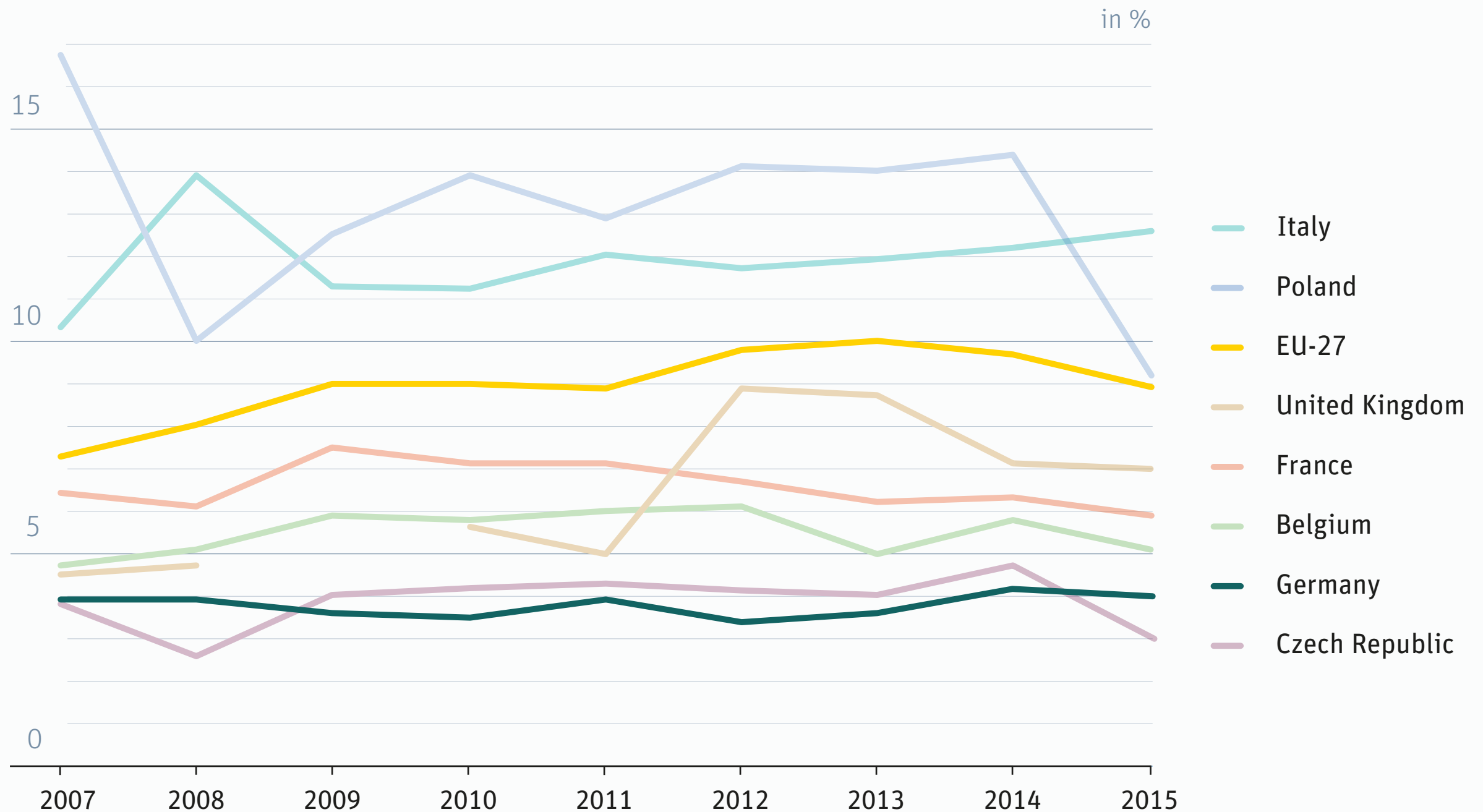
Source: www.unendlich-viel-energie.de



Energiewende not causing “energy poverty” in Germany

Percentage of households unable to pay energy bills on time

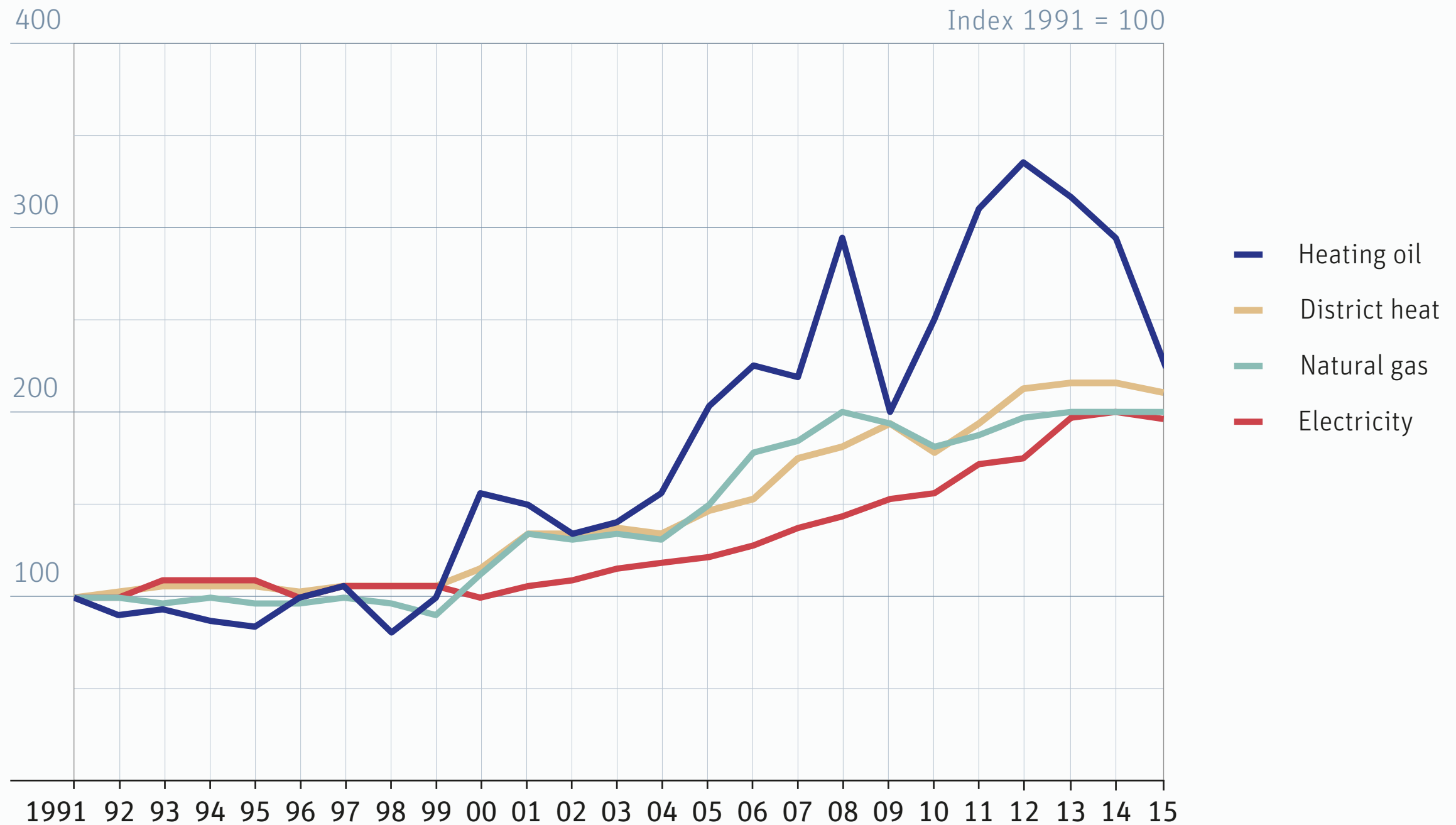
Source: Source: Eurostat. UK data for 2009 not available.



Cost of electricity has risen less than other energy sources in Germany

Index of household energy prices relative to 1991

Source: BMWI

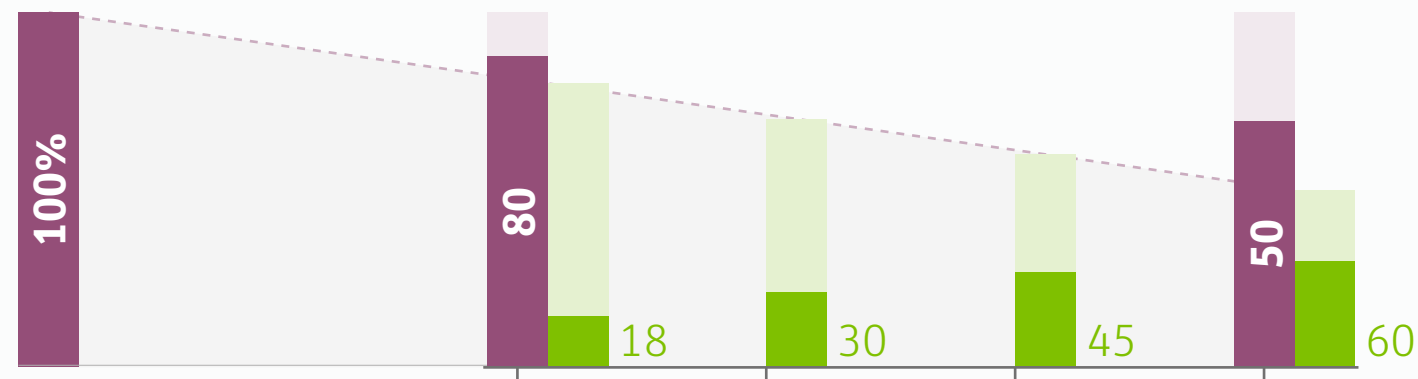


German energy transition: high certainty with long-term targets

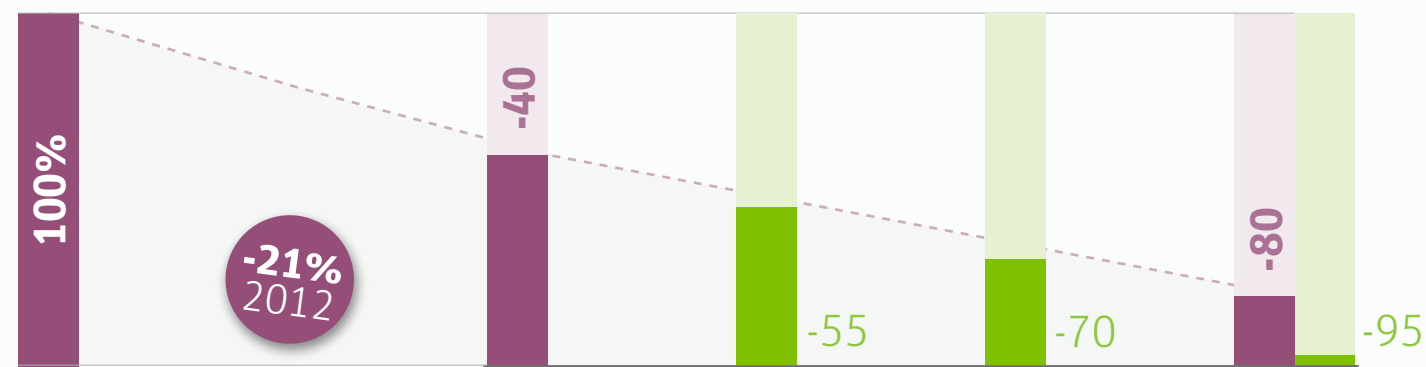
Long-term, comprehensive energy and climate targets set by the German government

Source: BMU

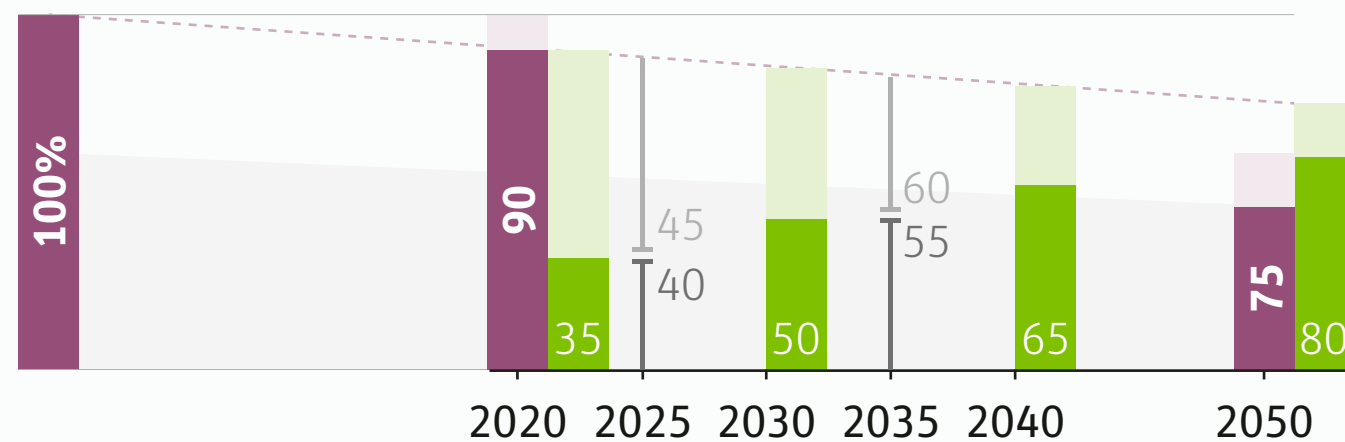
Gross energy consumption
(compared to 2008)



Greenhouse gases
(compared to 1990)



Power consumption
(compared to 2008)

