

German energy transition - Energiewende

Filip Černoch
cernoch@mail.muni.cz

Origins of EW

1st pillar: nuclear phase-out.

- Long and successful tradition of nuclear industry in Germany – in 70s 17 000MW.
- German anti-nuclear movement – *Ausserparlamentarische Opposition* in 60s (leftist students), environmental movements, local opposition.
- Three Mile Island in 1979, Chernobyl in 1986.
- 1998 Greens in federal govt (with SPD) – Germany's plan to gradually withdraw from the atom.
- In 2010 the Atomic Energy Act amended – plant lifespan extended, production limits on nuclear electricity increased.
- 2011 Fukushima – phase-out by 2022.

Origins of EW

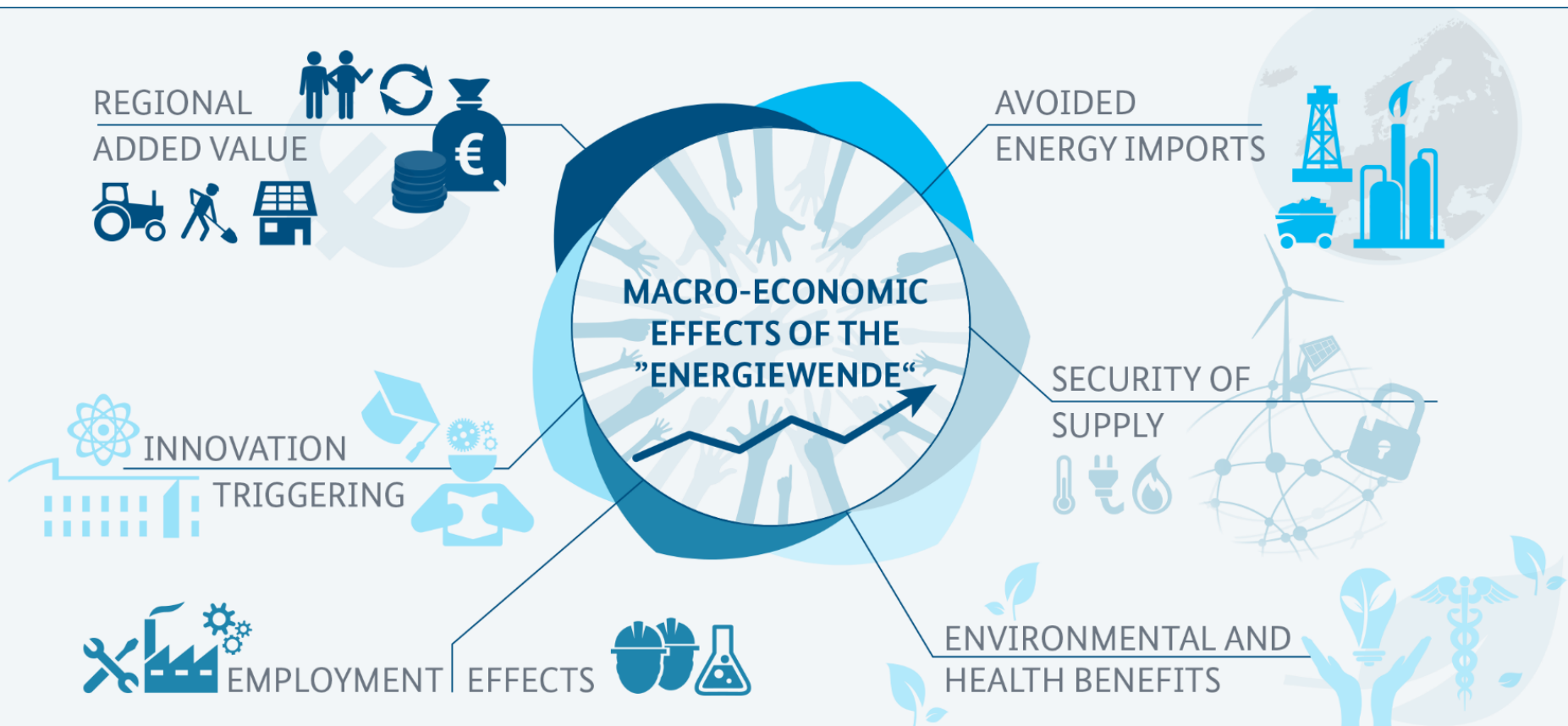
2nd pillar: climate protection measures.

- In 70s anti-nuclear sentiment, environmental consciousness and oil crisis raised the issue of RES.
- 1974 first RES subsidy program – PV parks. Furthered in 1977 – 25% of investment costs reimbursed.
- 1990 – Act on the Supply of Electricity from RES into the Grid (StrEG).
- 2005 – Merkel’s great coalition (CDU/CSU + SPD) – ambitious climate plans, incl. RES and EE.
- 2010 – Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply ->Energiewende.