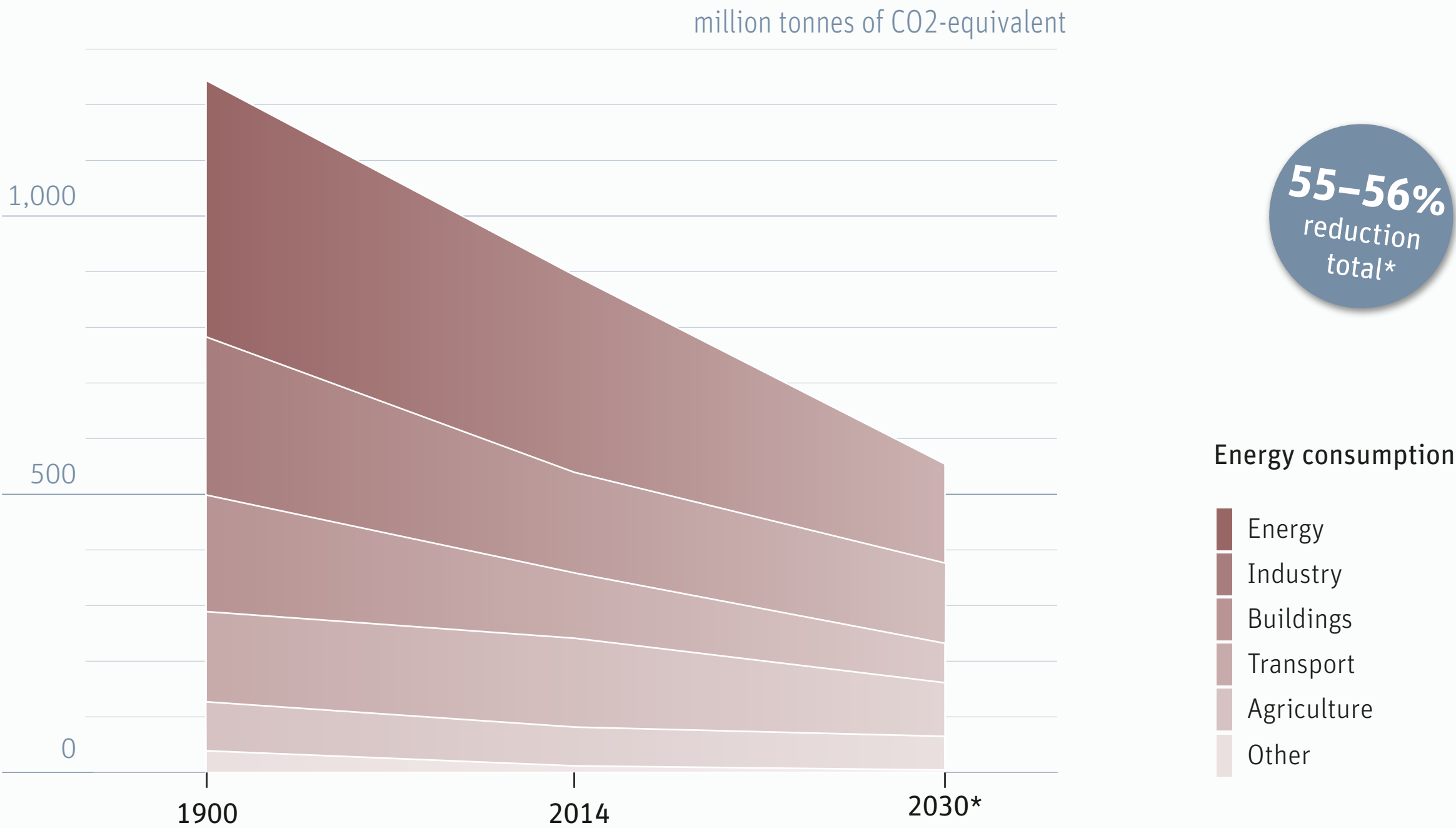


- Target in %
- Share of renewables in %
- Trend
- * In terms of primary energy

Greenhouse gas reduction targets in Germany by sector

Climate Action Plan 2050 adopted in 2016

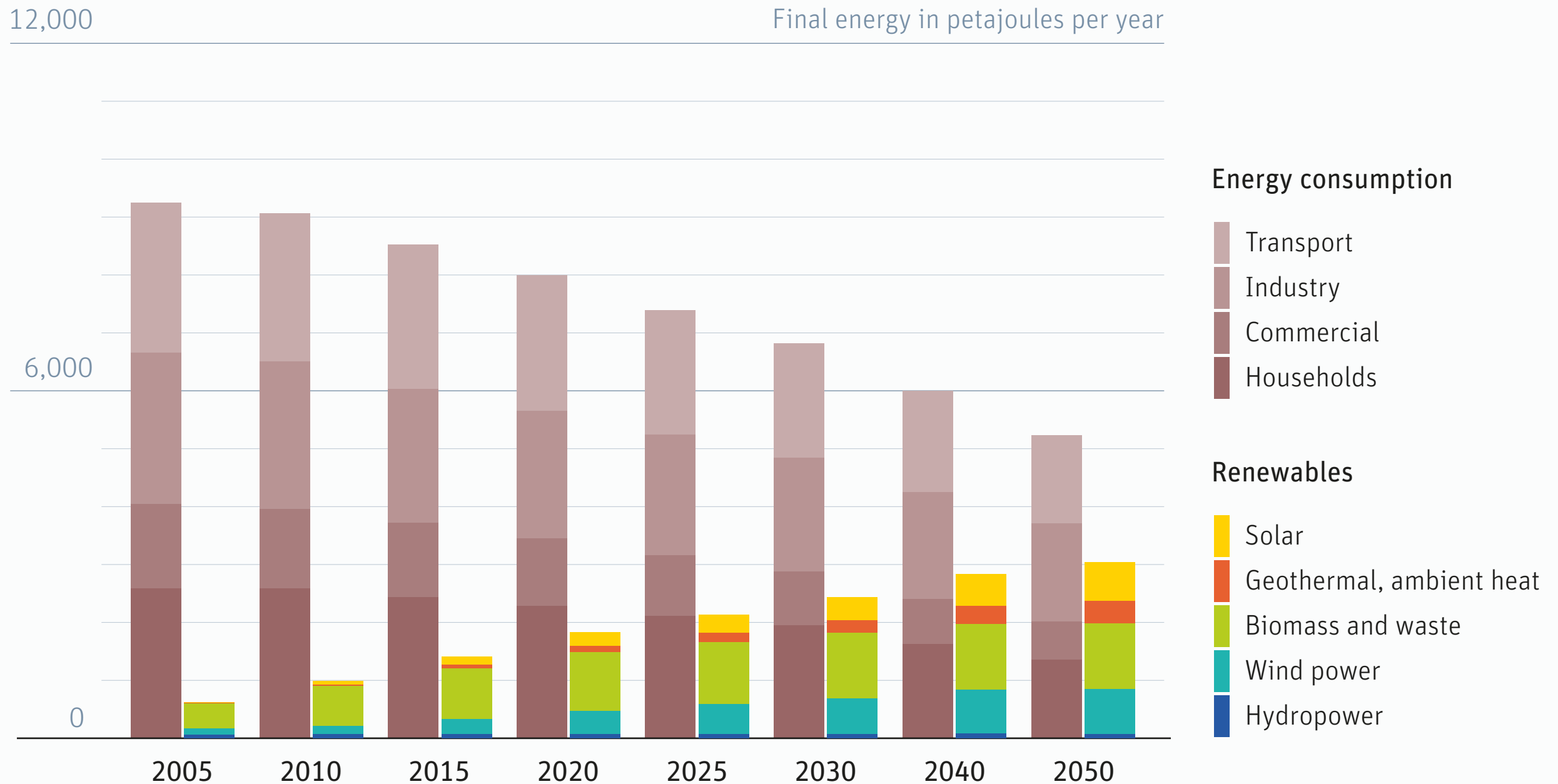
Source: German government



Germany's plan: ramp up renewables, drive down energy consumption

Final energy supply and demand in Germany 2005-2050, scenario

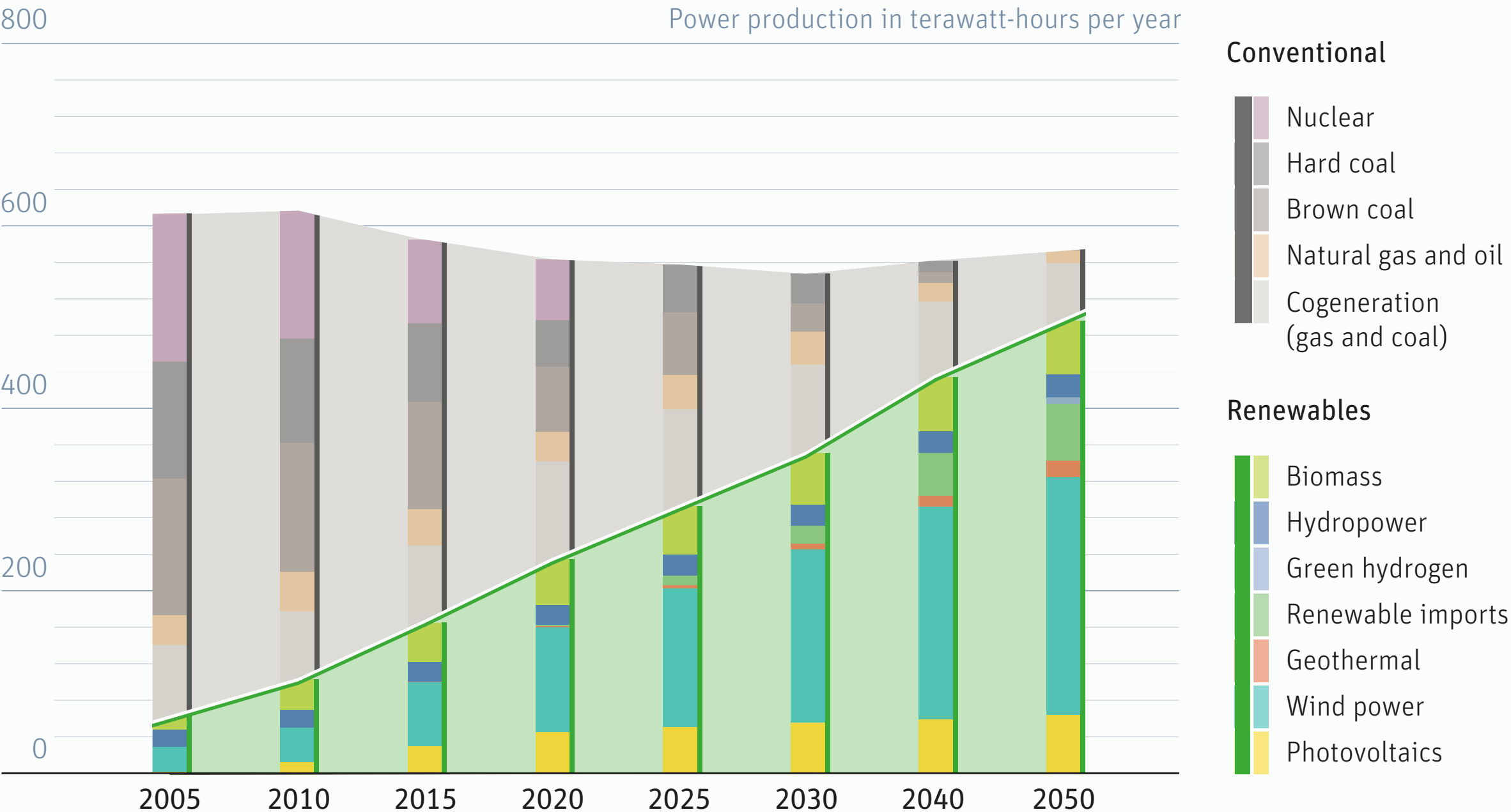
Source: DLR Lead Study, scenario A



Germany's plan: switch from coal and nuclear to renewables

Electricity generation in Germany 2005-2050, scenario

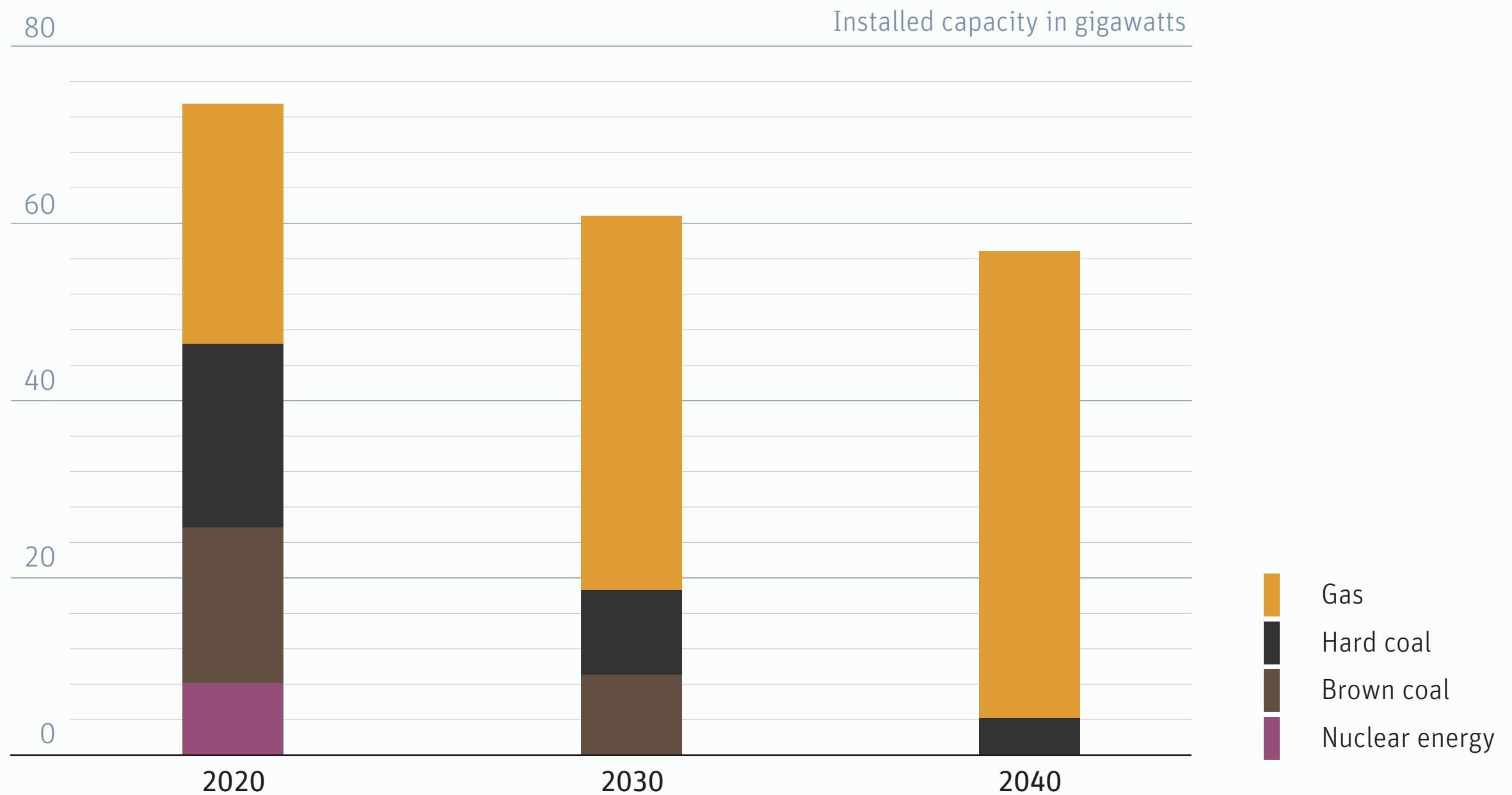
Source: DLR and Fraunhofer IWES



Germany's plan: declining role for coal power

Overall installed conventional electricity generation capacity in Germany, 2020-2040

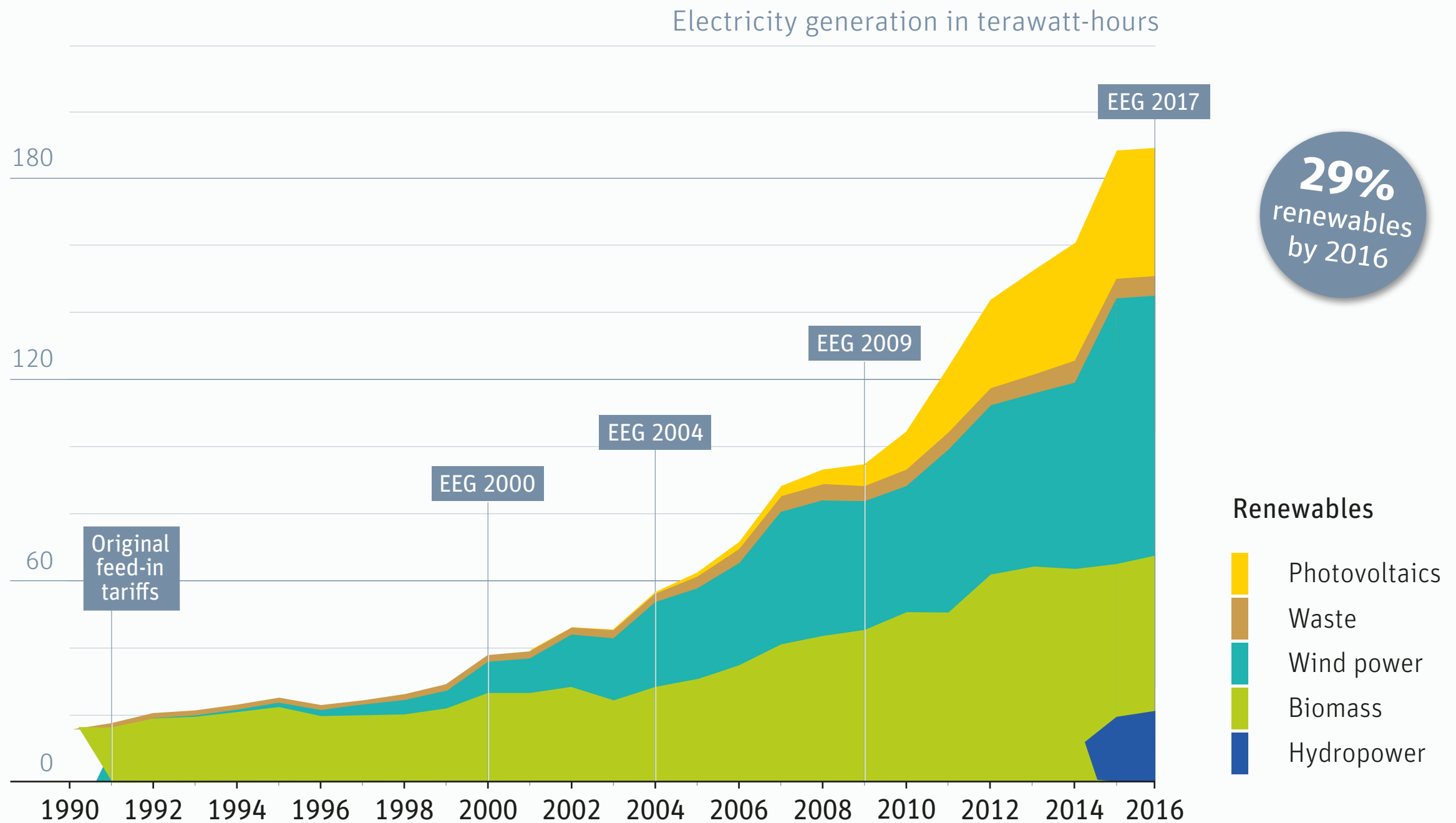
Source: Fraunhofer IWES



Feed-in tariffs grow renewables

Renewable electricity generation in Germany, 1990-2016

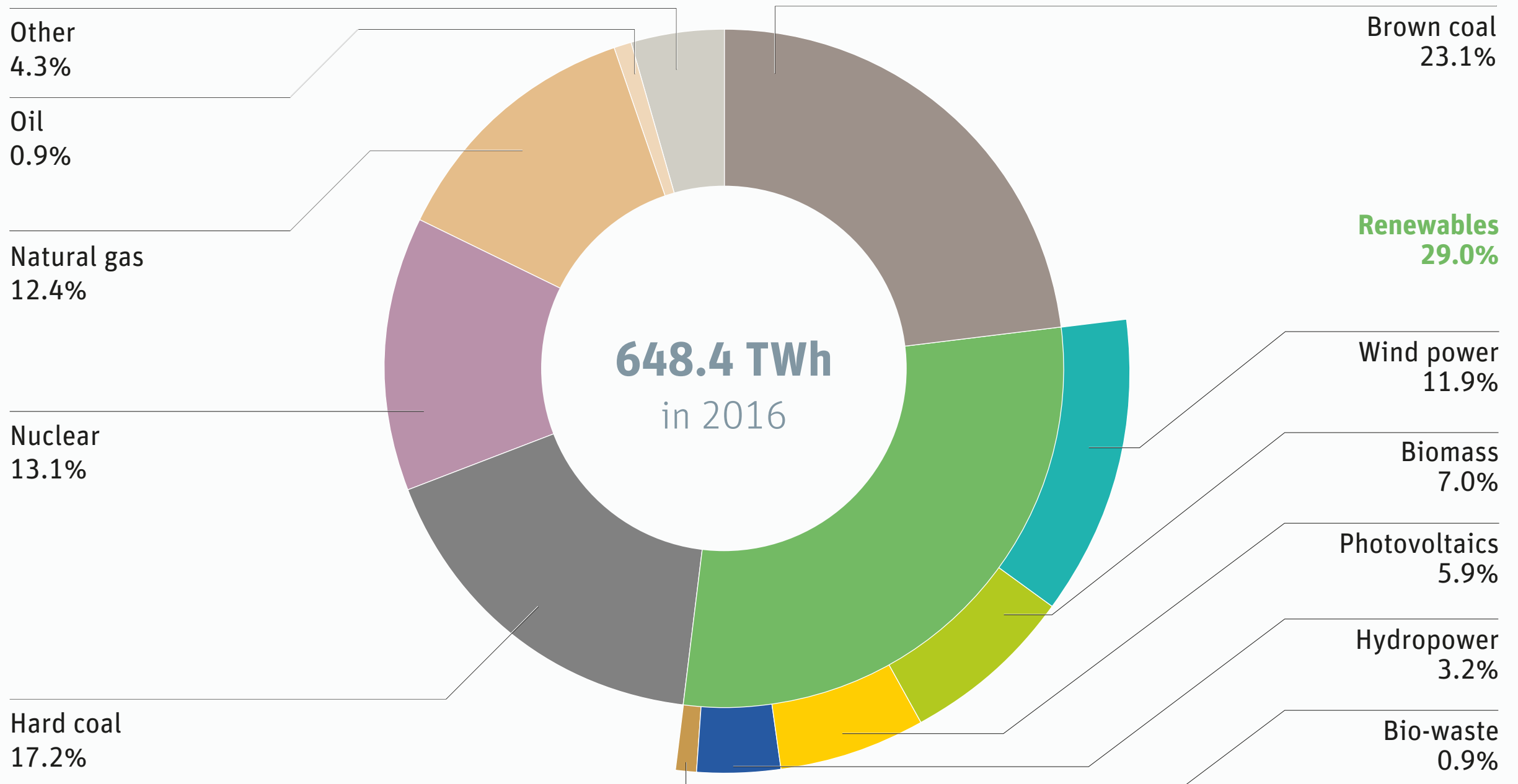
Source: BMU



Germany reaches 29 percent renewable power in 2016

Gross power generation mix

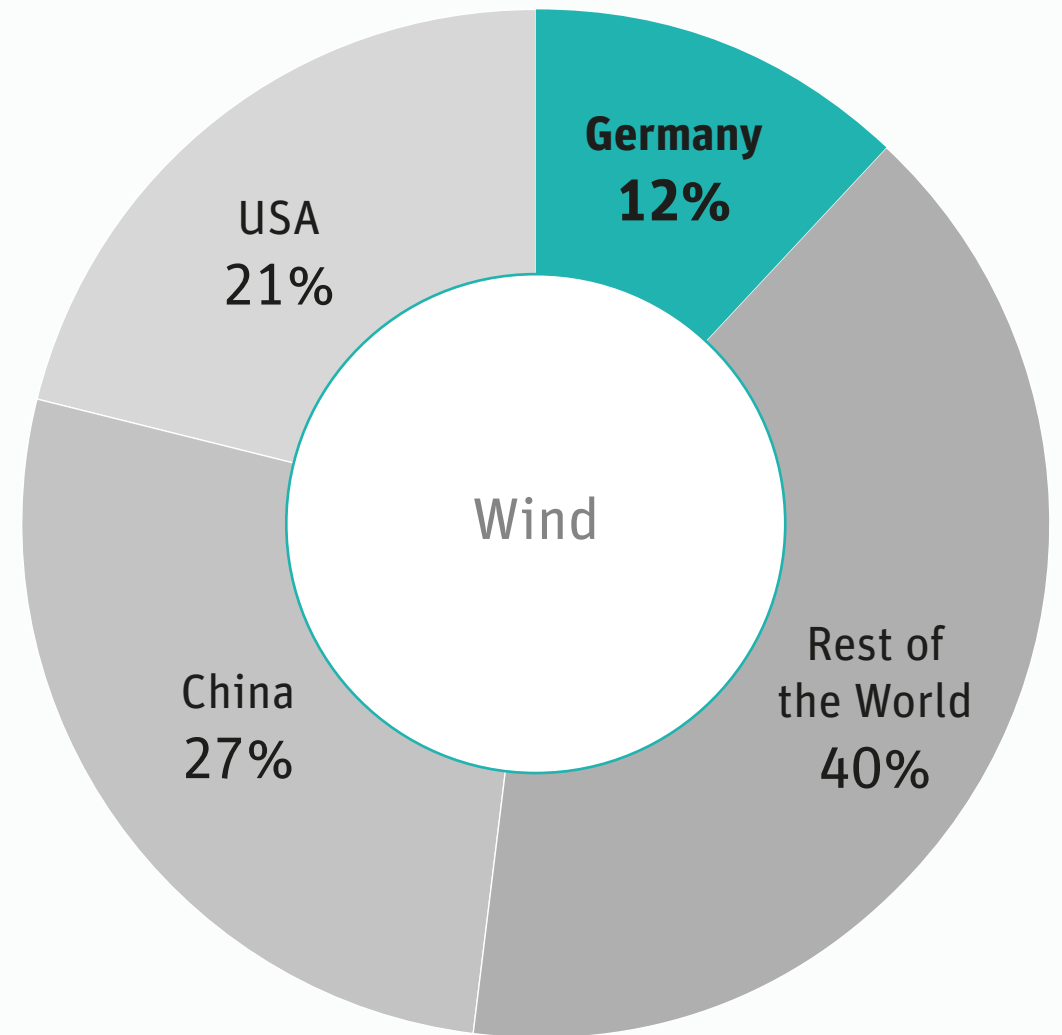
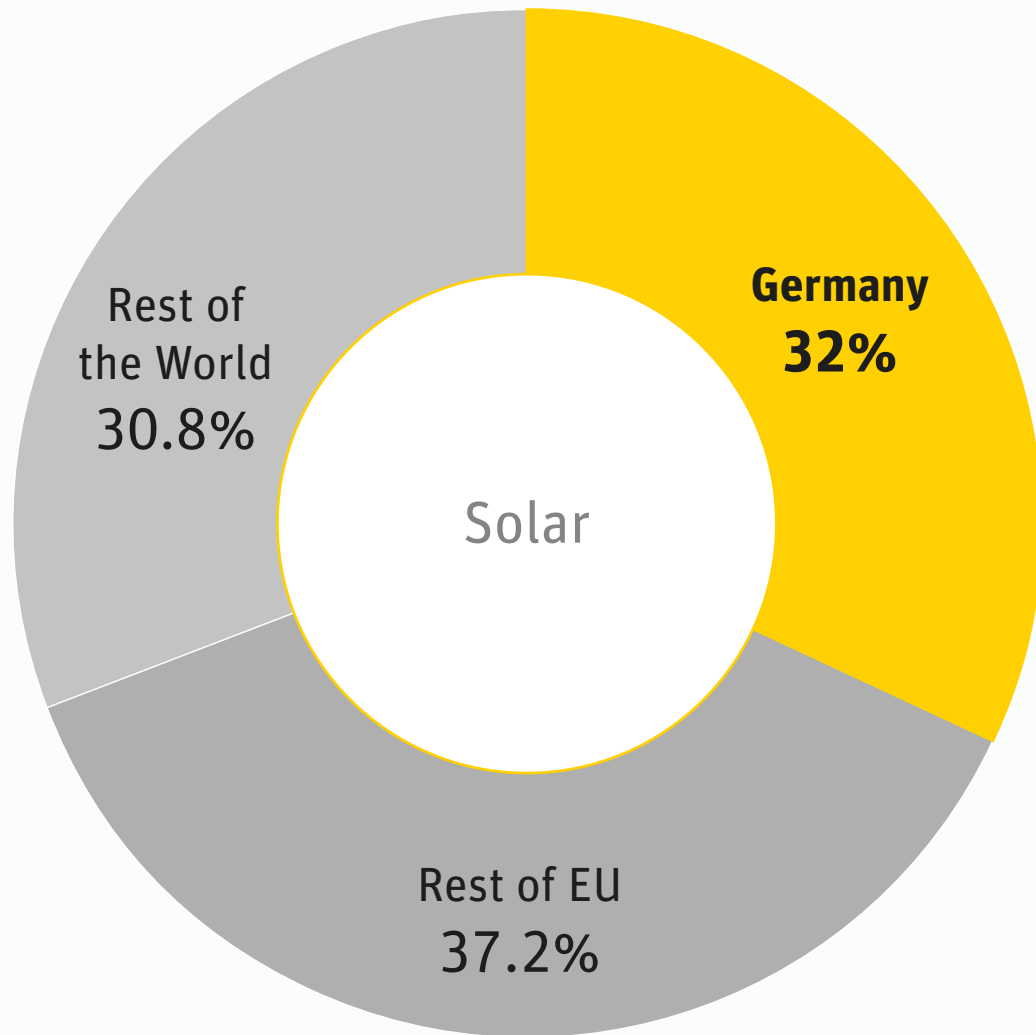
Source: AGEB