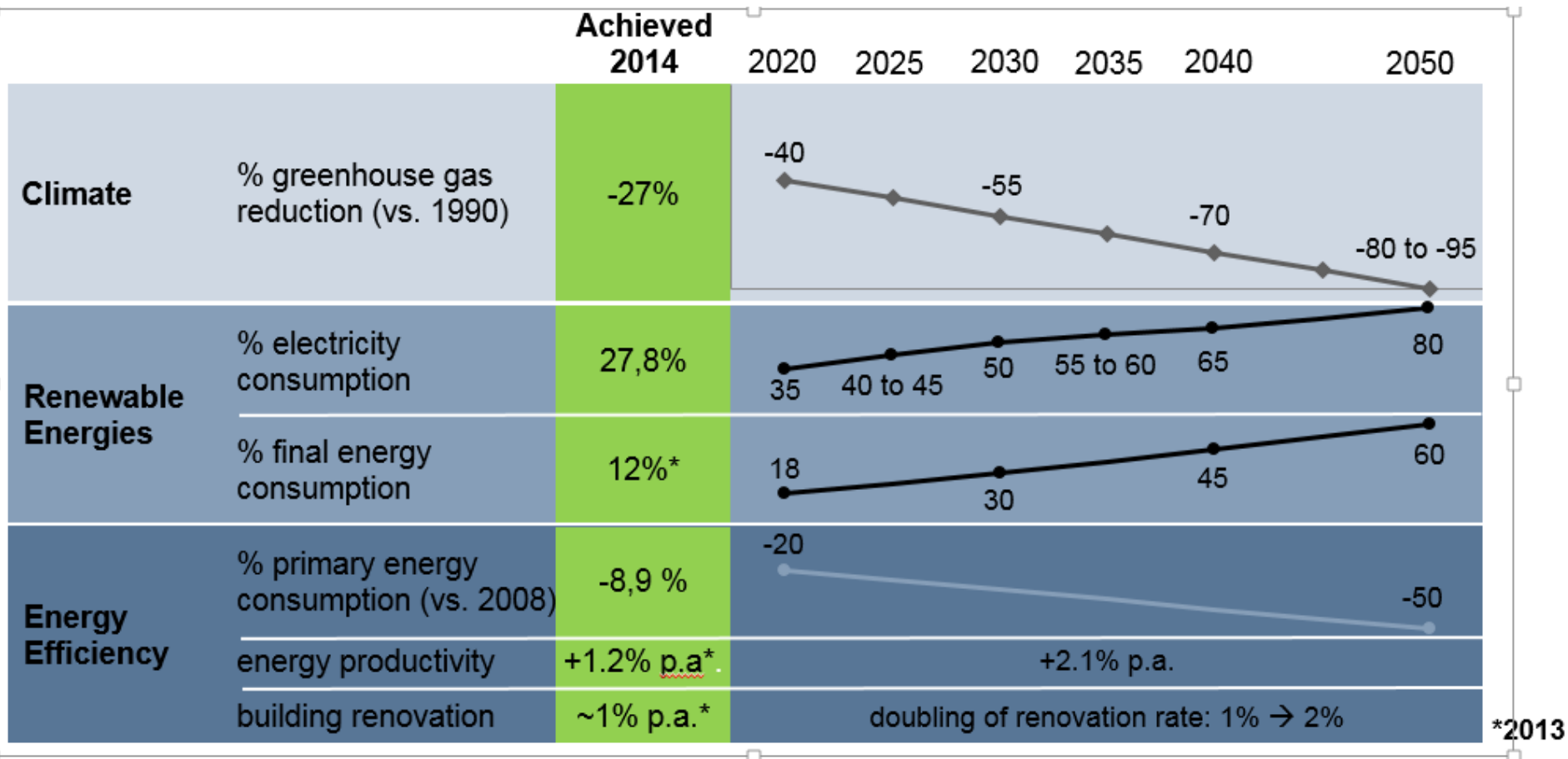
Targets of the EW

- To cut greenhouse gas emissions by 40% by 2020, by at least 80% by 2050.
- Share of RES in gross final energy consumption to 60% in 2050 (10% in 2010). The share of RES in electricity supply 80% by 2050.
- Reduction of energy consumption by 50% by 2050 (reference year 2008).
- By 2050, electricity consumption to drop by 25% compared to 2008. Final energy consumption in the transport sector to be reduced by around 40% by 2050 compared to 2005 levels.
- Nuclear phase out by 2022. (Fukushima Daiichi 2011).

Declared benefits of the Energiewende

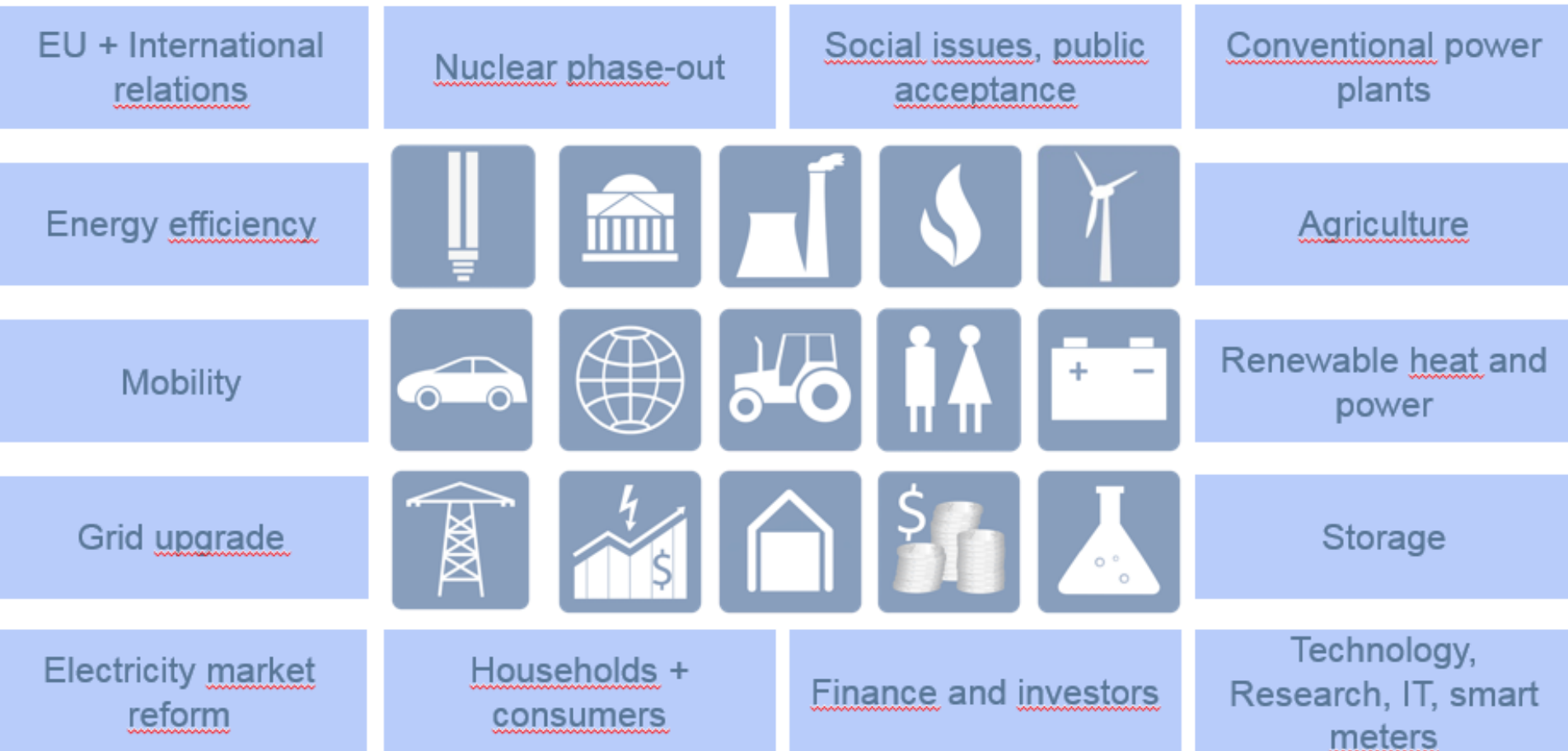


Targets of the EW



Complexity of EW

EW is not limited to the power sector only, it is multidimensional restructuring of the supply system