Germany paved the way for solar and wind at an early stage

Solar and wind operating capacity, Germany and rest of world, 2012

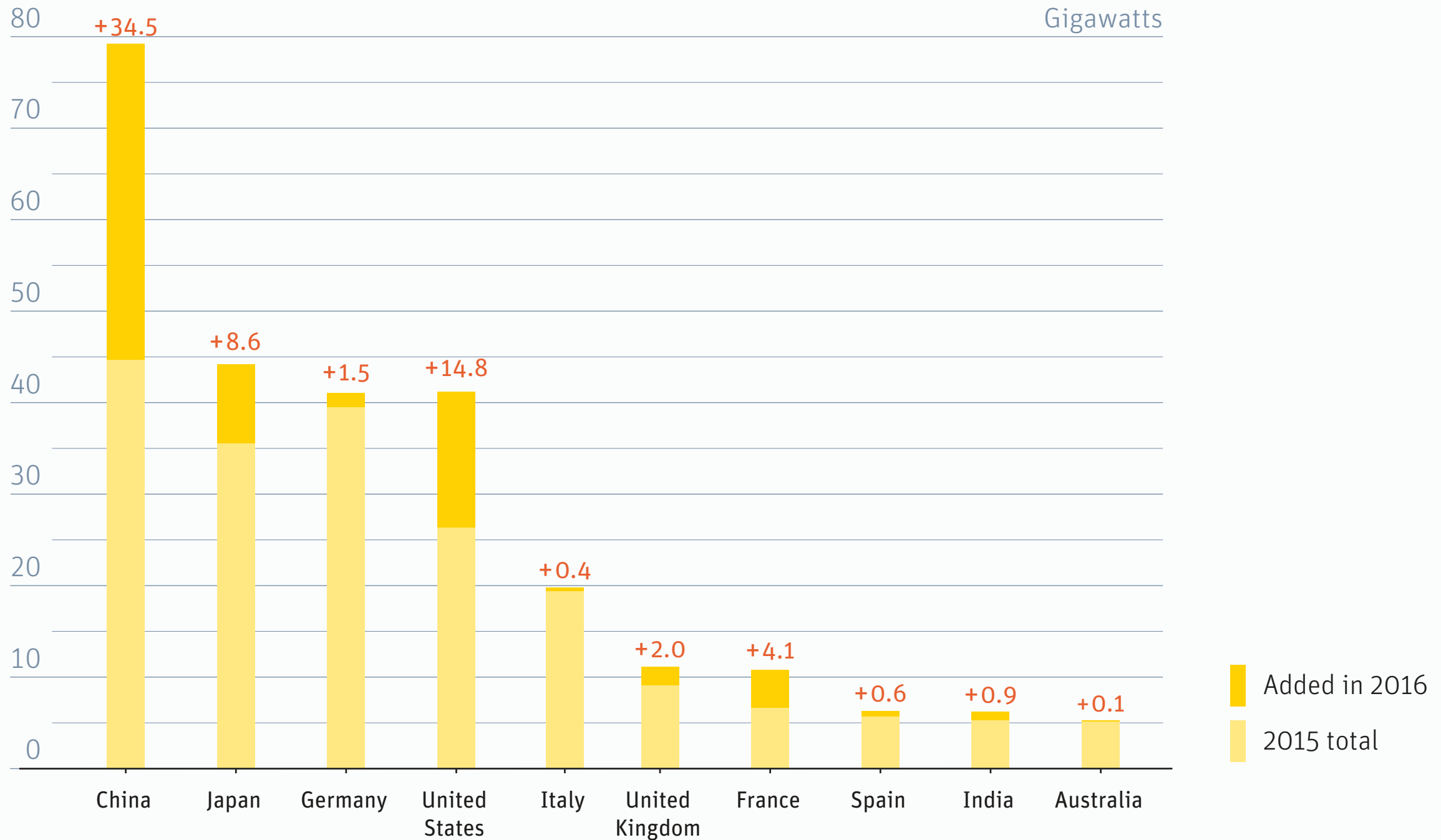
Source: REN21



Germany is a leader in solar

Top 10 countries for solar power in terms of total installed capacity, 2016

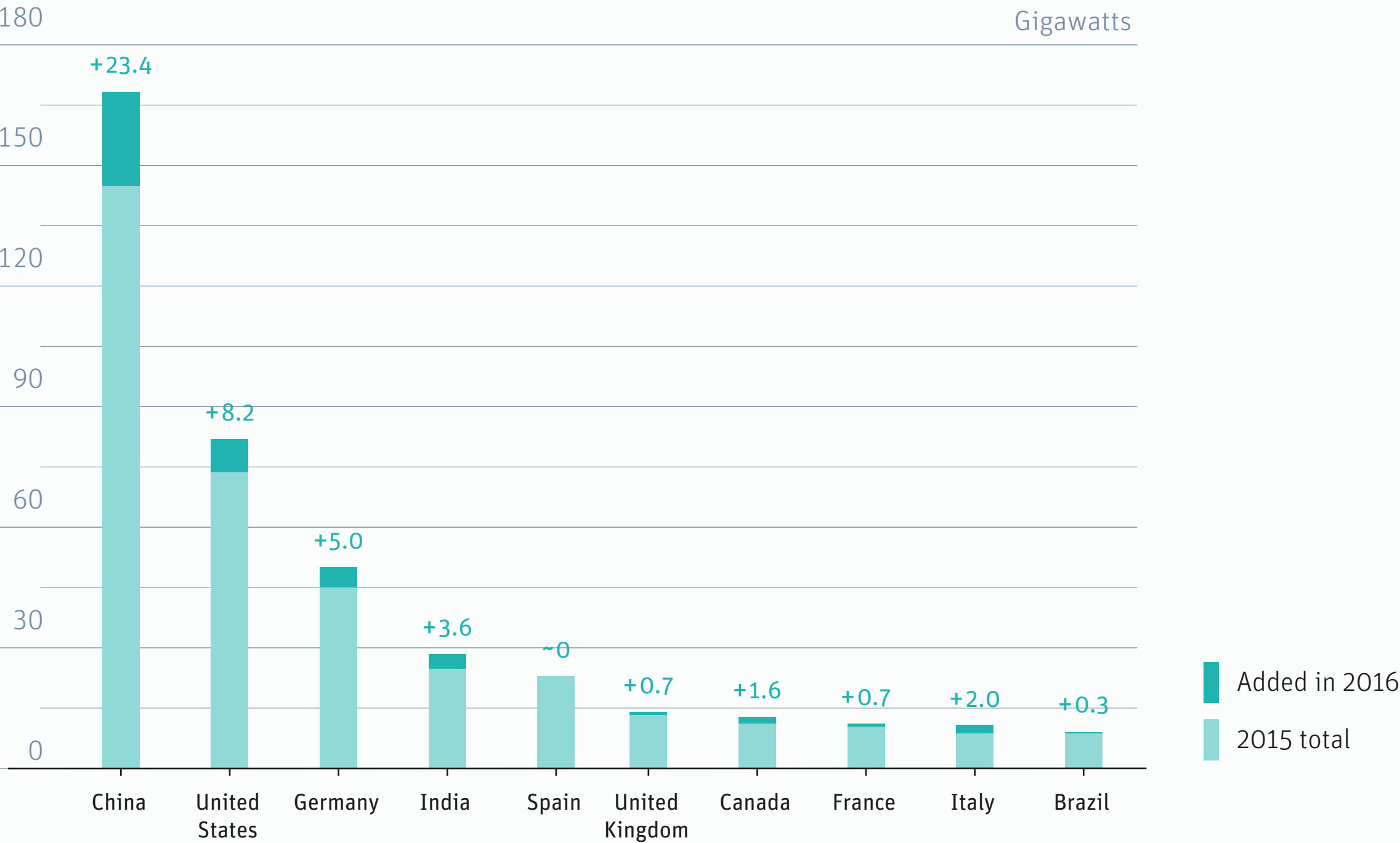
Source: REN21, BNetzA



Germany is a leader in wind power

Top 10 countries for wind power in terms of total installed capacity, 2016

Source: REN21

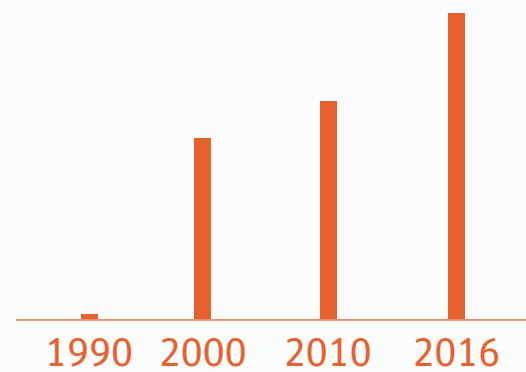


Wind turbines 50 times more powerful today than 20 years ago

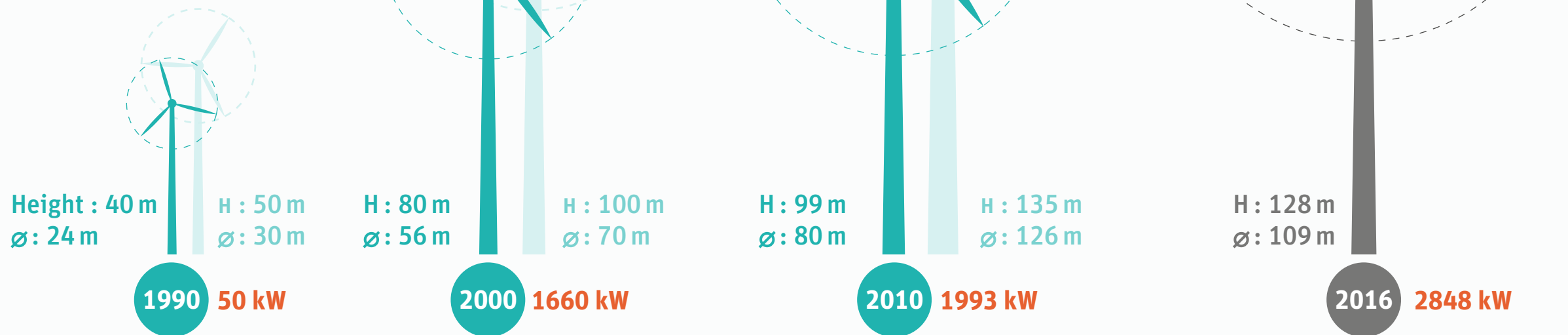
Development in size and power of wind turbines, 1990-2016

Source: DEWI

Average rated output



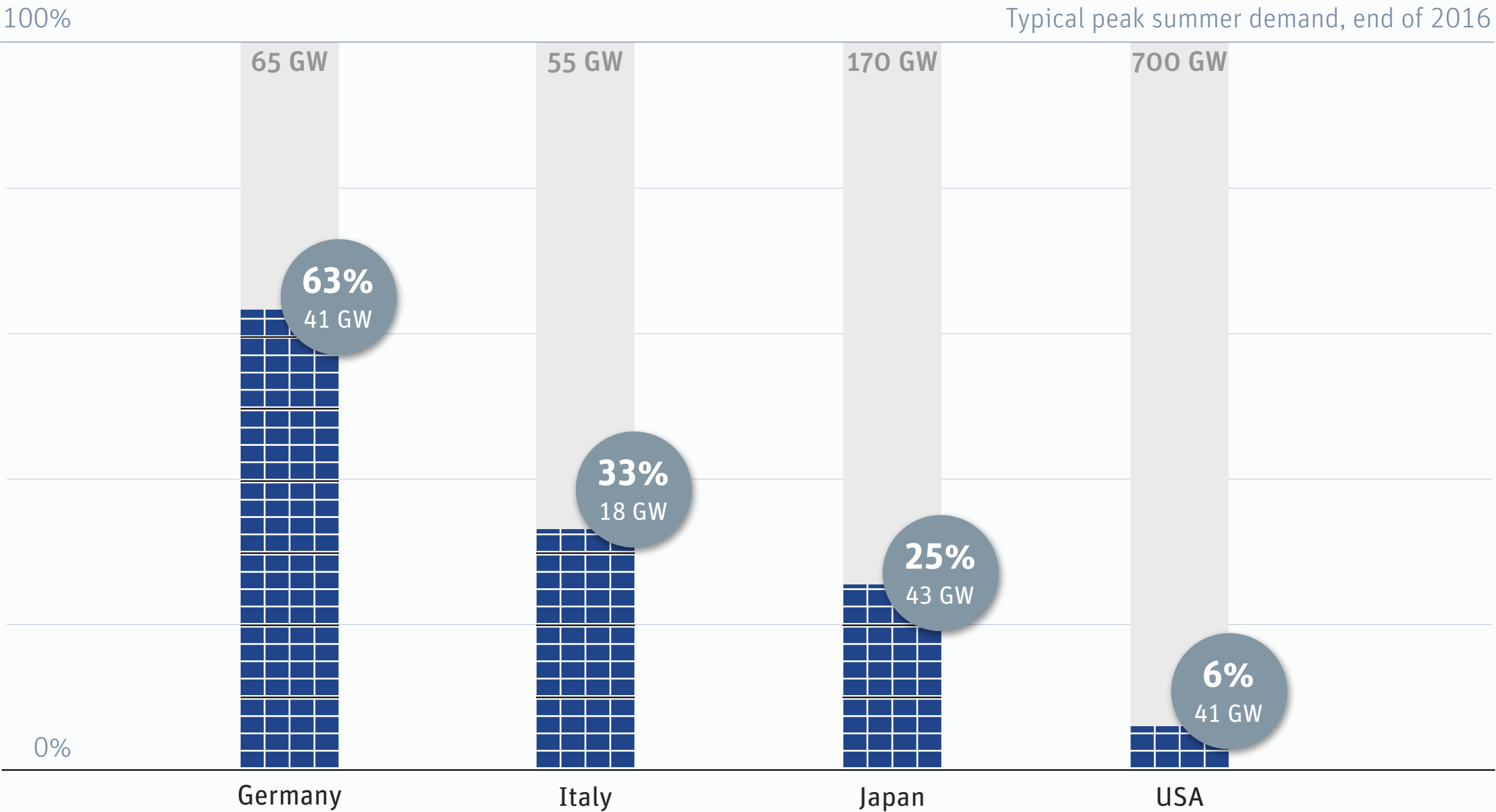
Average size | Max size



Germany's installed solar PV capacity is already half of power demand

Germany has most solar PV installed in absolute (41GW) and relative terms (63% of peak demand)

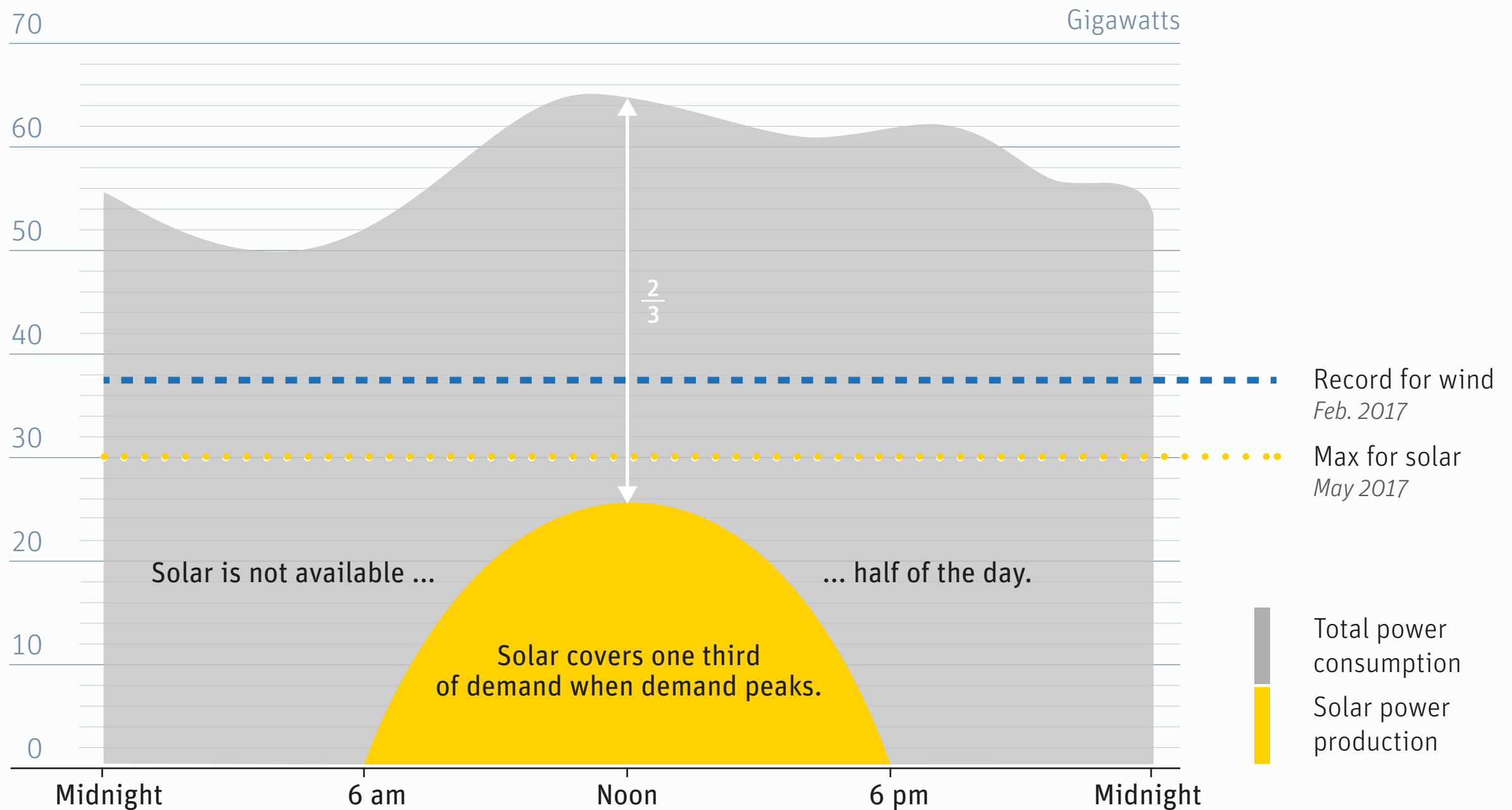
Source: REN21, own calculations



Solar power can already cover a third of peak power demand

Power demand and solar power production in Germany, estimate based on actual data from February 2017

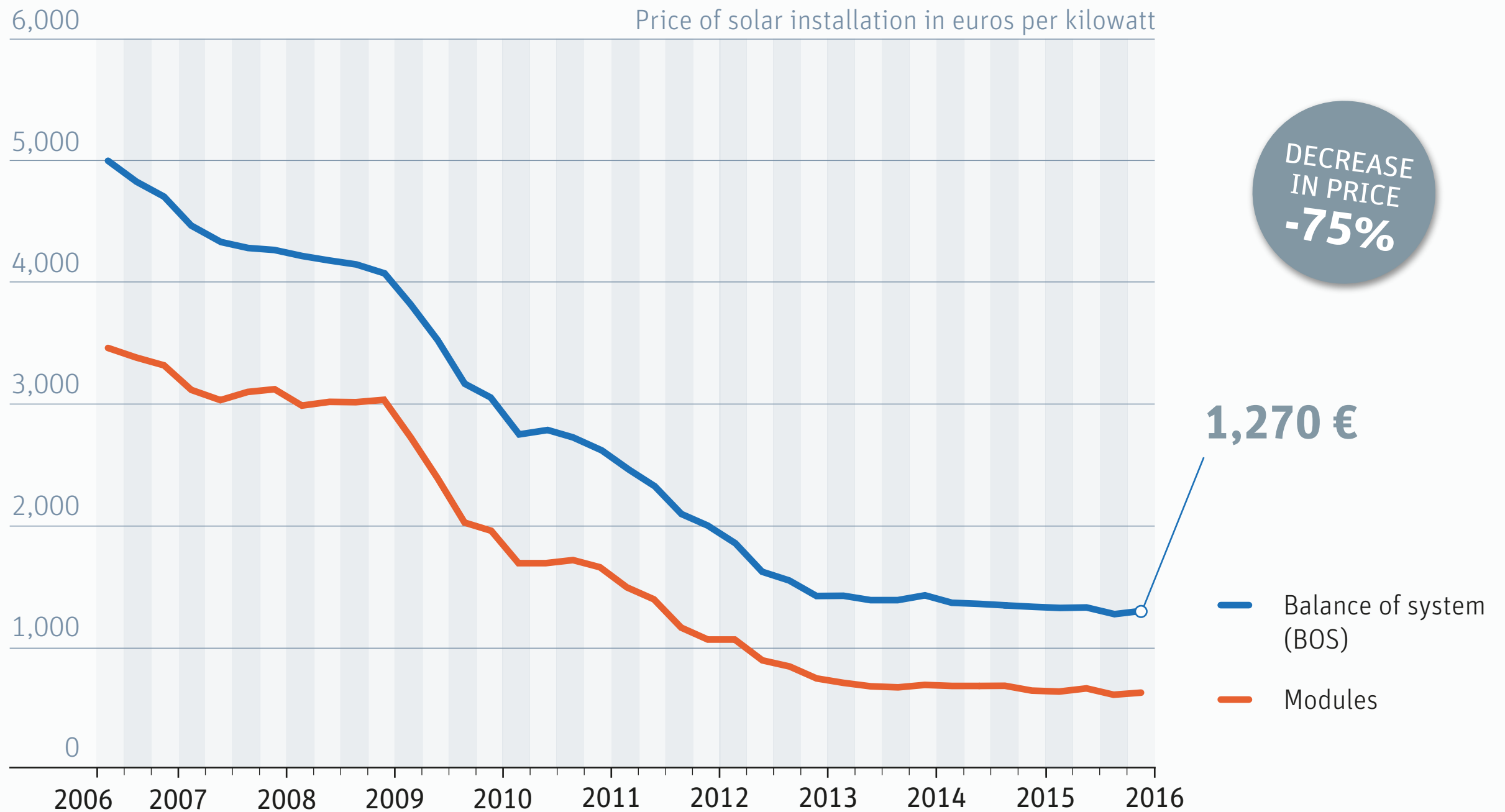
Source: *Frauenhofer ISE, EEX*



Price of solar down in Germany by 75 percent from 2006-2016

Average system price for installed rooftop solar from 10 to 100 kilowatts

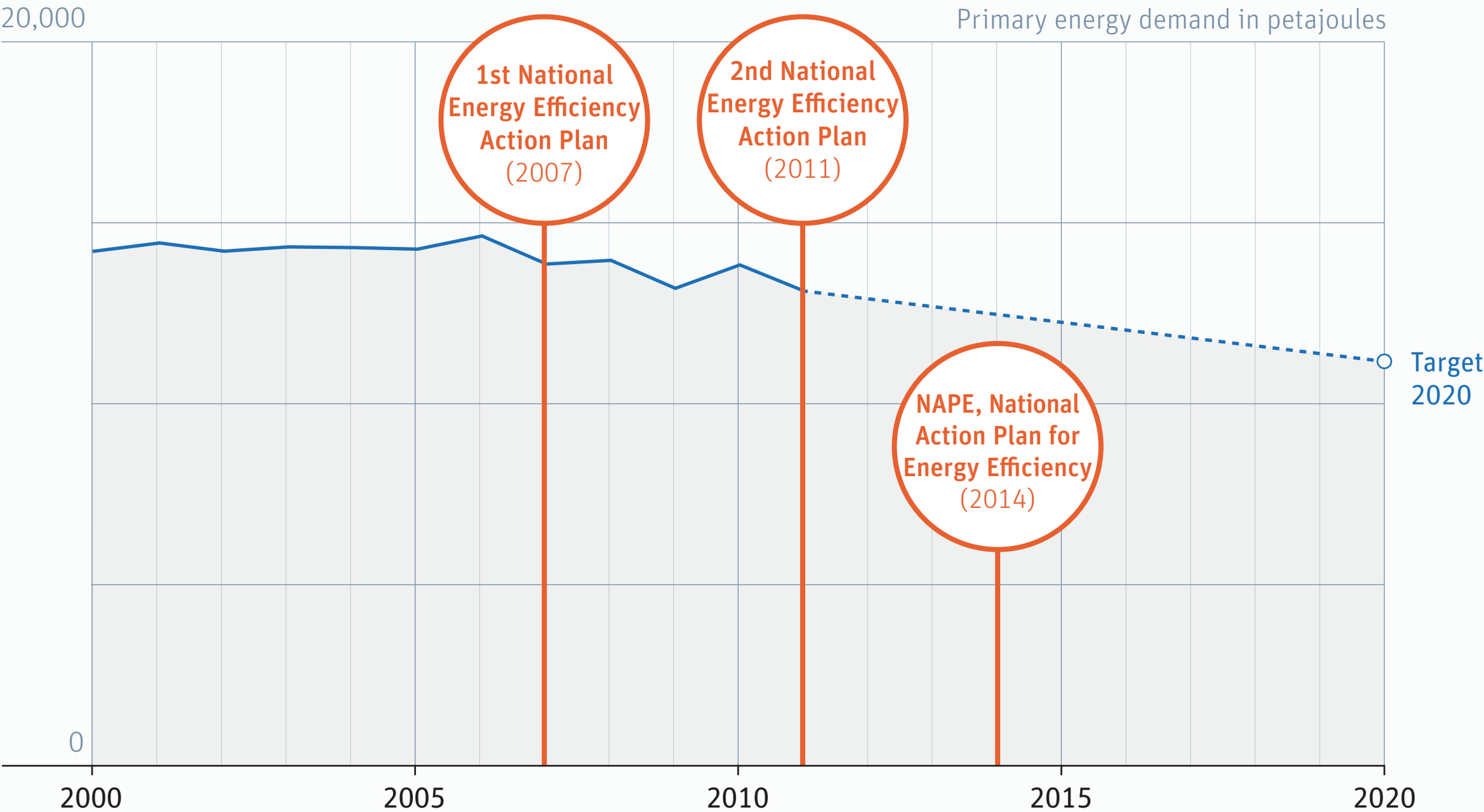
Source: EUPD Research and BSW-Solar



Germany's plan: drive down energy demand

Primary energy demand in Germany, 2000-2020

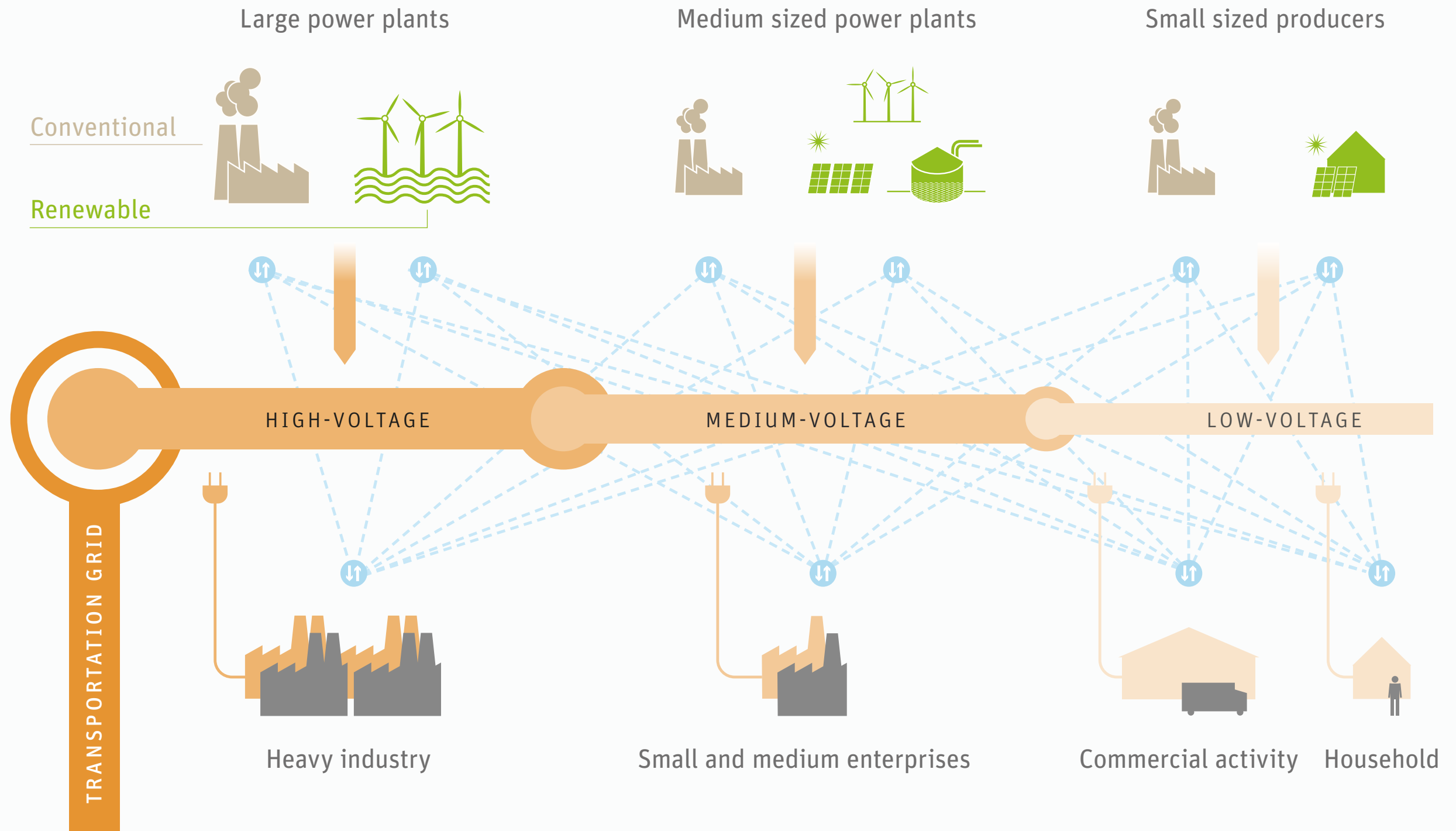
Source: AGEBA, BMWi



The future power grid will be bidirectional and intelligent

Electricity and information flow in power grid

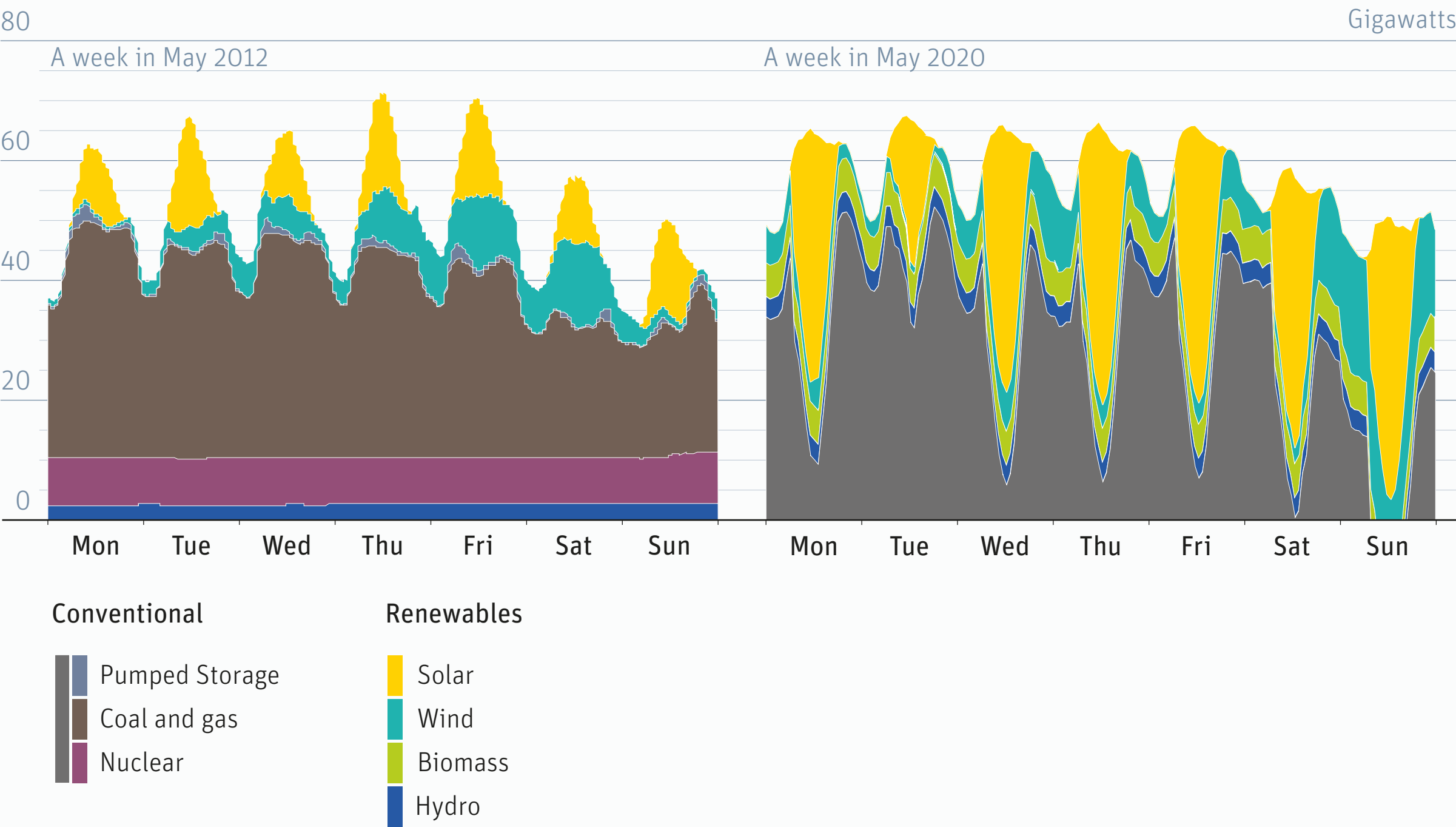
Source: IFEU



Renewables need flexible backup, not baseload

Estimated power demand over a week in 2012 and 2020, Germany

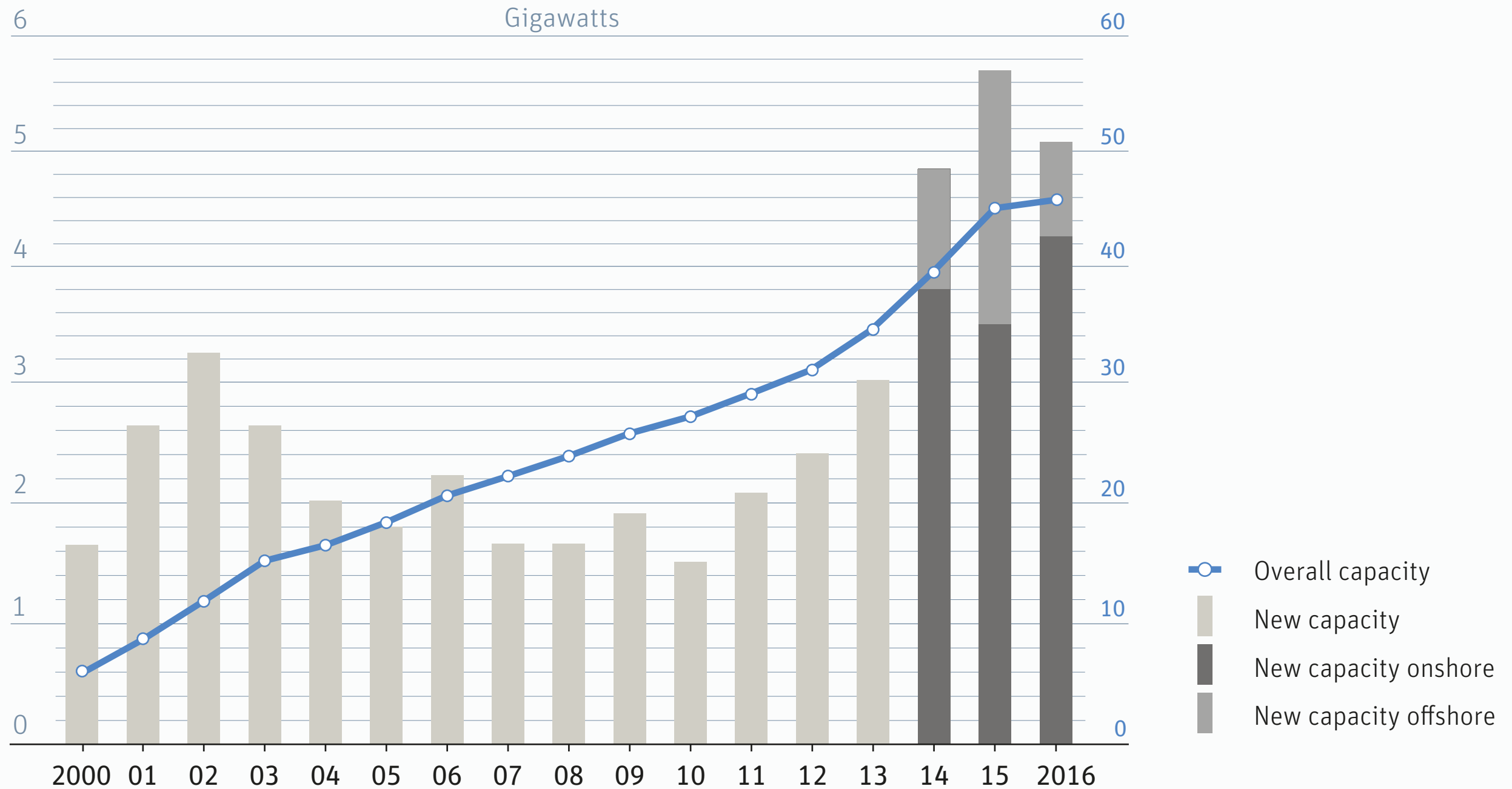
Source: Volker Quaschnig, HTW Berlin



Germany has steady wind power growth

Cumulative and newly installed wind power capacity in Germany, 2000-2016

Source: DEWI

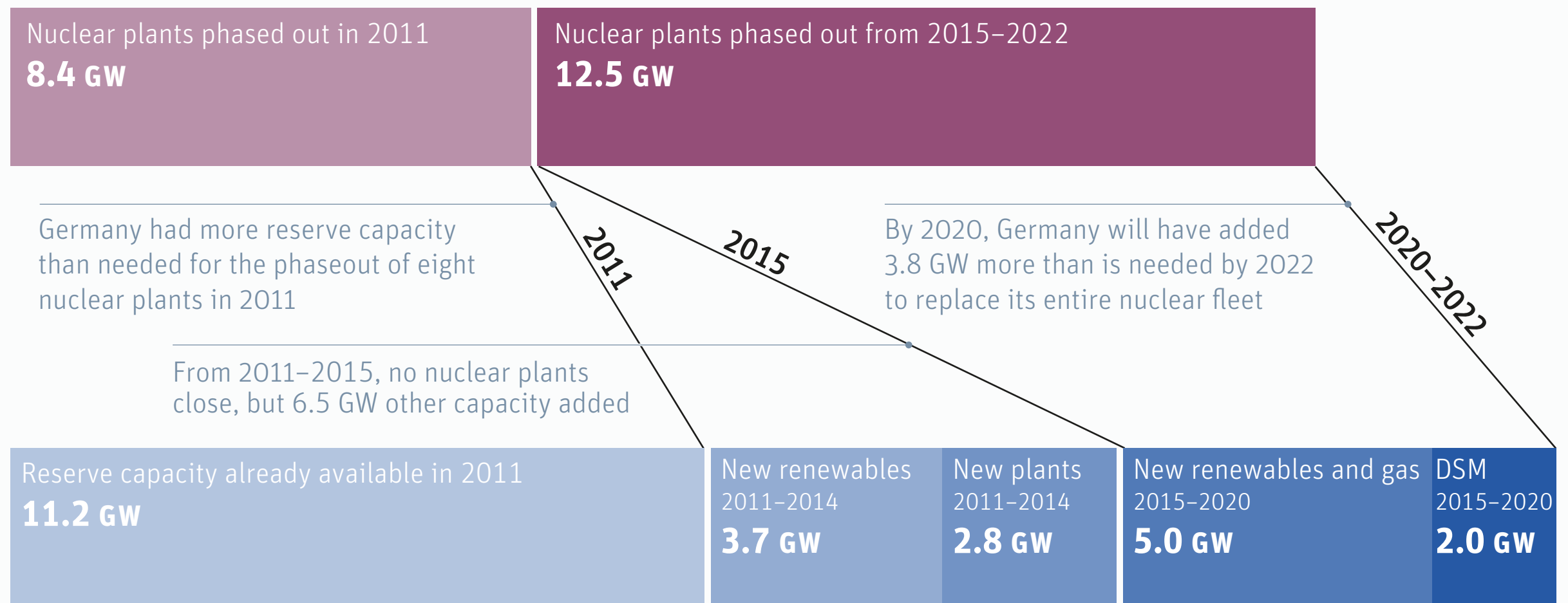


Germany can easily replace its nuclear capacity on the phaseout schedule

Replacing nuclear plants with reserves, new renewables, gas, and demand-side management (DSM)