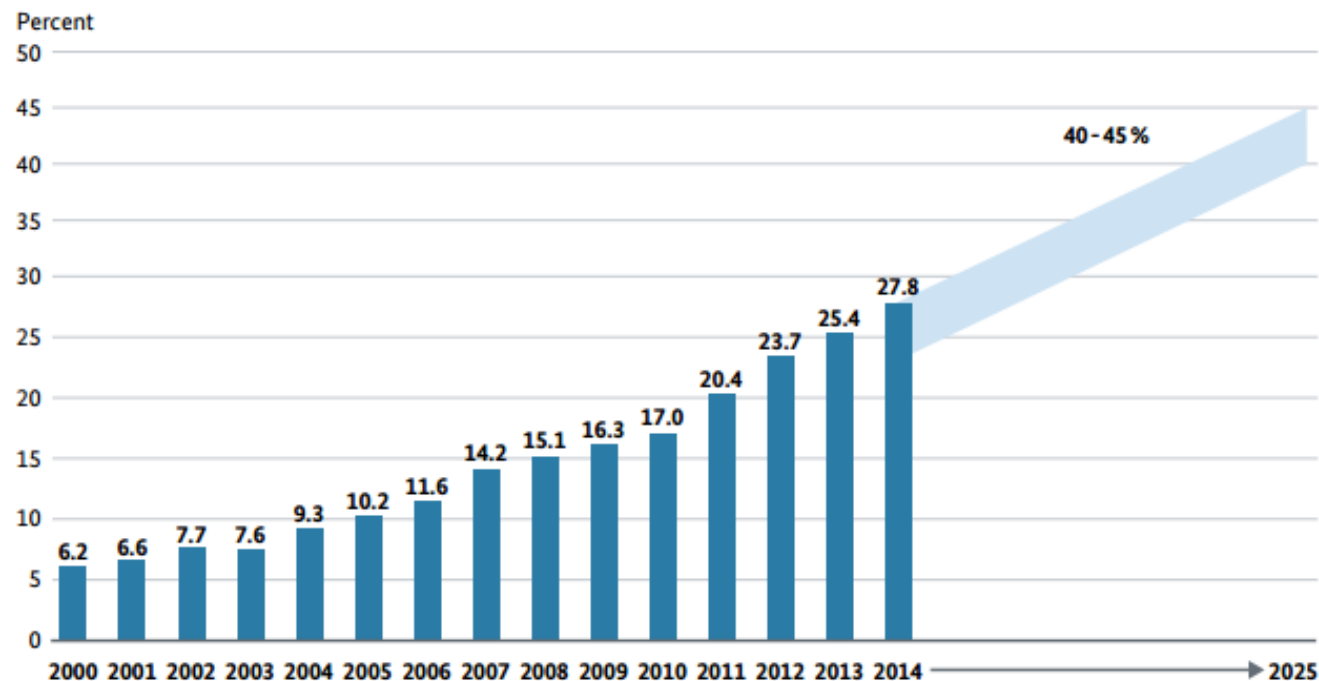


Performance of German energy sector

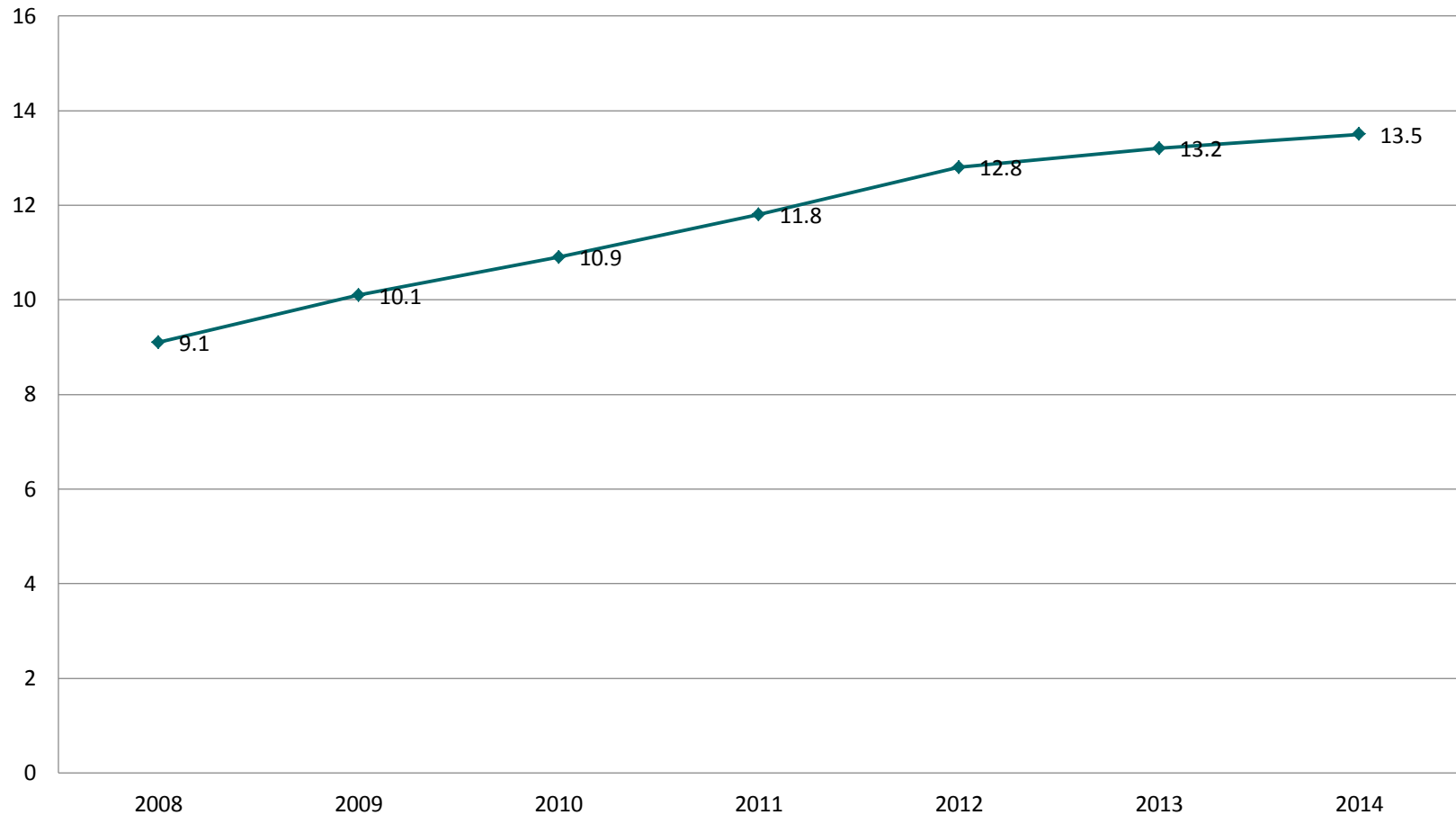
Performance of German energy sector

- In 2015 RES covered almost 33% of gross electricity consumption.
- As a result of lowered financial support the pace of new instalations has plateued since 2012.

Share of gross electricity consumption covered by renewable energy



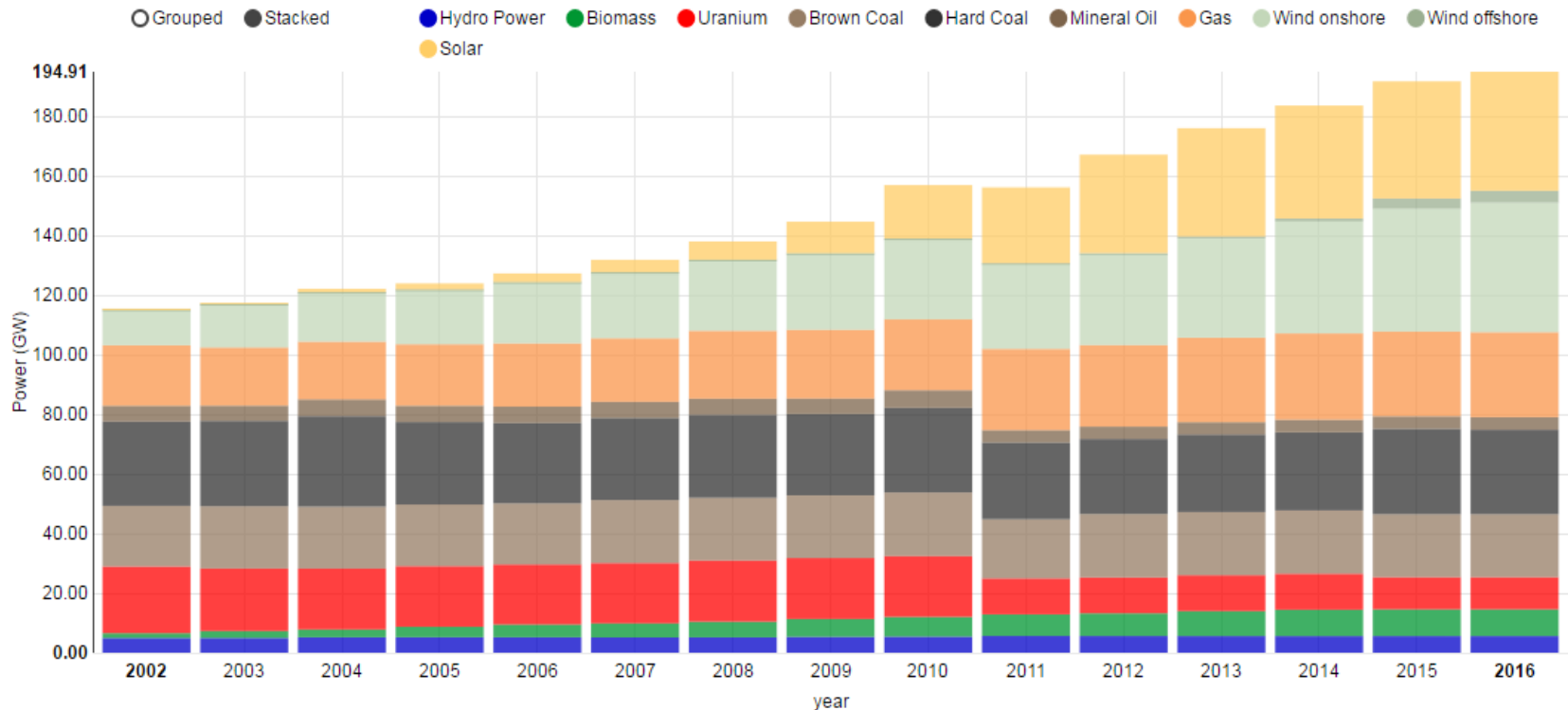
Share of RES in gross final energy consumption (in %)



Performance of German energy sector

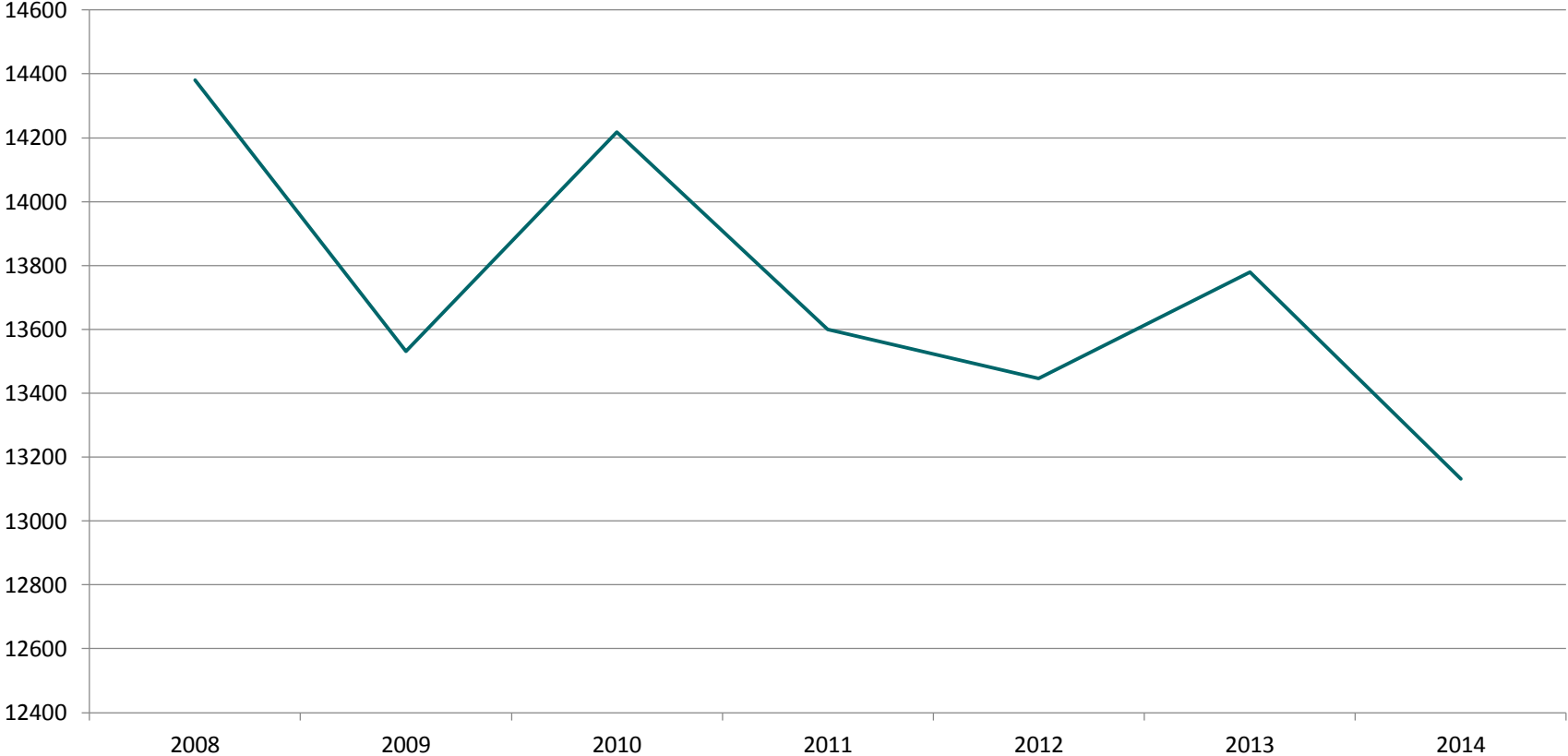
- Increasing of the proportion of hard (from 117 TWh to 121,7 TWh between 2010-2013) and brown (from 145,9 TWh to 160,9 TWh) coal in electricity production.
- Emissions of CO₂ has been increasing slowly.
- The proportion of nuclear power in the primary electricity consumption decreased from 10,8% to 7,7% between 2010-2013.

Net installed electricity generation capacity in Germany



Datasource: AGEE, BMWi, Bundesnetzagentur
 Last update: 03 Sep 2016 09:05

German annual final energy consumption (in PJ)

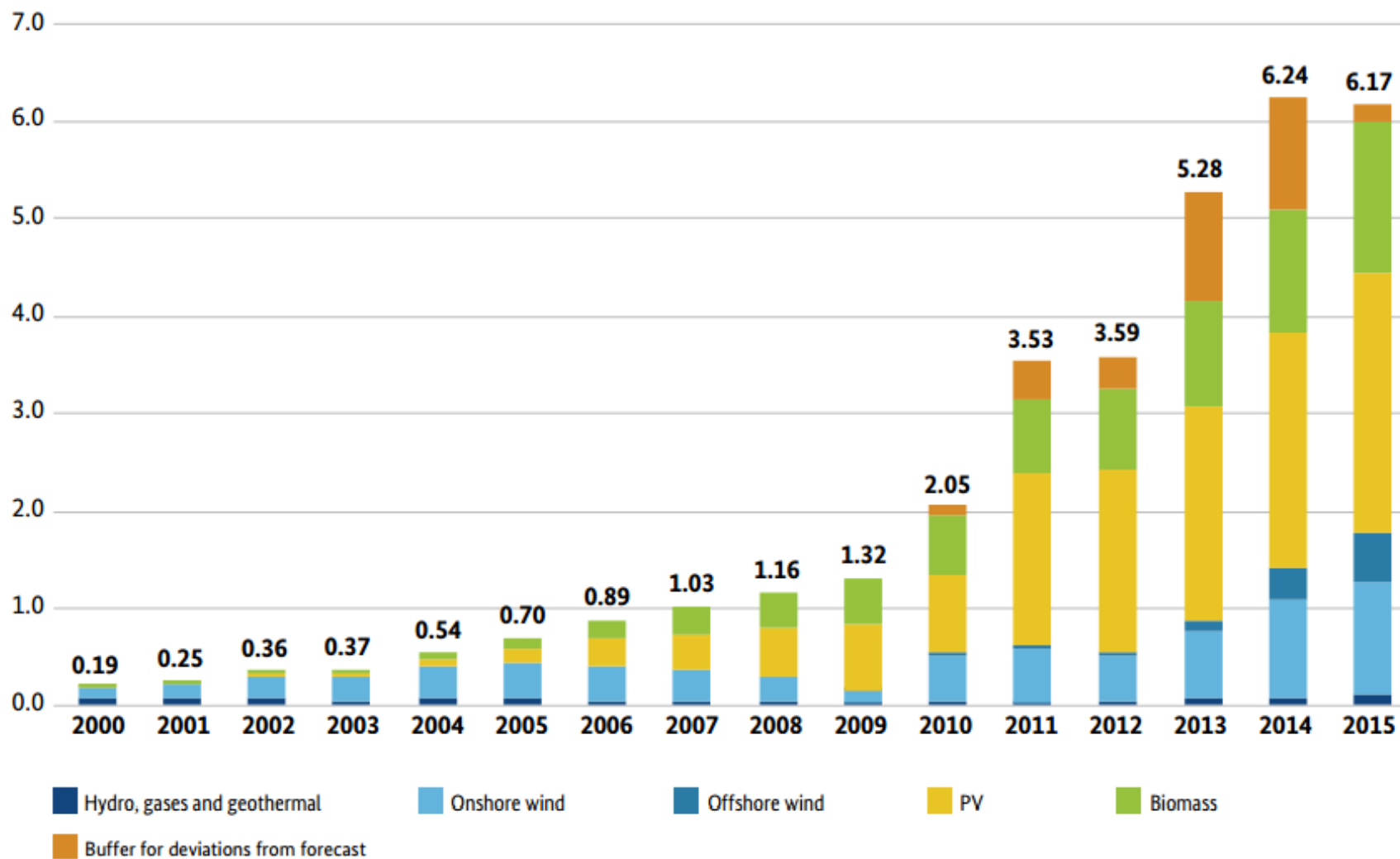


Major challenges

1) Costs of EW

- €550 bn. until 2050 (yearly investments €15bn., or 0,5% of GDP respectively).
 - EEG surcharge and other levies.
 - Expenses on construction of power grid increases - in 2012, the expenses of all four German TSOs on development of network were €1,152 billion, about 305 millions more than in 2011. Estimates for 2013 were €1,242 billion.