Source: Institute of Applied Ecology, own calculations

20.9 GW of nuclear capacity

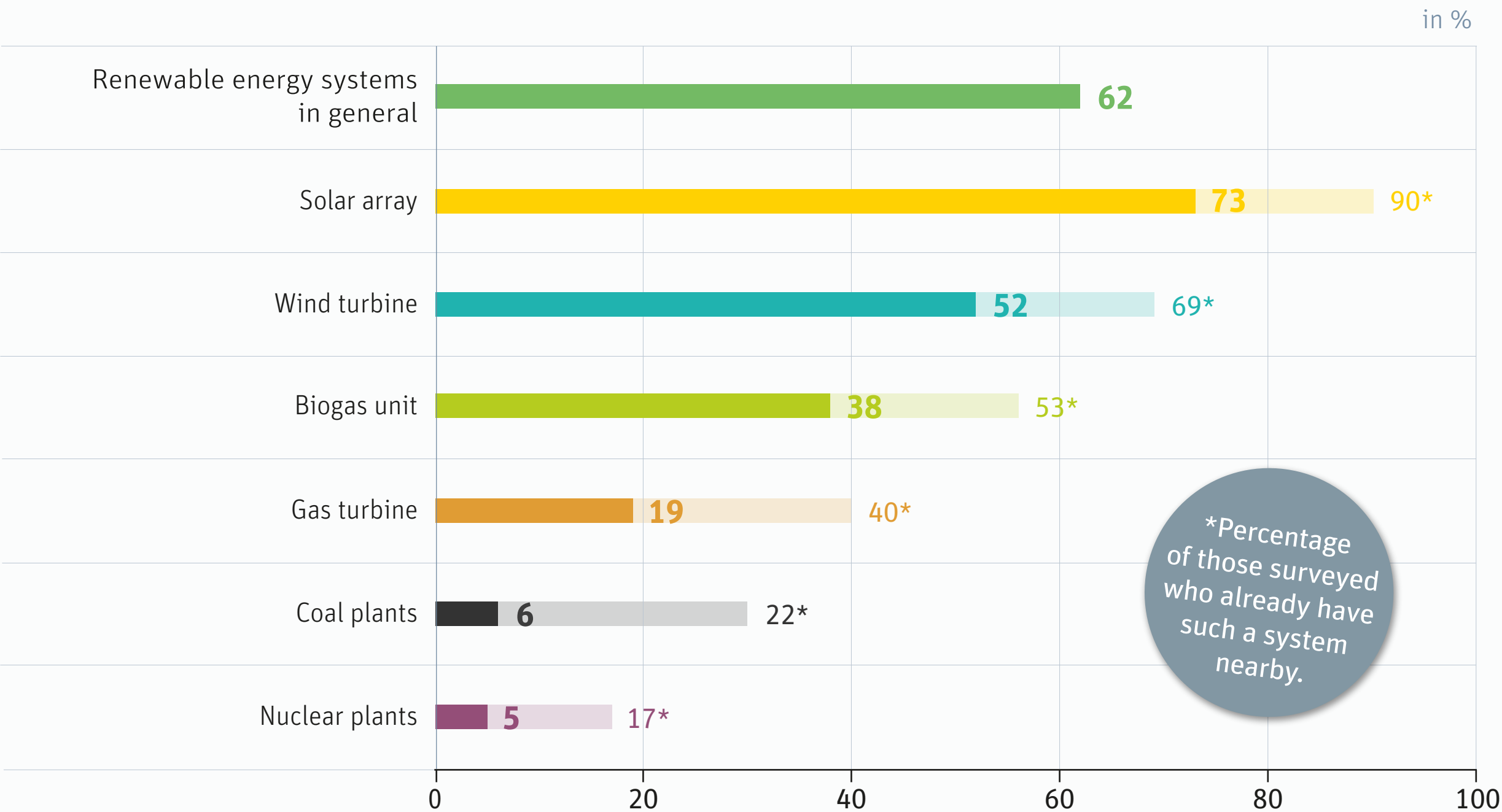


... to be replaced by **24.7 GW**

High acceptance rates of renewable energy systems

The percentage of Germans who think a nearby system is good or very good

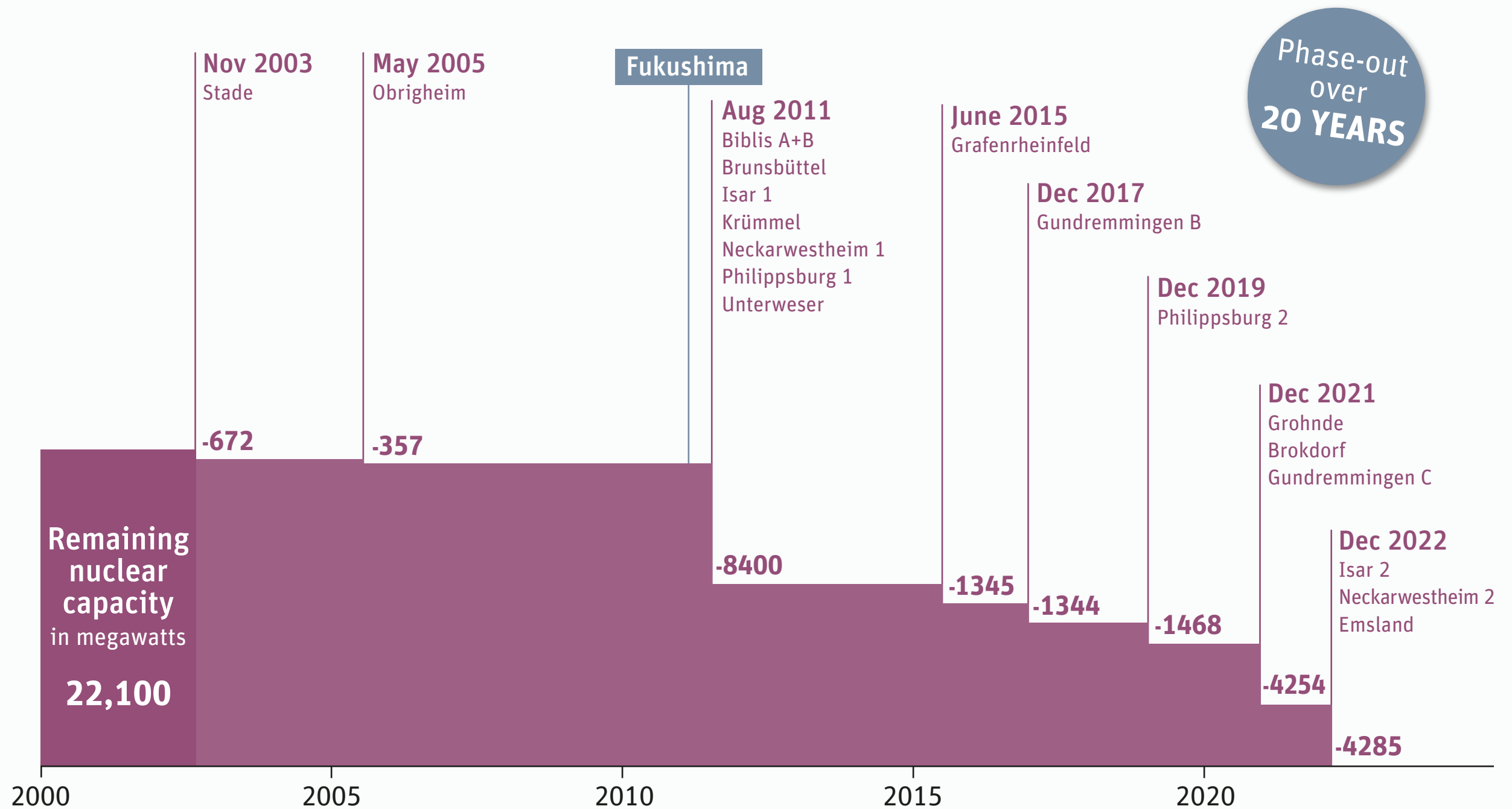
Source: TNS Emid study conducted for the AEE, 1,006 participants – September 2016



Germany is gradually shutting down all nuclear power plants

Declining nuclear energy installed capacity in Germany, 2000-2022

Source: Institute of Applied Ecology, BMJ, own calculations

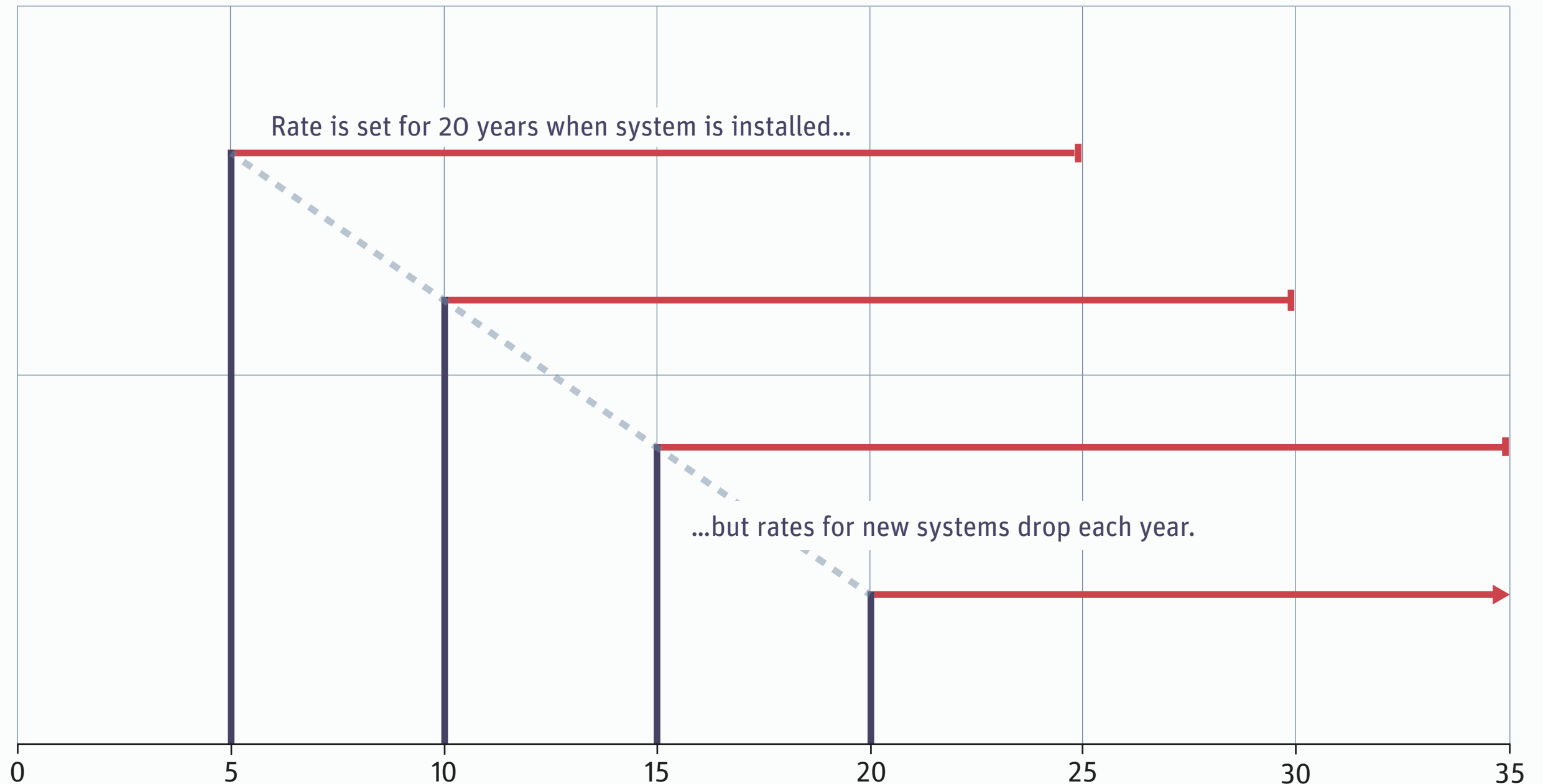


Feed-in tariffs provide investment certainty and drive costs down

Simplified generalization of feed-in tariff with 20 year duration

Source: Own estimates based on WFC

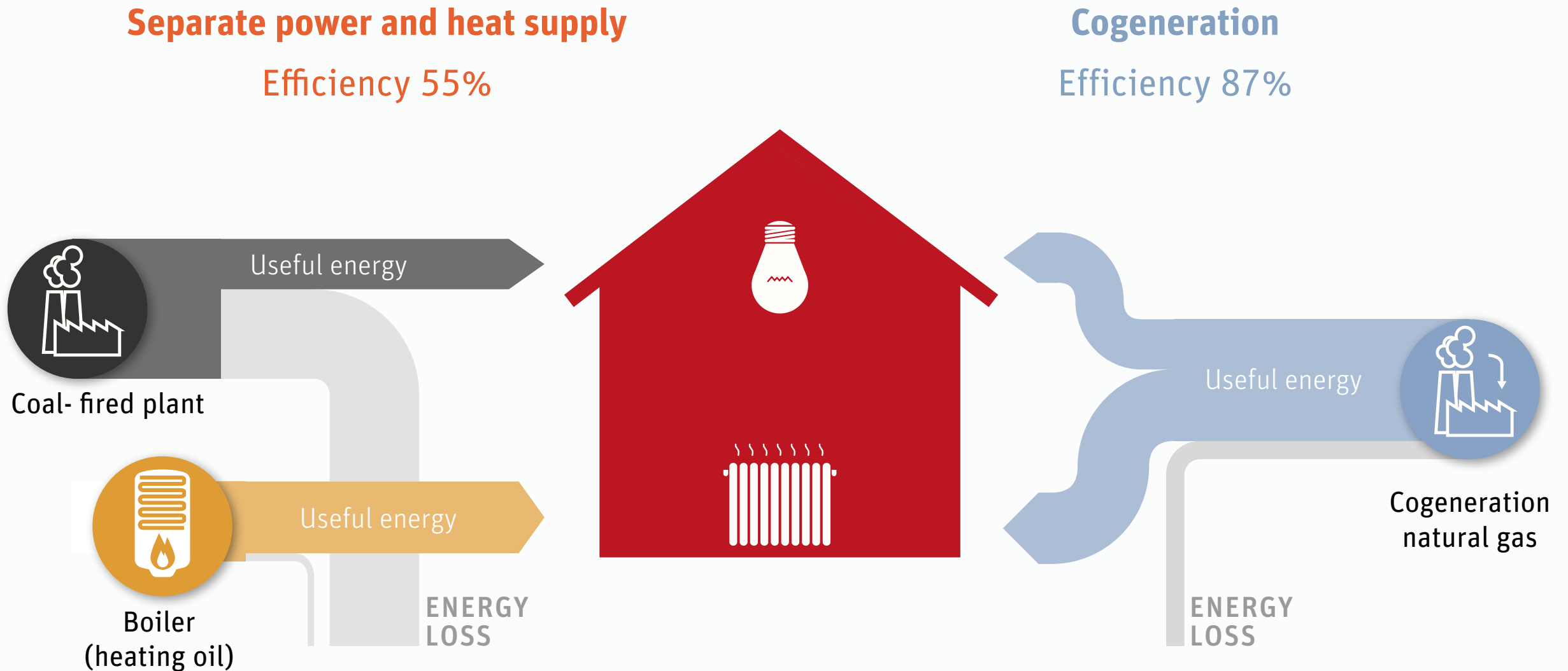
Rate level



Why cogeneration is more efficient than conventional coal power plants

Comparing the energy efficiency of cogeneration with conventional coal power plant and heating system

Source: ASUE

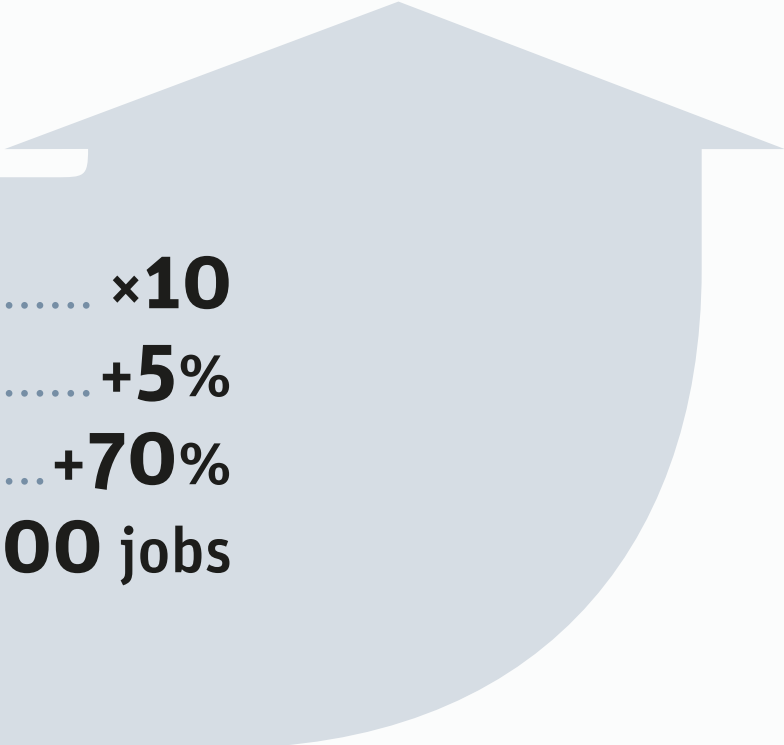


With a coal fired power plant, more than half the energy input is wasted.
Cogeneration reduces the primary energy demand by 36%.

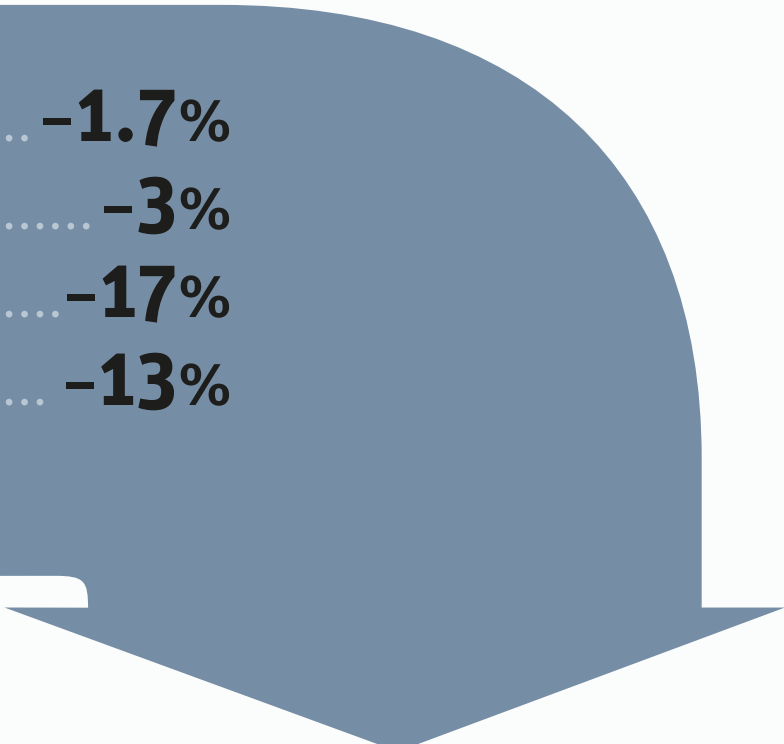
Eco tax reform: taxing energy instead of jobs

Benefits of Germany's ecological tax reform which raised taxes on energy and cut payroll taxes

Source: Green Budget Germany



Gas-powered cars.....	×10
Public transport	+5%
Car sharing.....	+70%
Employment.....	+250,000 jobs
More tax revenue to lower payroll taxes	

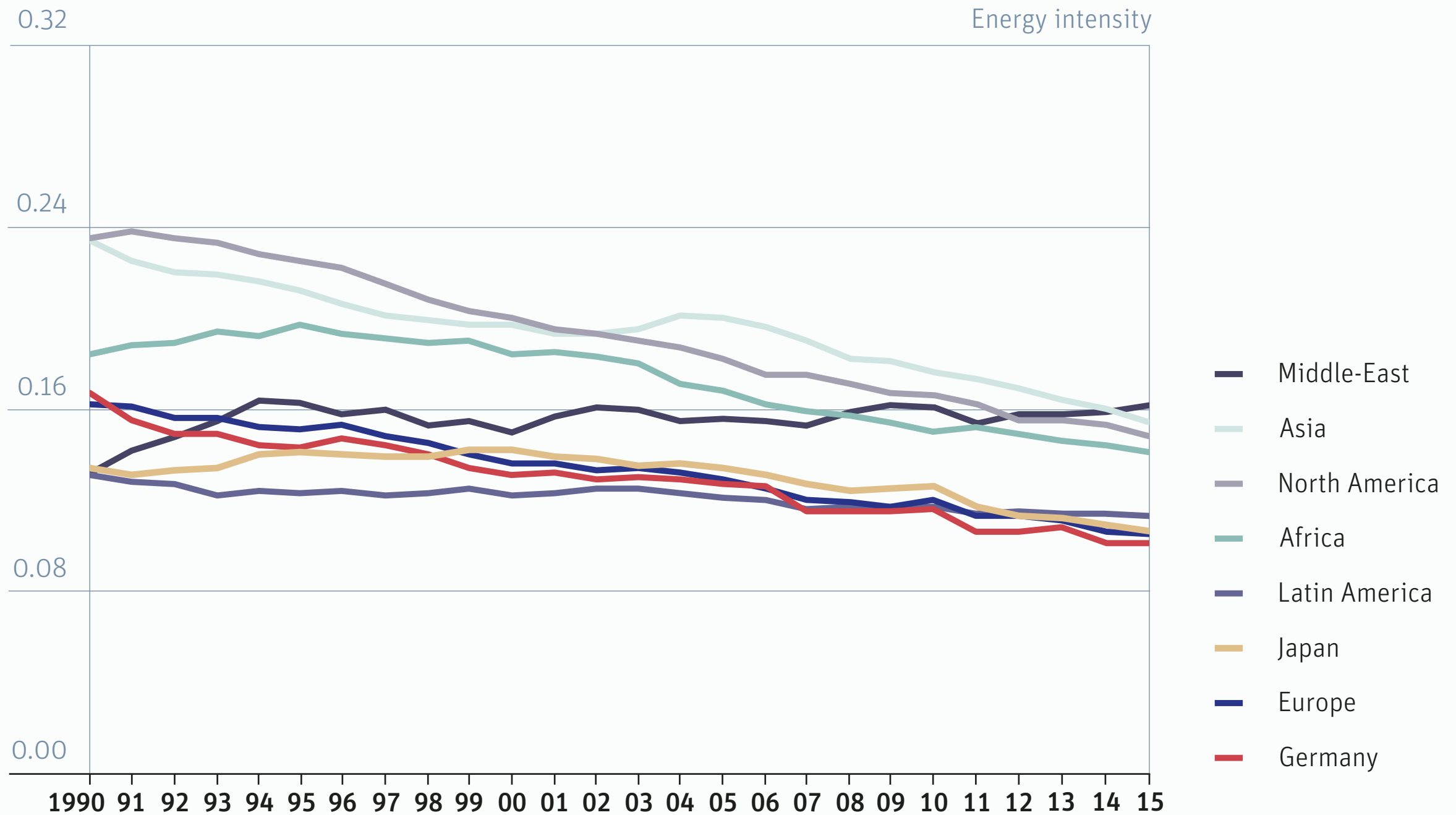


Pension costs.....	-1.7%
Carbon emissions.....	-3%
Fuel consumption.....	-17%
Fossil fuel import.....	-13%