EEG surcharge in cents/kWh

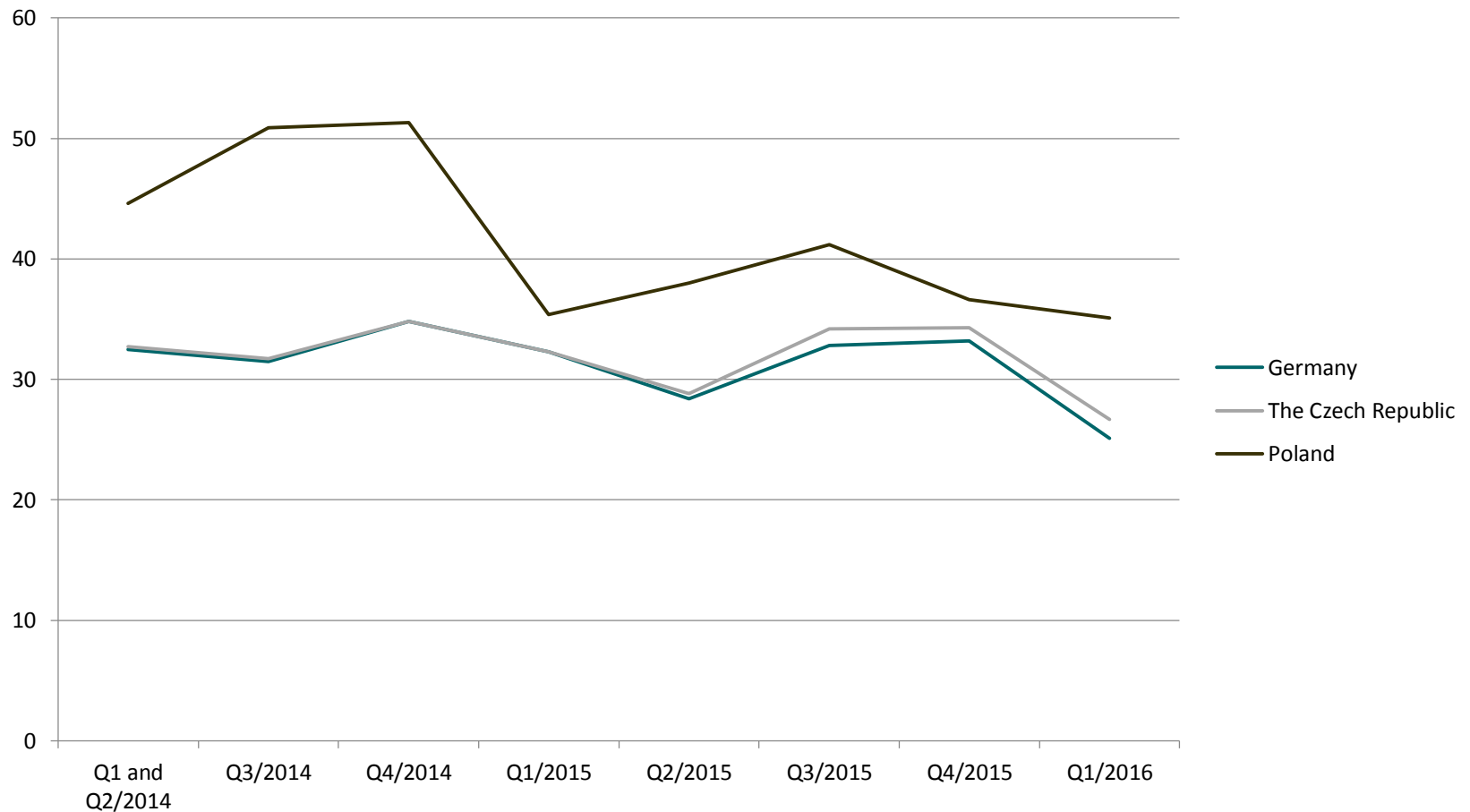


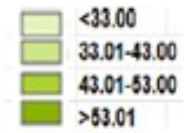
Source: Federal Ministry for Economic Affairs and Energy

Prices of electricity

- Wholesale prices of electricity among the lowest in the EU (this reinforces the competitiveness of industry).
- Households pay one of the highest prices in the EU (regulated component of prices).
- Cost unevenly distributed. Paid mainly by households, companies exempted to a great extent.

Average wholesale baseload electricity prices (in €/MWh)

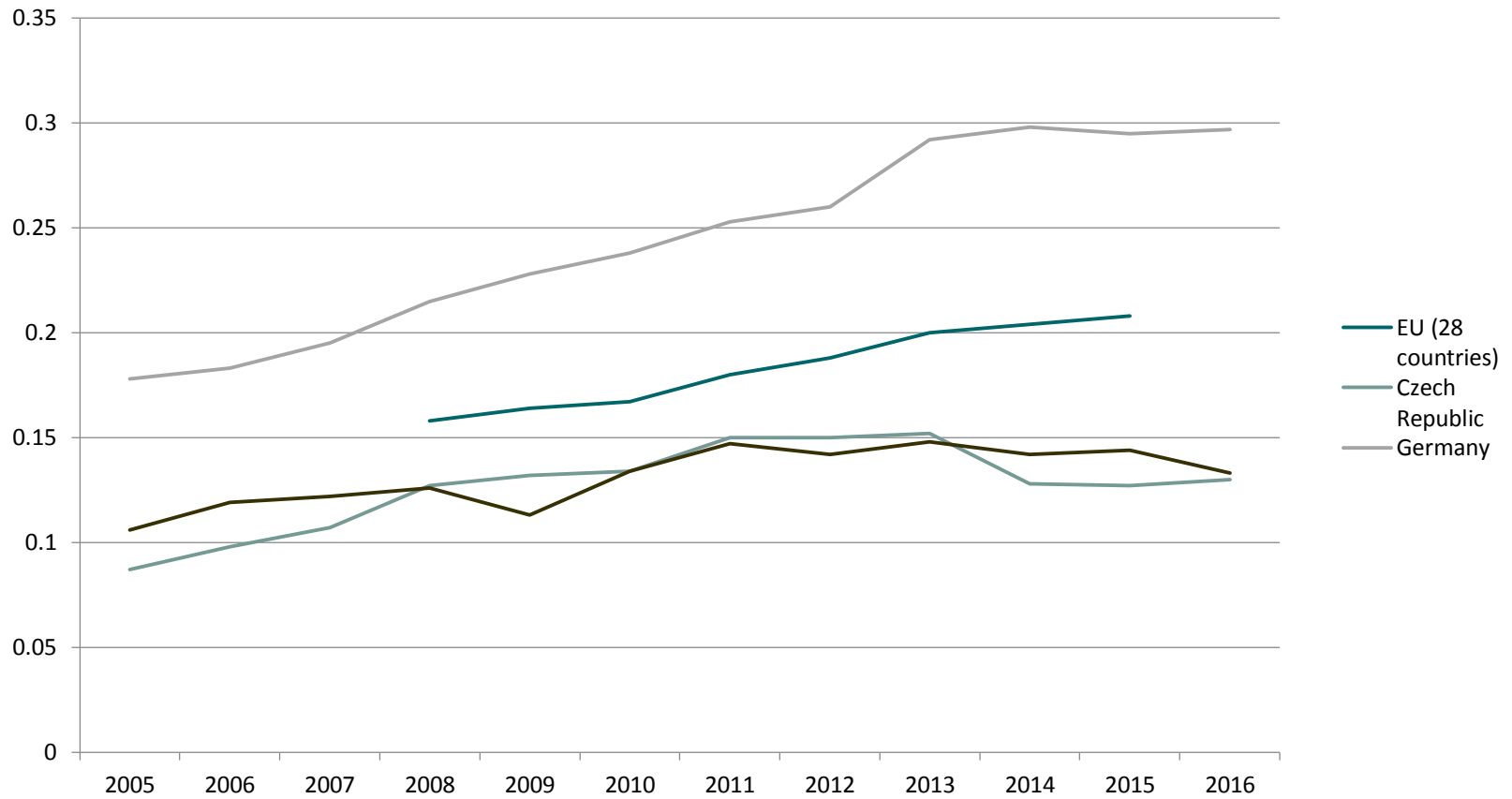




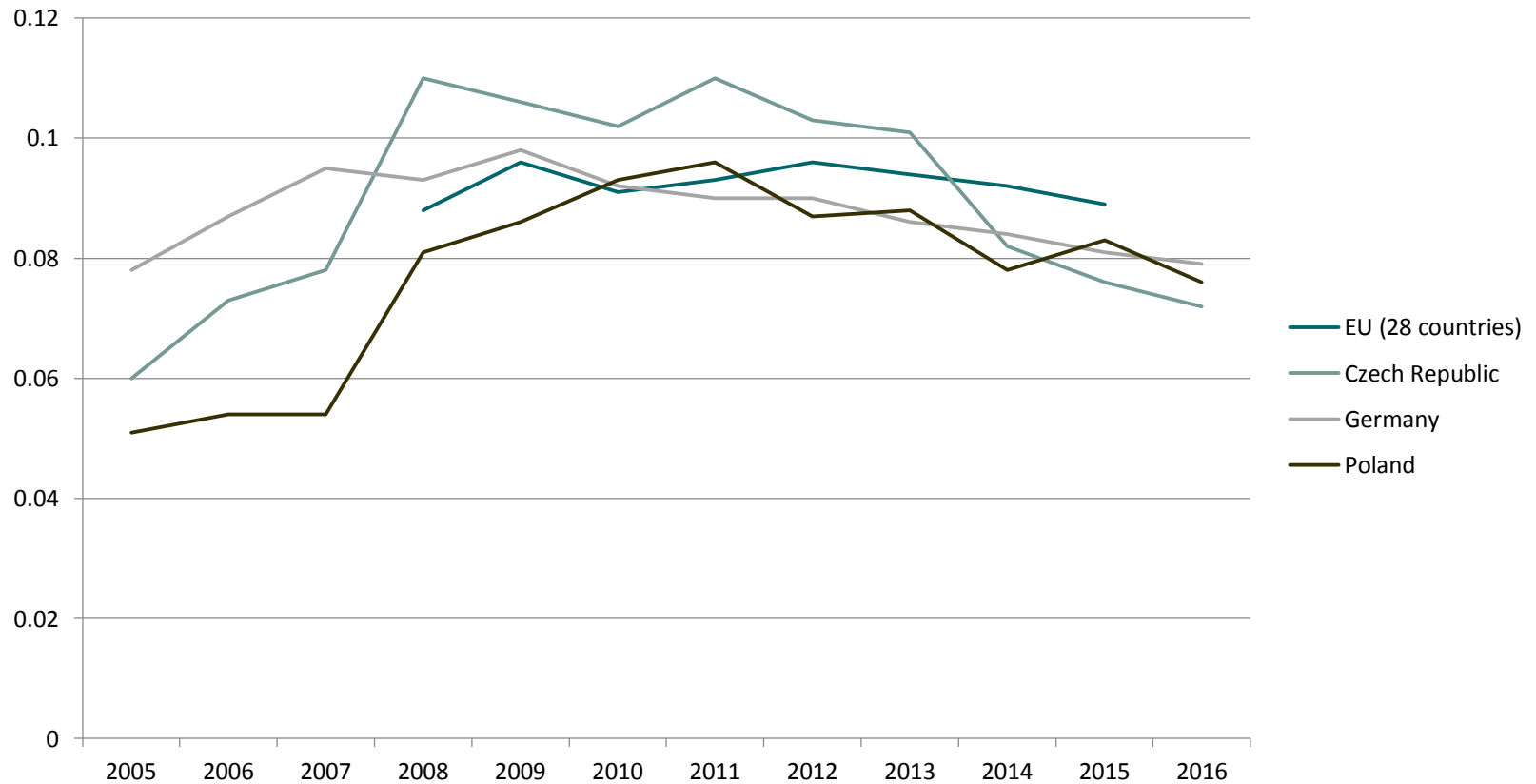
MT: No Data
Malta

CY: No Data
Cyprus

Electricity prices – medium size households (eur/kWh)



Electricity prices – medium size industries (eur/kWh)



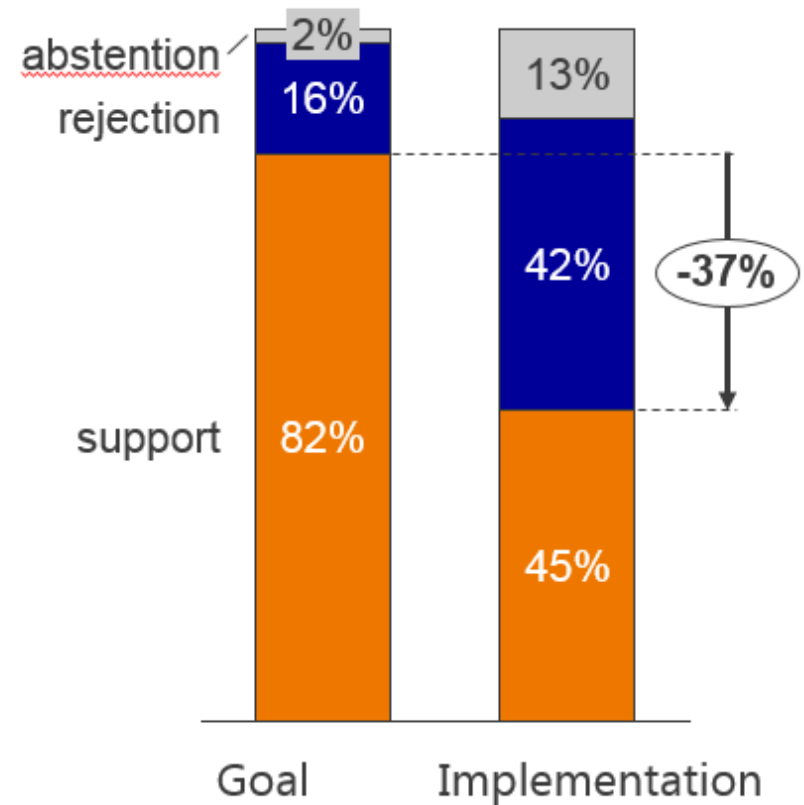
Reform of EEG in 2014

- Annual growth targets (2,5 GW each for wind and solar-PV).
- Growth targets for new biomass minimal (100MW).
- Auctions for PV-parks (starting 2015) and wind energy announced for 2017.
- Balancing and wholesale market integration mandatory for new installations (except small ones).