Germany continues to produce more GDP with less energy

Energy intensity (=energy use per unit of GDP) of different world regions, 1990-2015

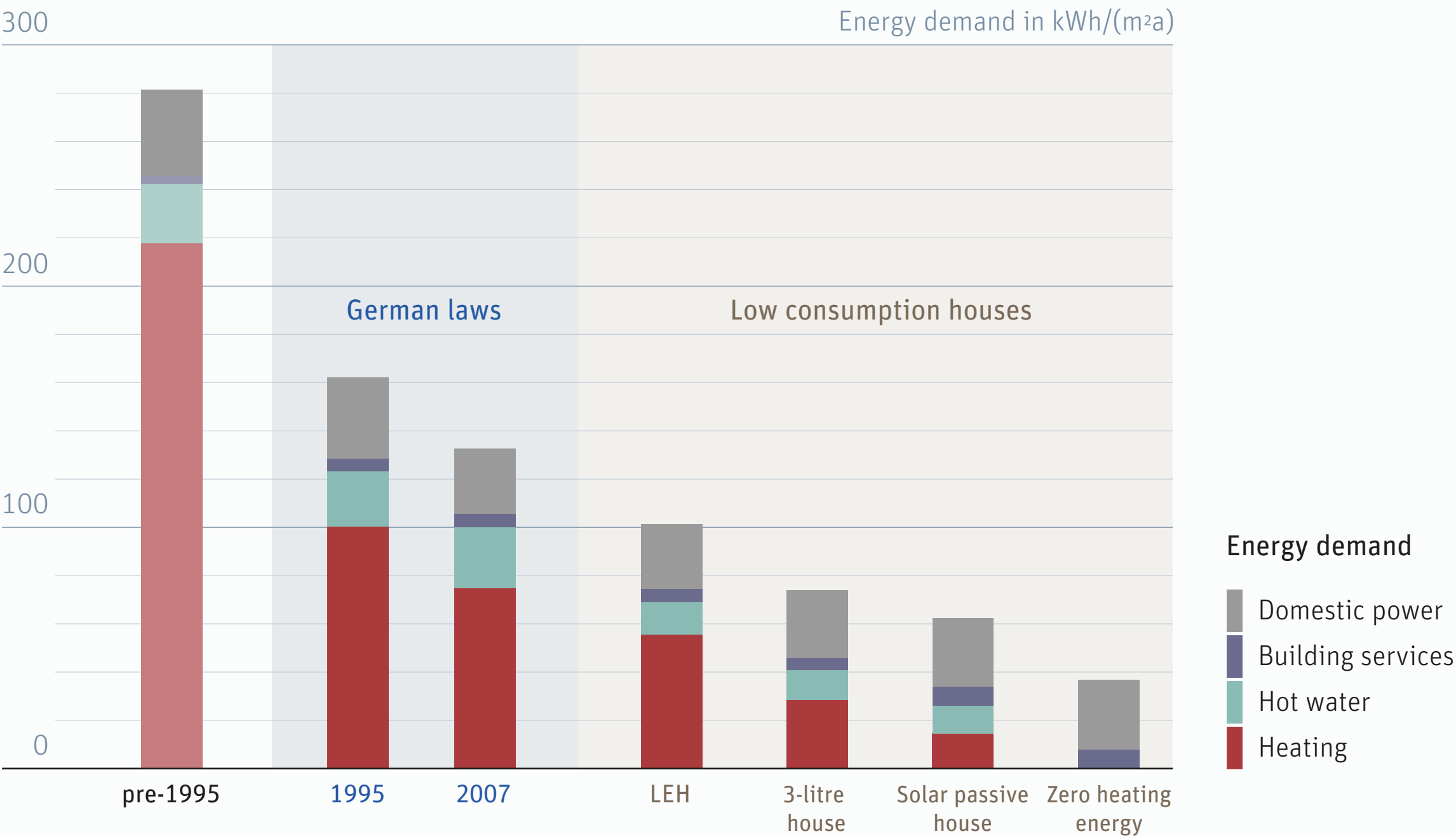
Source: Enerdata Yearbook



The housing sector offers large potential for energy savings

Characteristic energy demand of buildings

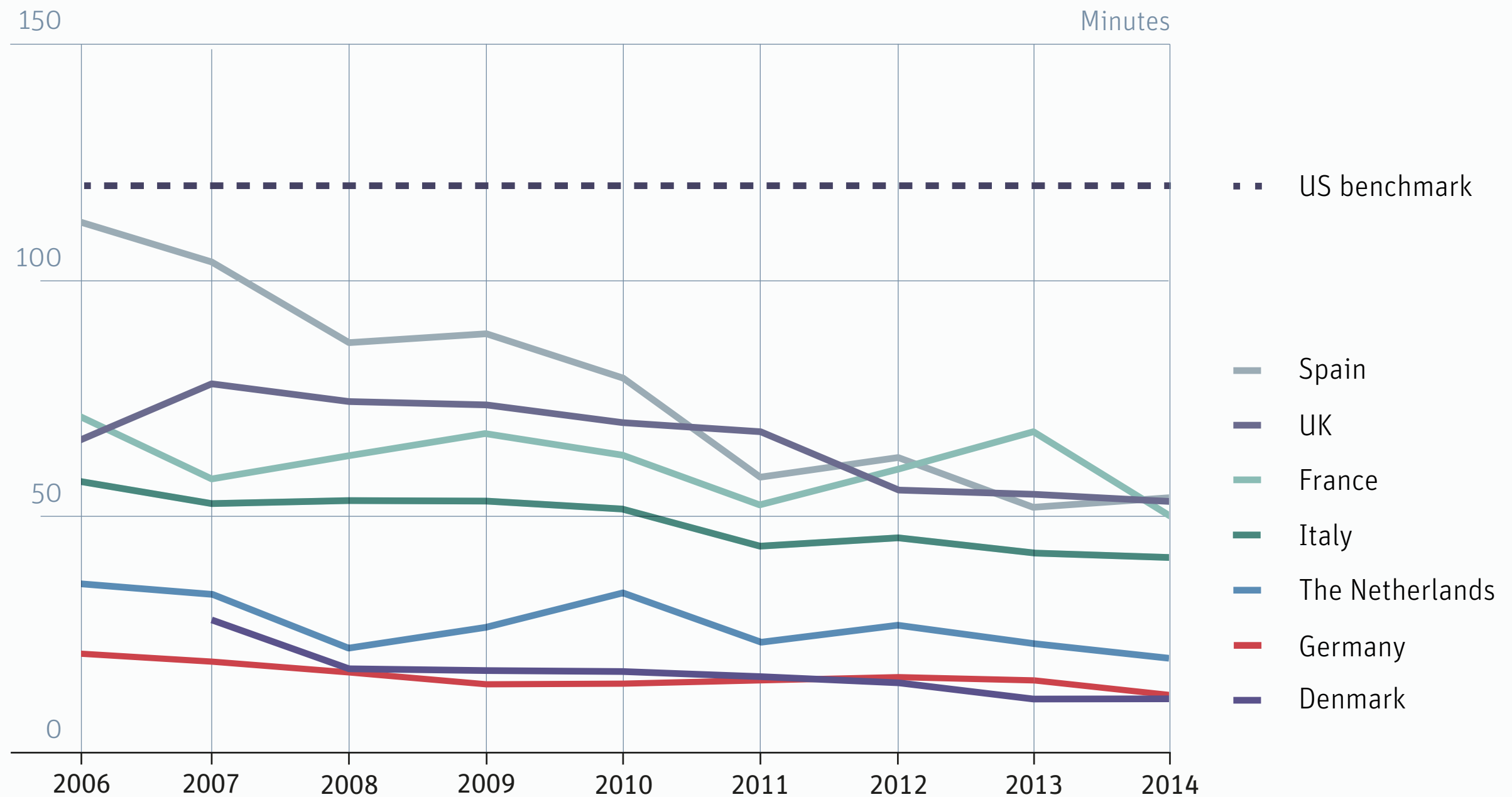
Source: IFEU 2011



Grid reliability and growth in renewables go hand in hand

Minutes of power outages per year (excl. exceptional events), based on Saidi

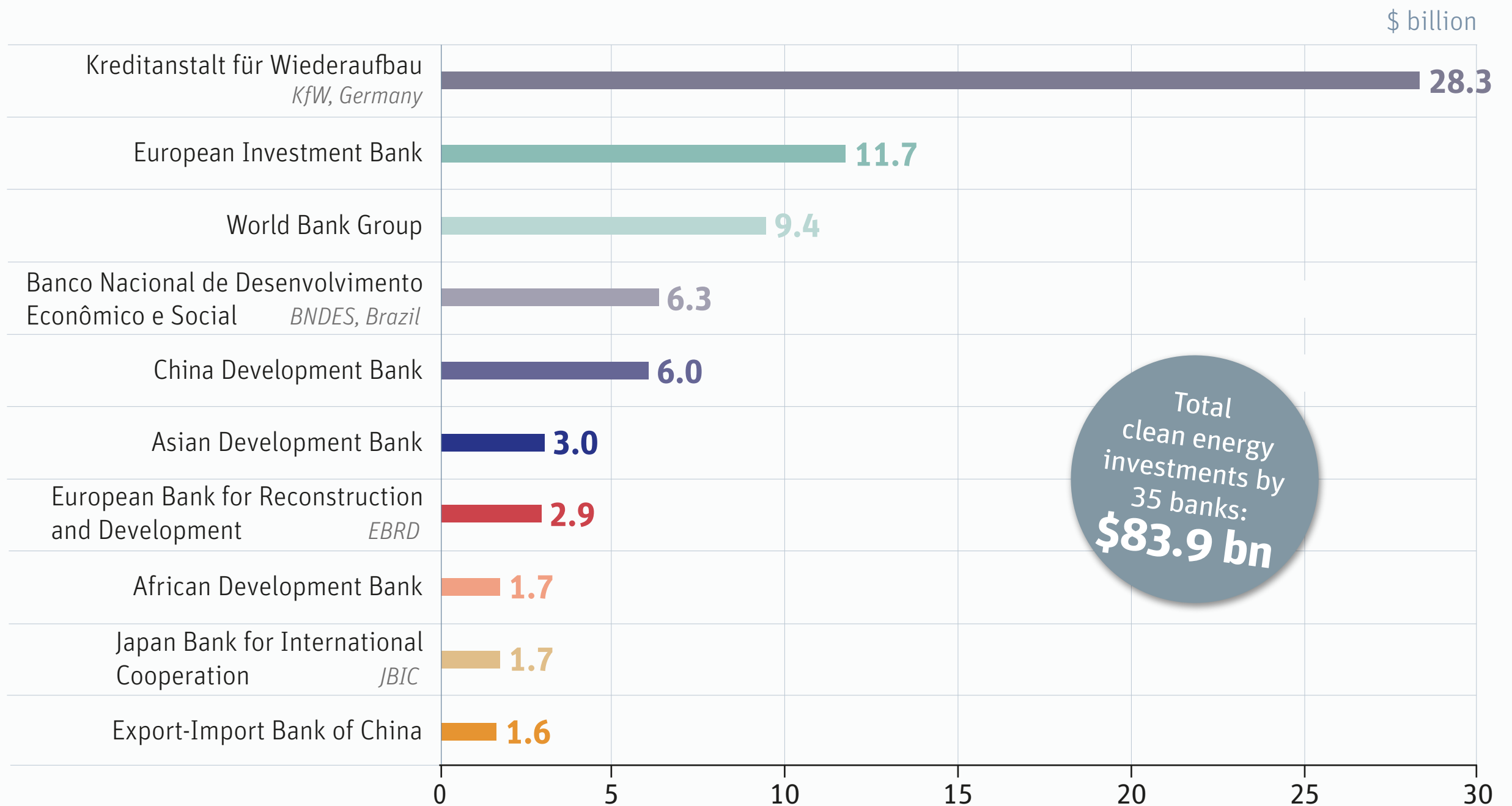
Source: CEER and own calculations



German development bank by far biggest clean tech lender

Top 10 clean energy financing institutions in 2014

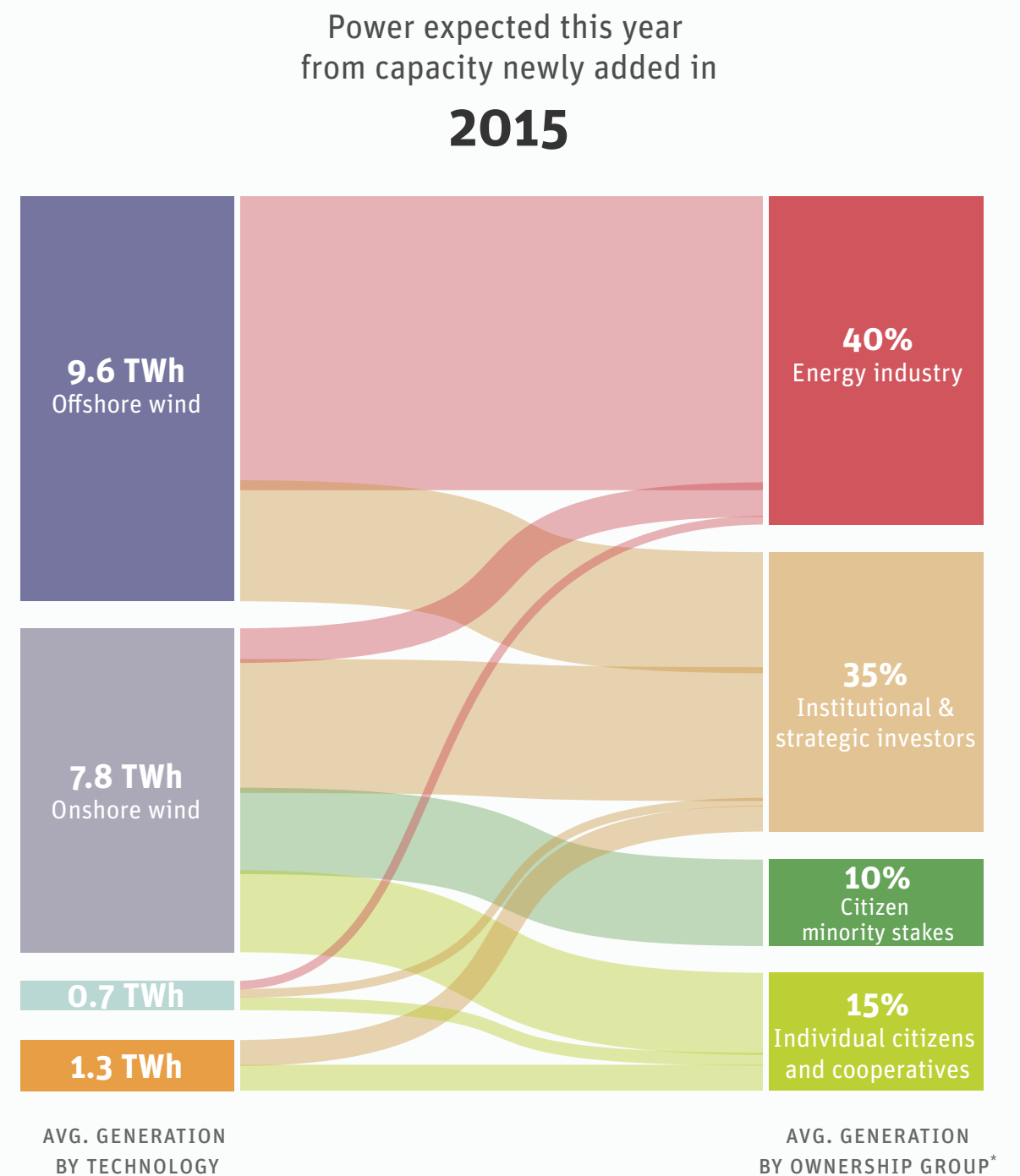
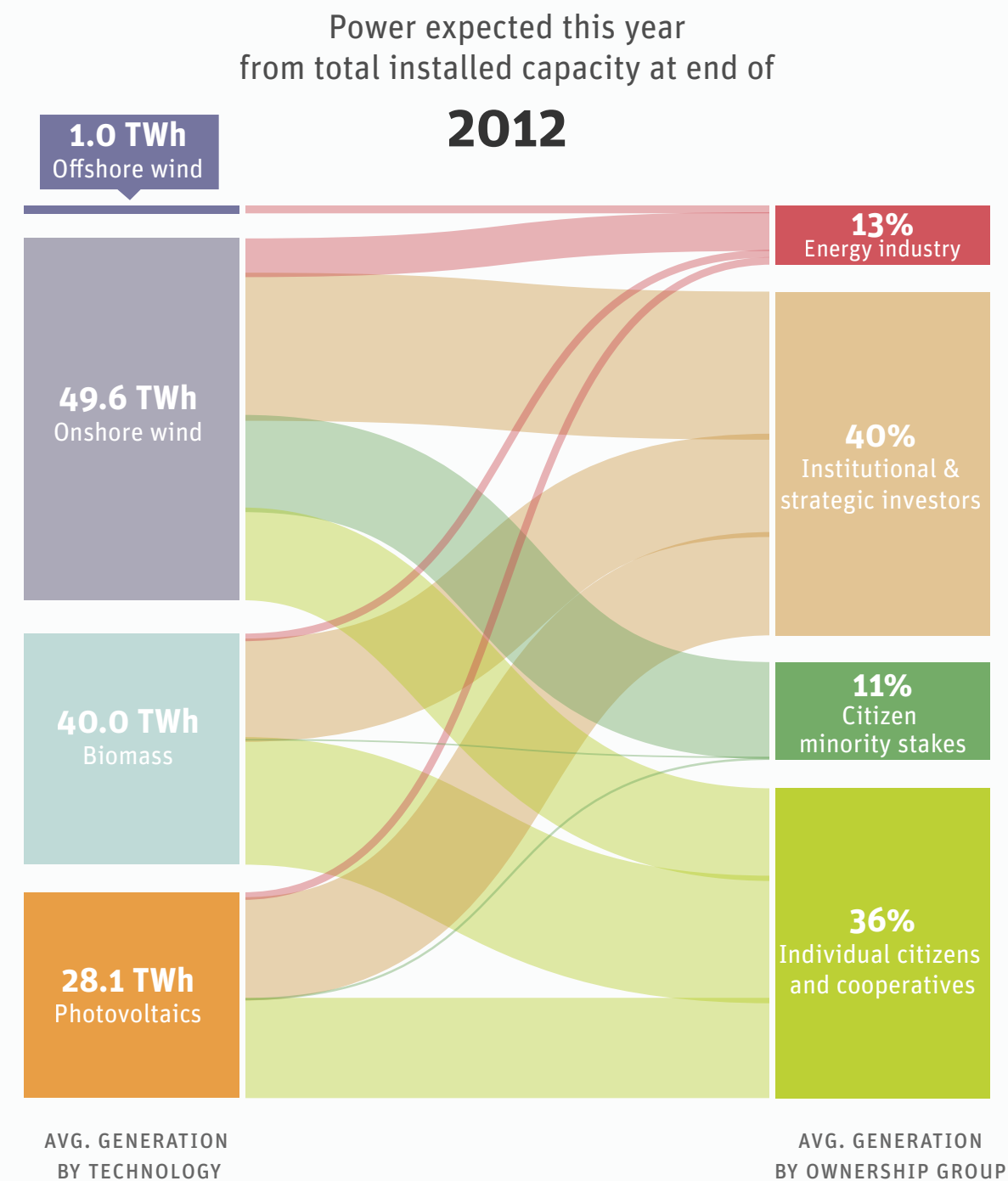
Source: Bloomberg New Energy Finance