2) Public support of EW

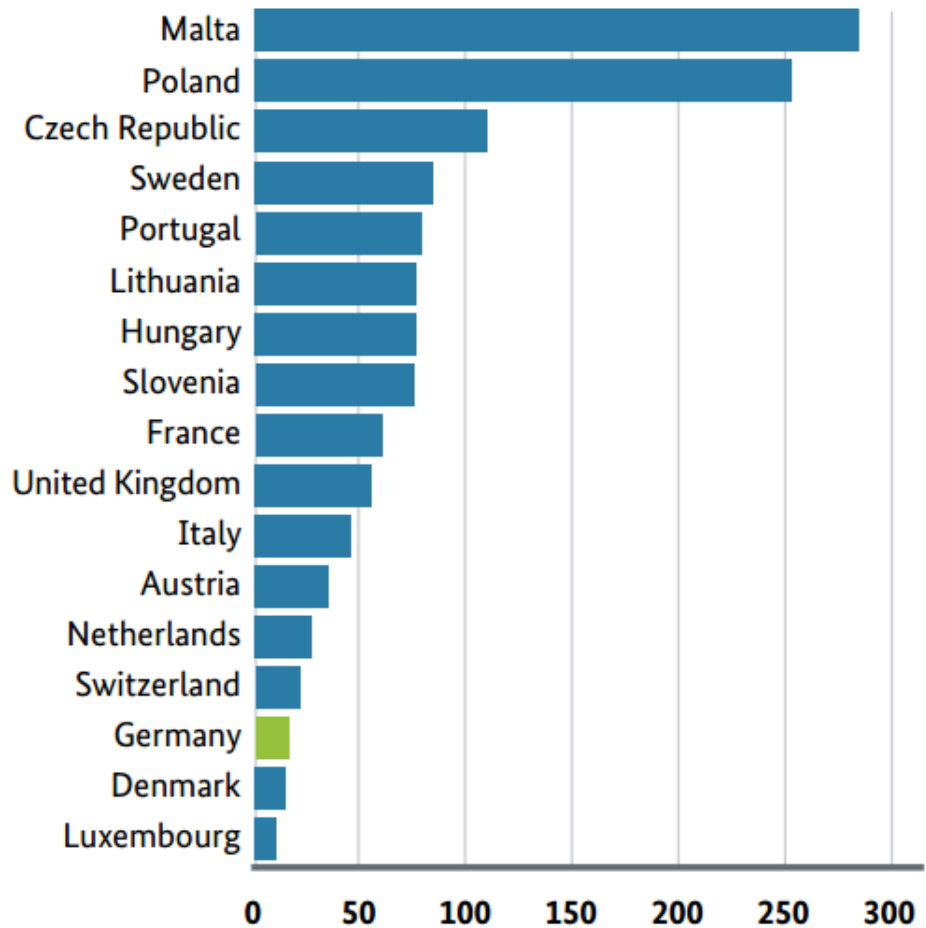
- 8 out of 10 German citizens support faster growth of RES.
- Resentments about perceived gap between ambitious targets and rhetoric and reality.
- Less than half of public with positive attitude toward implementation of EW.
- Politics identified as reason for deficits in implementation.

Q: Are you satisfied with goals and implementation of EW?



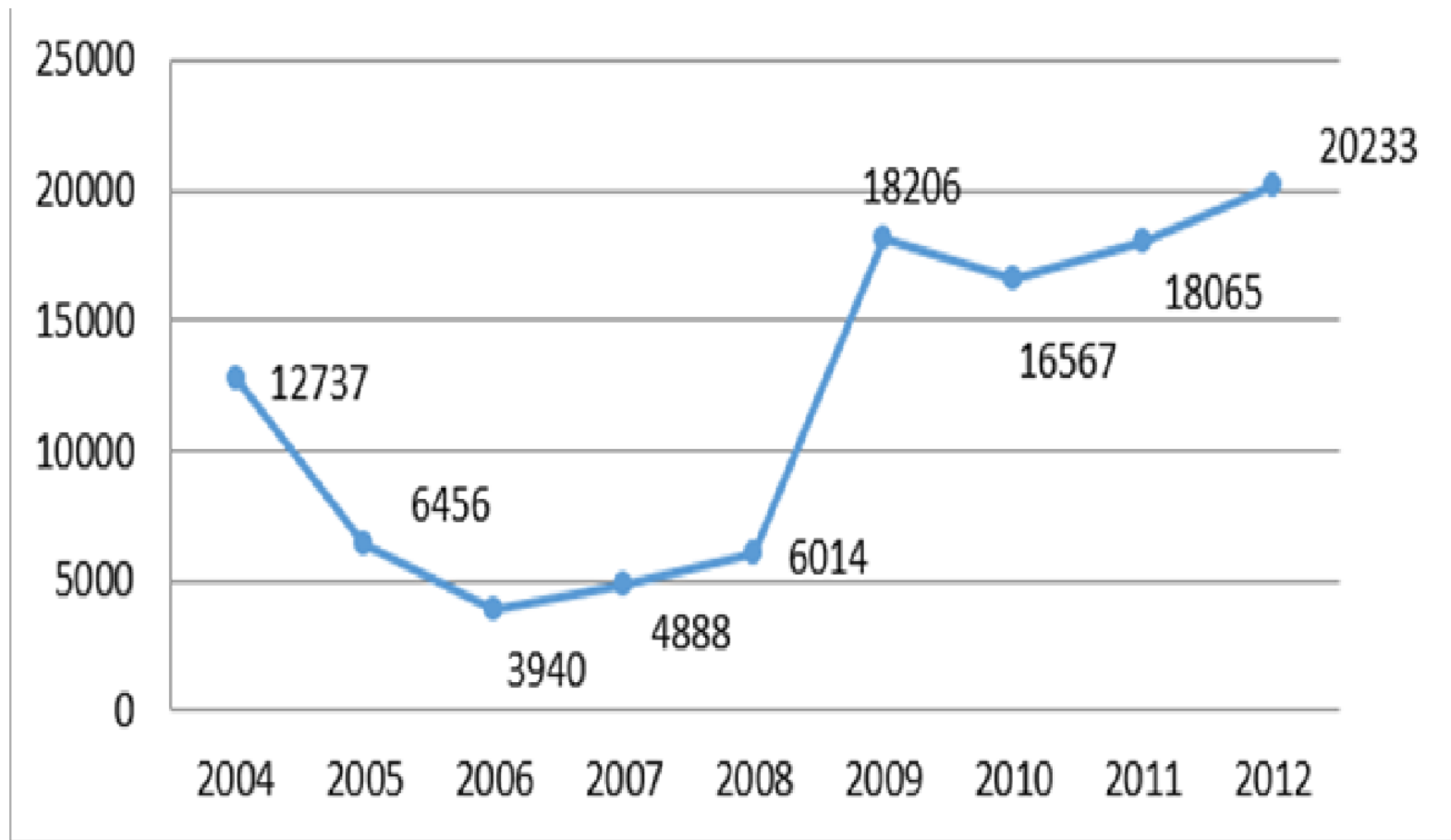
3) Stability of the grid

Unscheduled outages in 2013 (minutes per year)