German government hands power sector back to energy corporations

Average electricity generation by non-hydro renewables and ownership structure

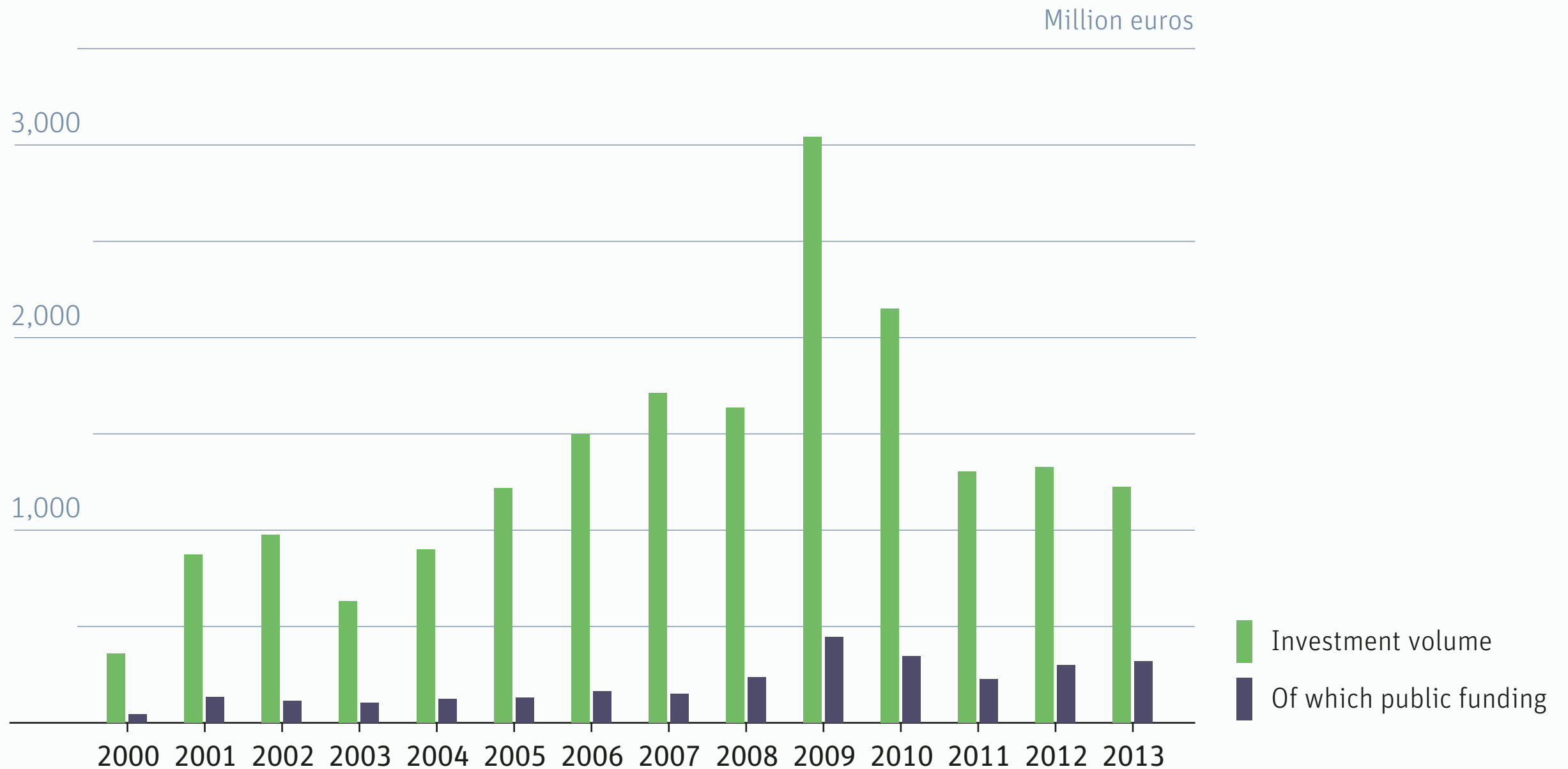
Source: AGEE, Leuphana, EnKlip | *based on 2012 market shares



Public funding triggers private investments

Renewable energy support in the heating sector under the German market incentive program (MAP)

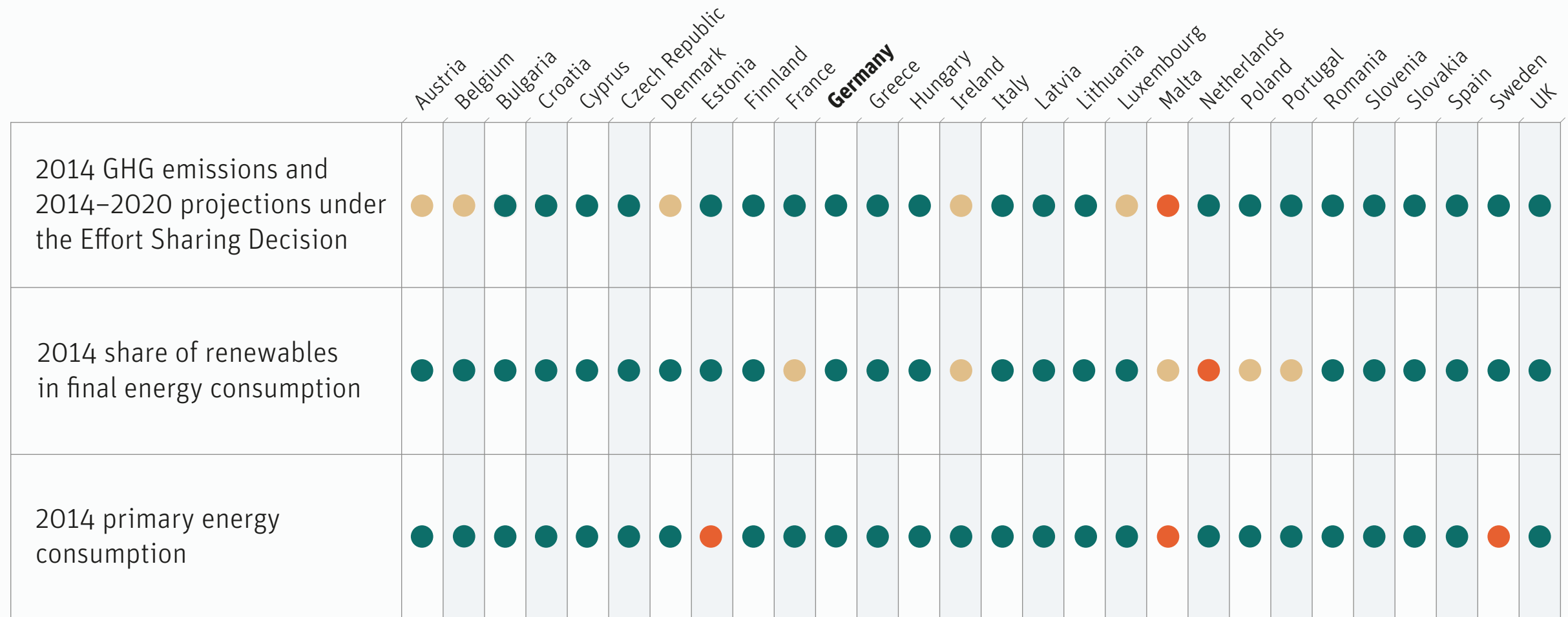
Source: BMWI



Progress of EU Member States towards 2020 climate and energy targets

Progress towards the goals of efficiency, carbon emissions, and renewable energy, 2014

Source: EEA

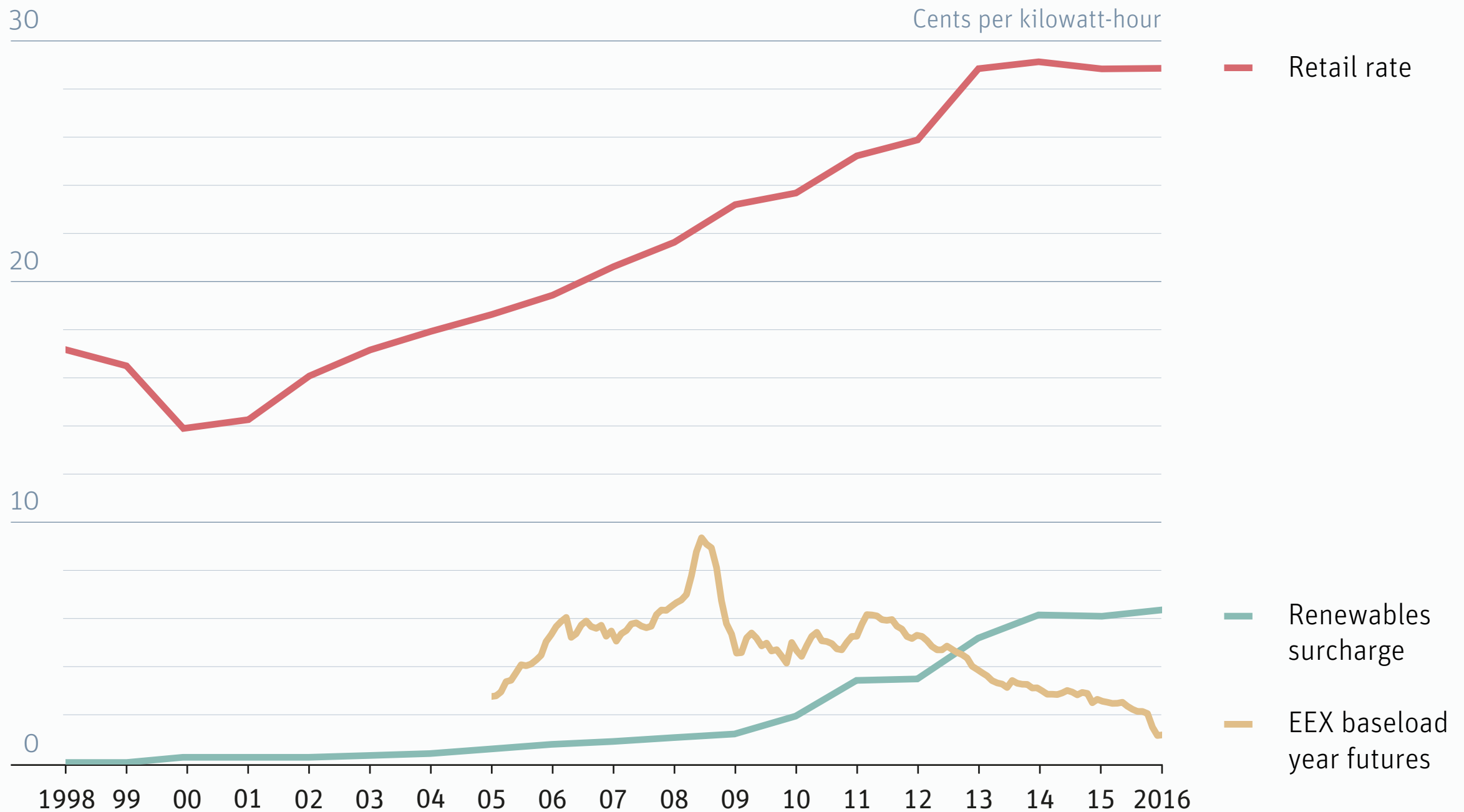


- On track
- Partly on track
- Not on track

Renewables are not the main driver for high power prices in Germany

Trends of retail rates, spot market price and renewable energy surcharge over past 18 years

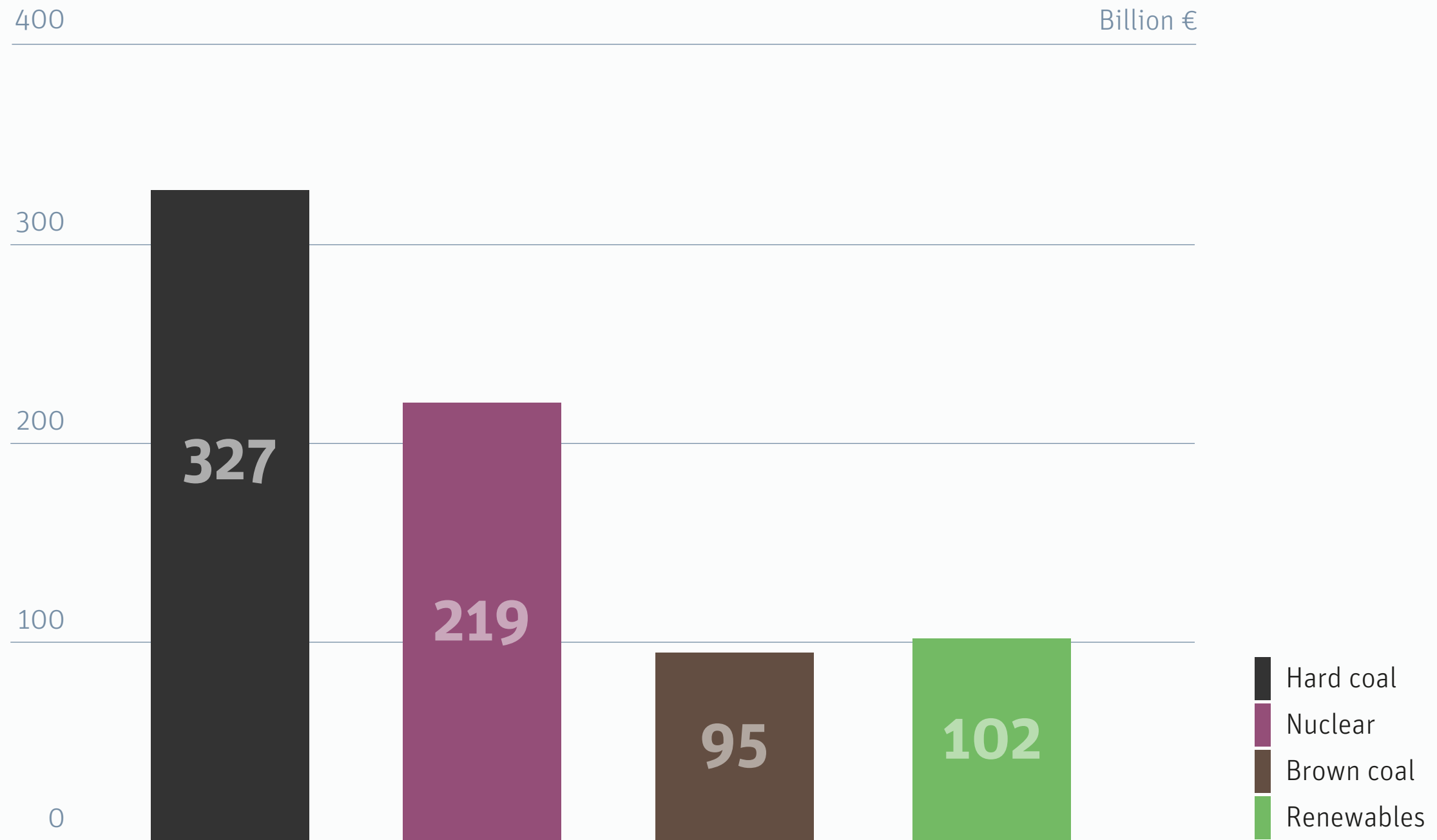
Source: www.unendlich-viel-energie.de



Fossil and nuclear have received by far more subsidies than renewables

Energy subsidies in Germany, 1970-2014

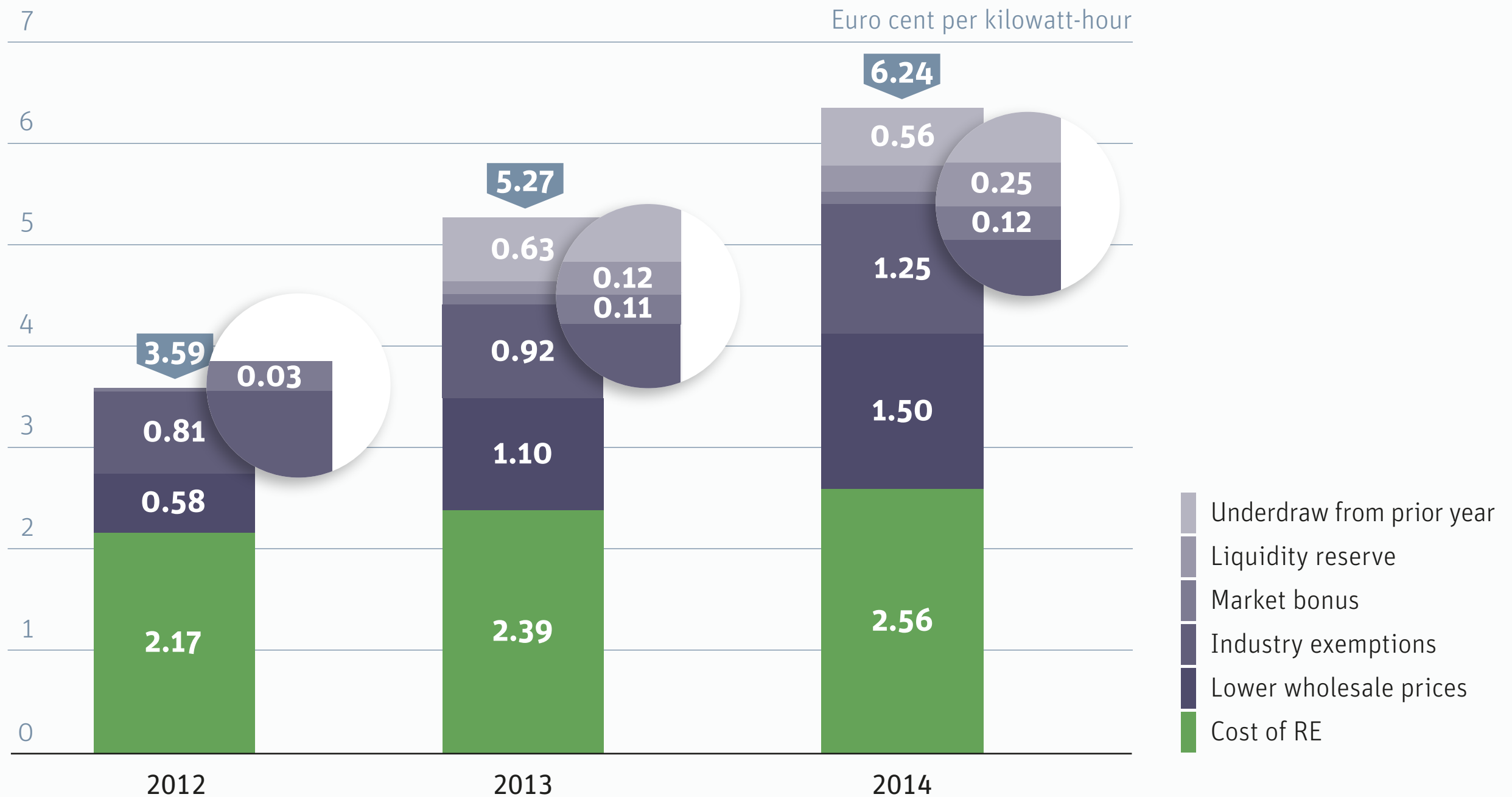
Source: *Was Strom wirklich kostet*, FÖS, 2015



Renewables are not the main reason for rising surcharge

Calculation of renewable energy surcharge in Germany. 2012-2014

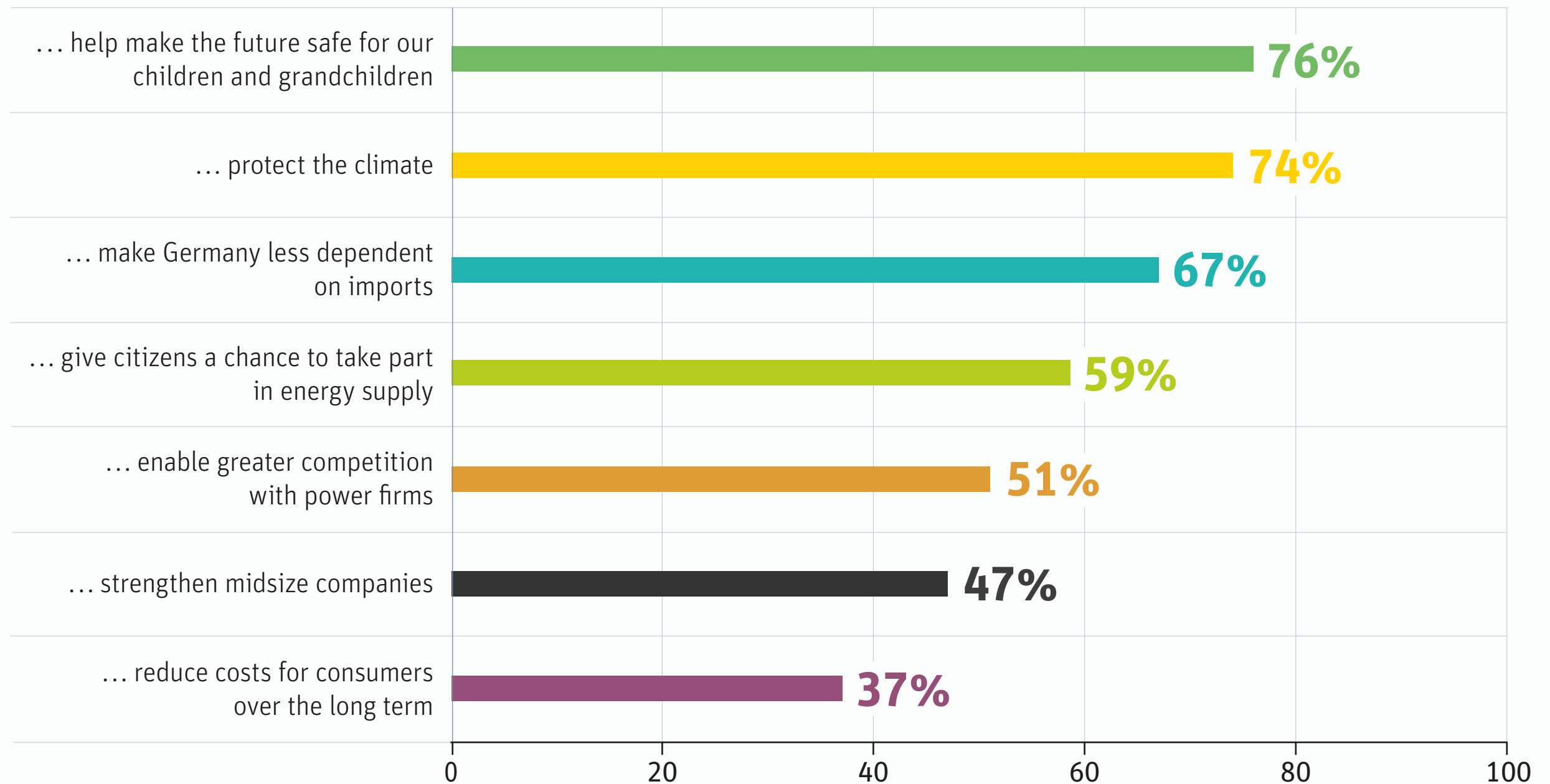
Source: BEE



The benefits of renewable energy: future technologies for climate protection

"Do you agree renewables ..." (multiple answers possible)

Source: TNS Emnid survey conducted for the AEE, 1015 participants – September 2016



93 percent of Germans support further growth of renewables

"The use and growth of renewable energy is ...", survey from September 2016

Source: www.unendlich-viel-energie.de



Less important or not at all

6%

No opinion or no answer

1%

Important

27%

93%
Support

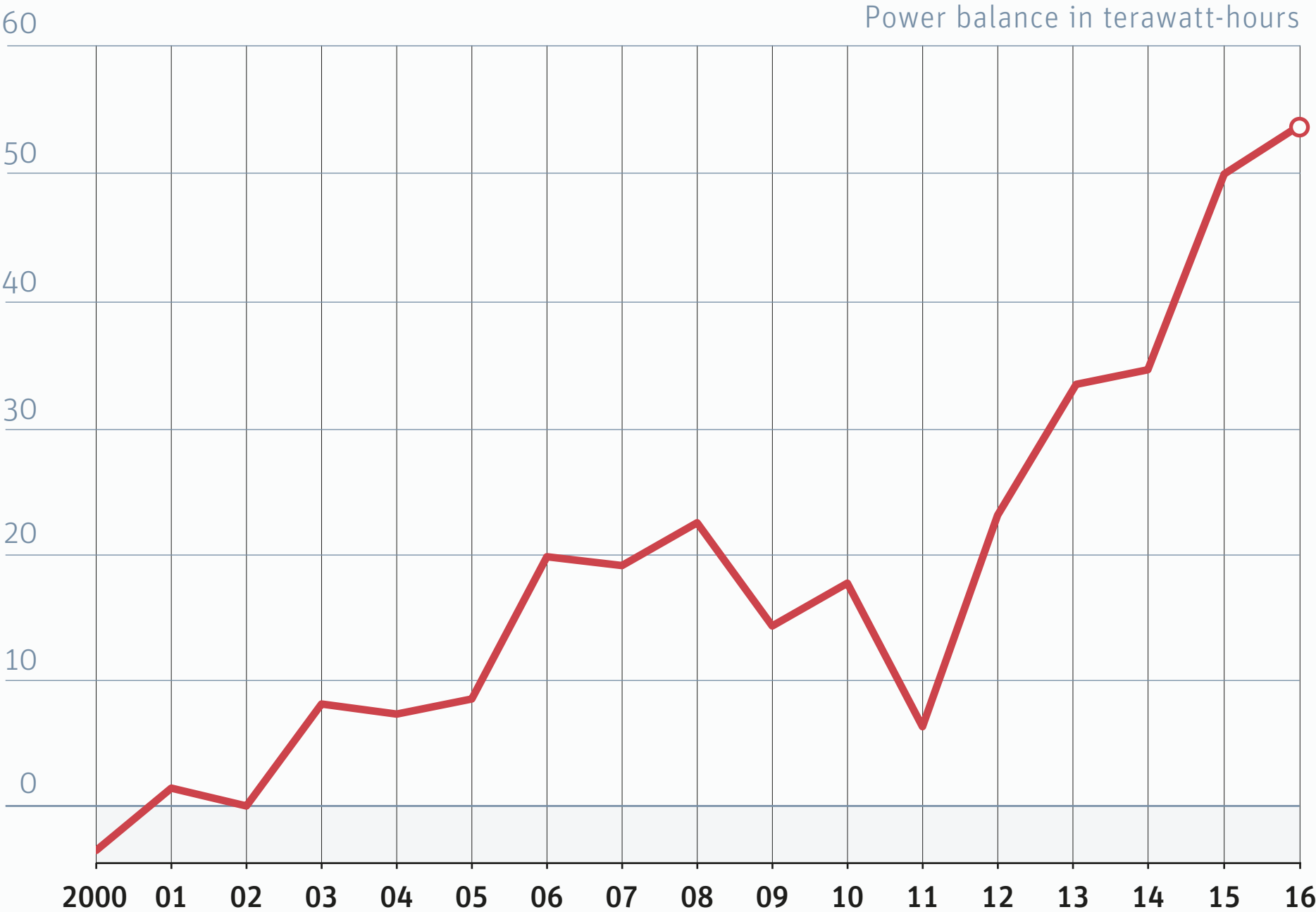
Very or extremely important

66%

German power exports continue to rise

Net power exports in TWh, 2000-2016

Source: Agora Energiewende, AGEB

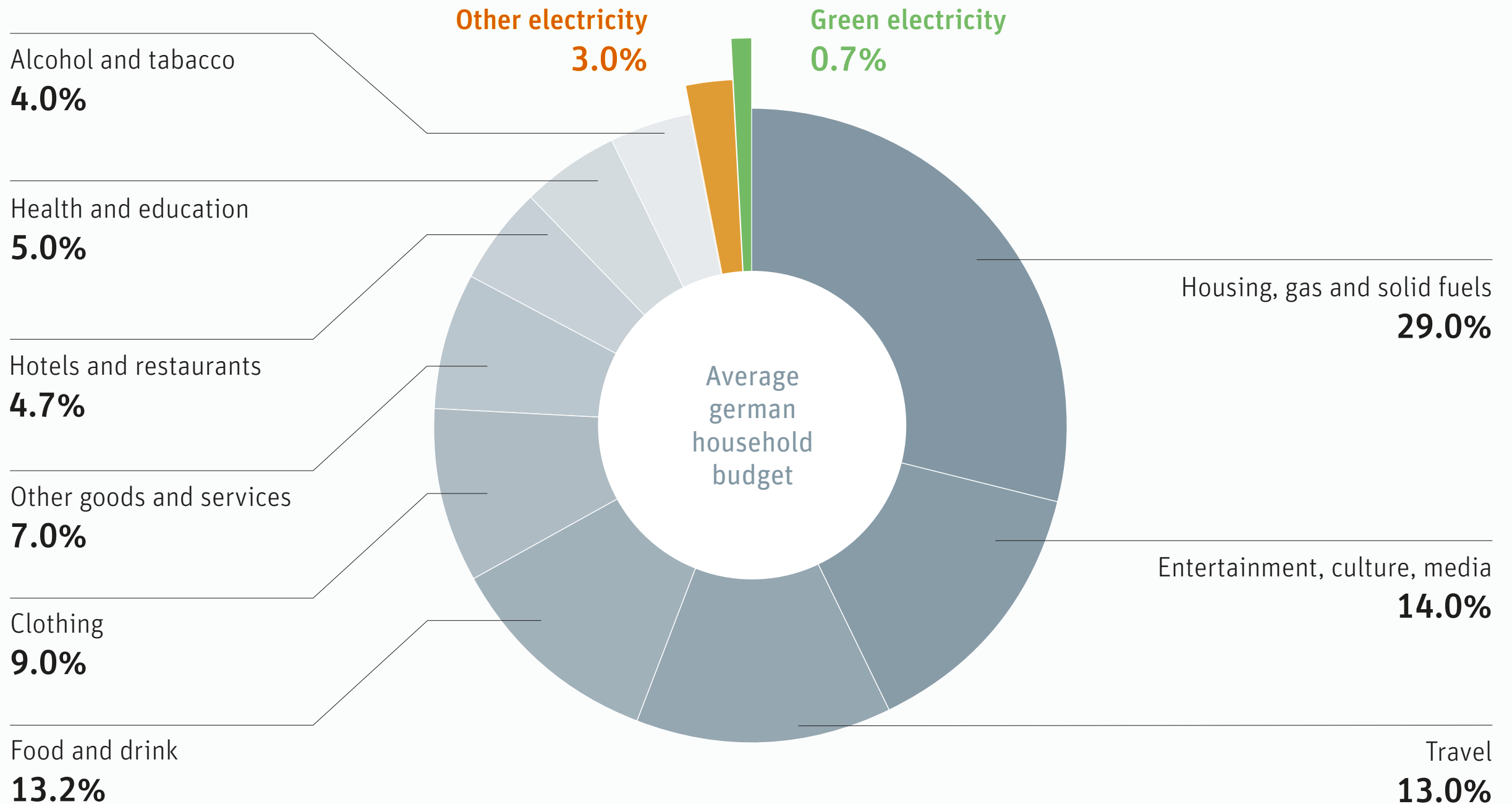


RECORD
NET EXPORT
BALANCE
+54TWh

Green electricity less than one percent of average household budget

Expenses of an average household in Germany at a renewables surcharge of five cents, 2016

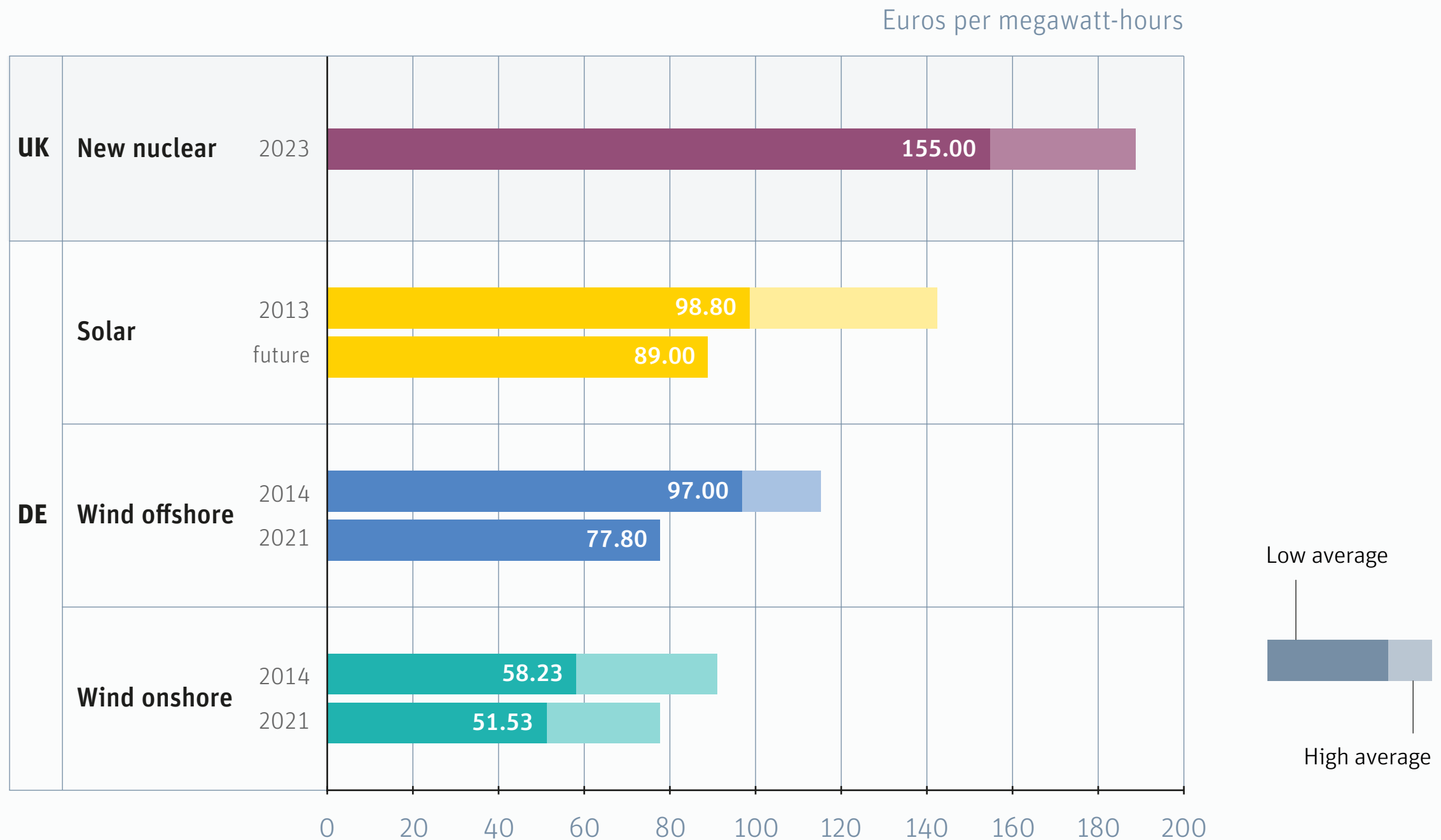
Source: www.unendlich-viel-energie.de



Price of new nuclear already higher than solar and wind

FITs for current and future solar and wind in Germany with strike price for nuclear at Hinkley

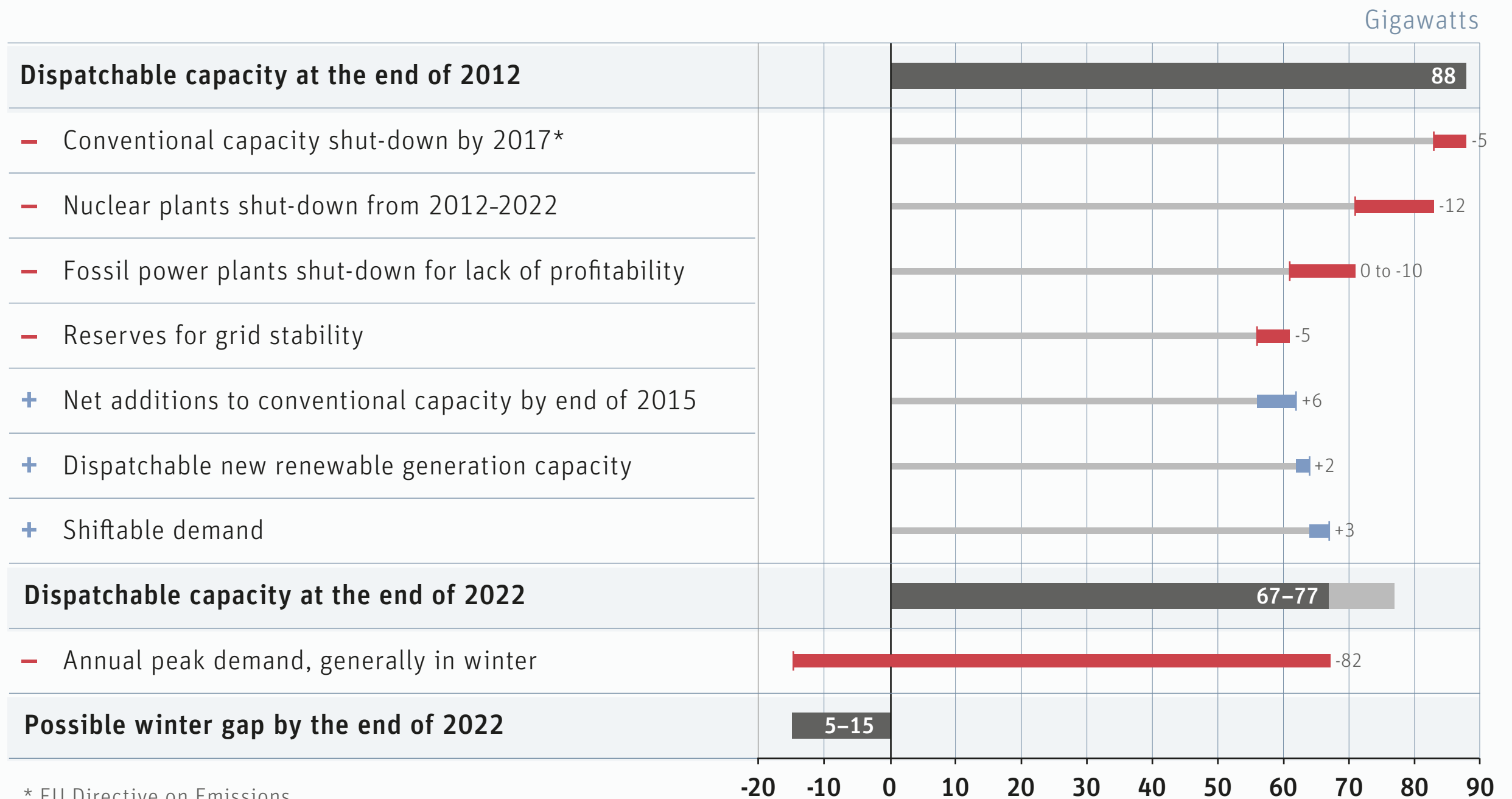
Source: Thomas Gerke, DECC, Agora Energiewende



Does Germany need a capacity market to close the "winter gap"?

Trends in dispatchable capacity 2012-2022

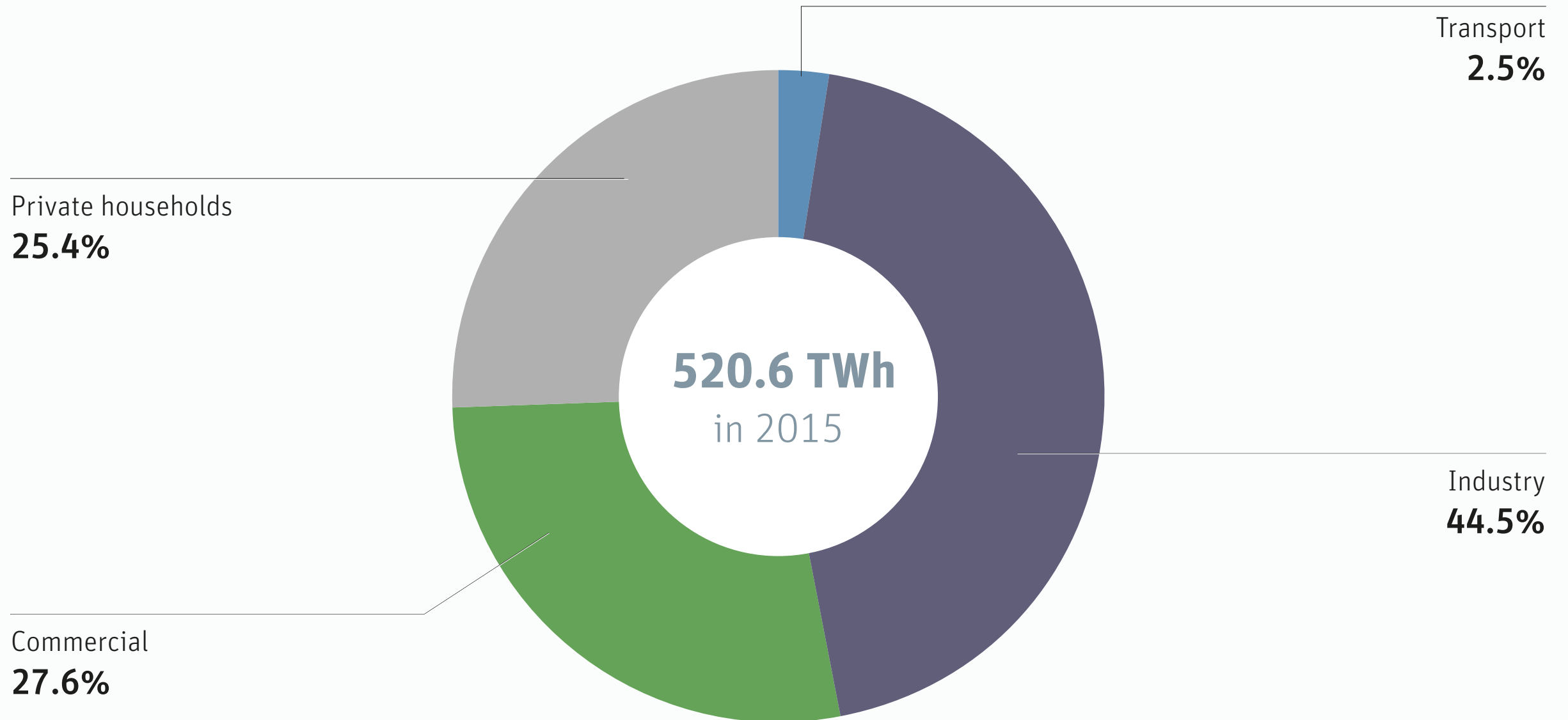
Source: Agora Energiewende



Industry by far biggest power consumer in Germany

Electricity consumption by sector, 2015

Source: BMWI, StBa



The cost impact of green electricity in Germany could start to fall in a few years

Wholesale power prices (Phelix base year futures) and the surcharge for renewables

Source: Agora Energiewende and Öko-Institut



German households are slow to switch power providers

Retail package chosen in North-Rhein/ Westphalia from 2009-2014

Source: Verbraucherzentrale NRW