Source: Council of European Energy Regulators

Number of activations of the minute reserve to balance RES



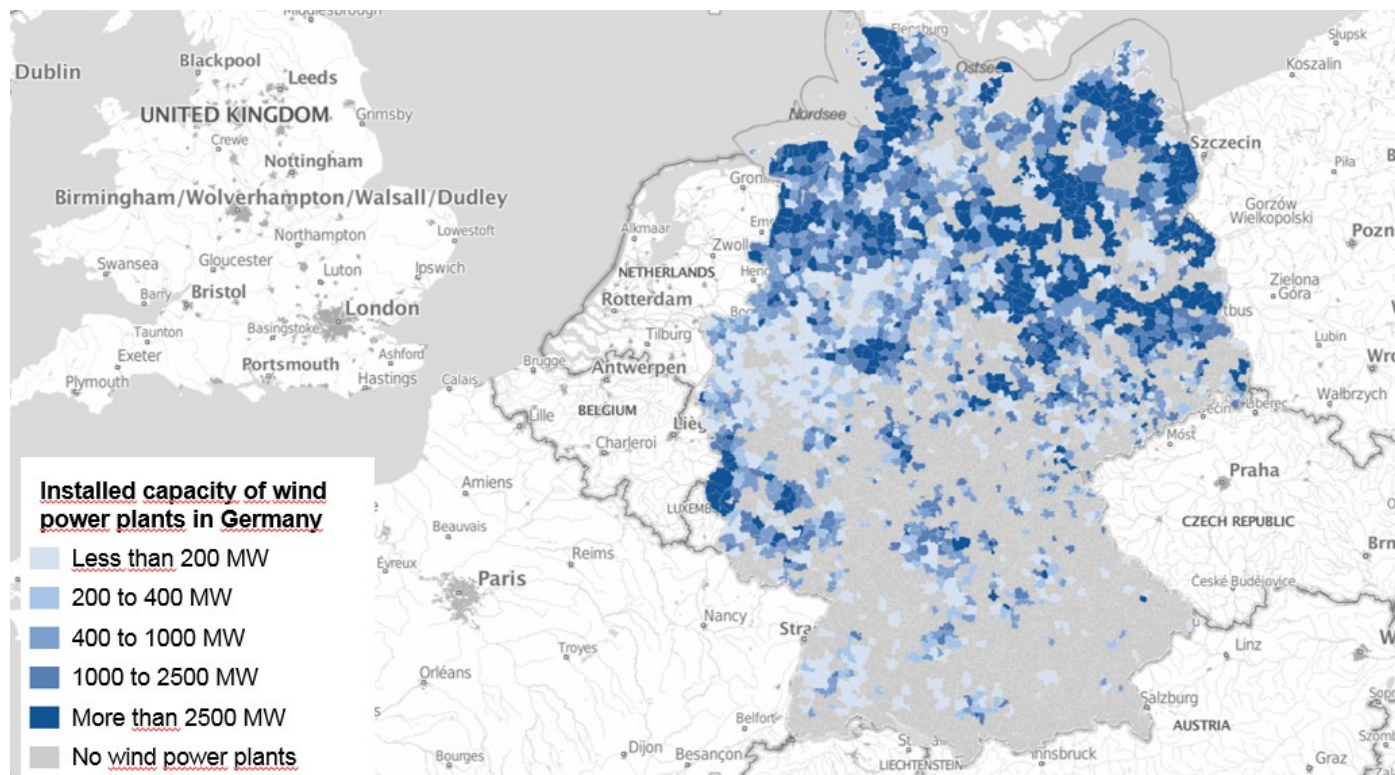
Zdroj: Bundesnetzagentur, 2014, str. 75

Non-dispatchable RES vs. consumption of regulation energy	2009	2012	Balance
Installed capacity of PV a wind energy (GW)	36	65	+55 %
Production of electricity from PV and wind energy (TWh)	45	77	+59 %
Consumption of regulation energy (MWh/month)	285	180	-37 %

Source: Bundesnetzagentur, 2014, pg. 77; Eurostat 2014

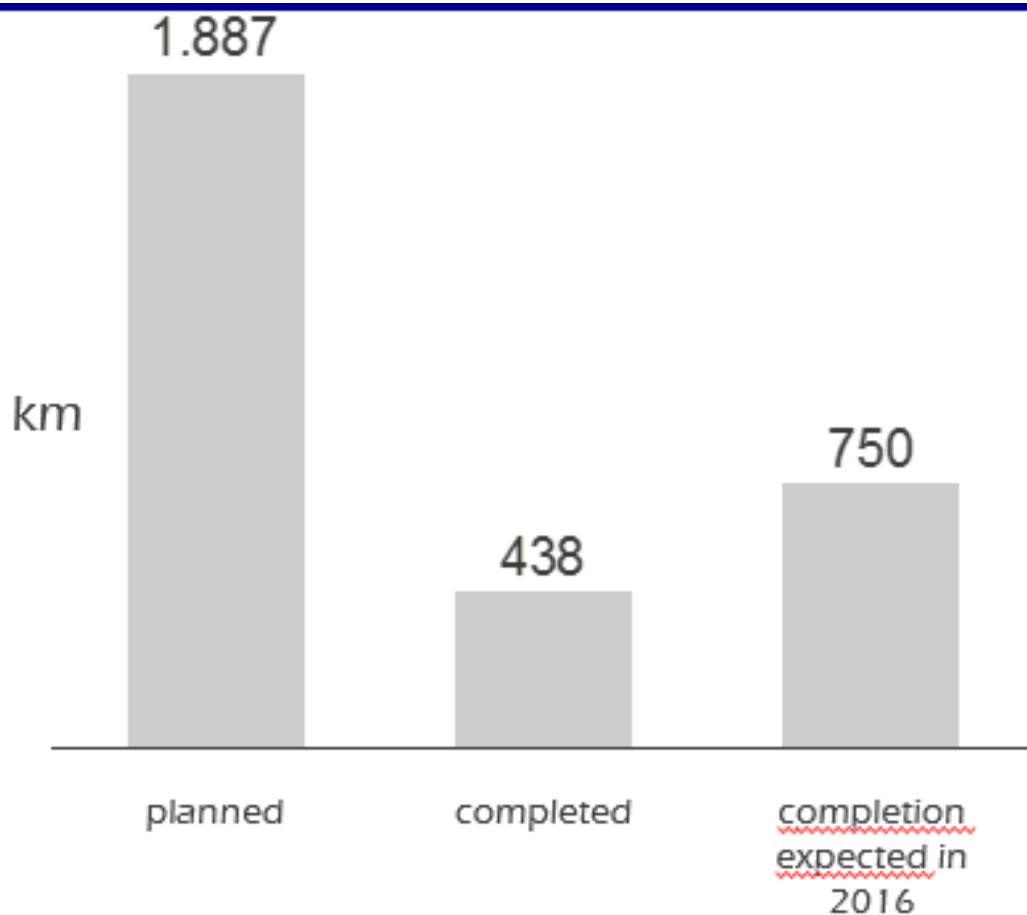
4) Grid capacity

Grid is not fit to accommodate 1 500 000 PV units and 23 000 wind turbines.

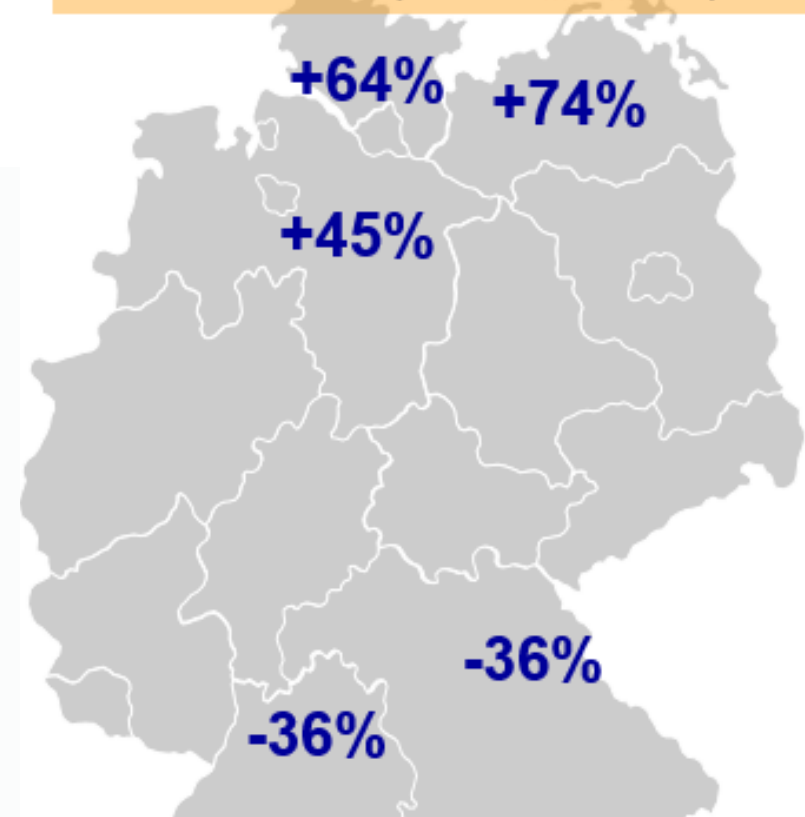


Building of the grid

In 2010 plan to build 1887km by 2015, in Q3 only 23% finished



Surplus energy quantities in the North (Wind feed-in)

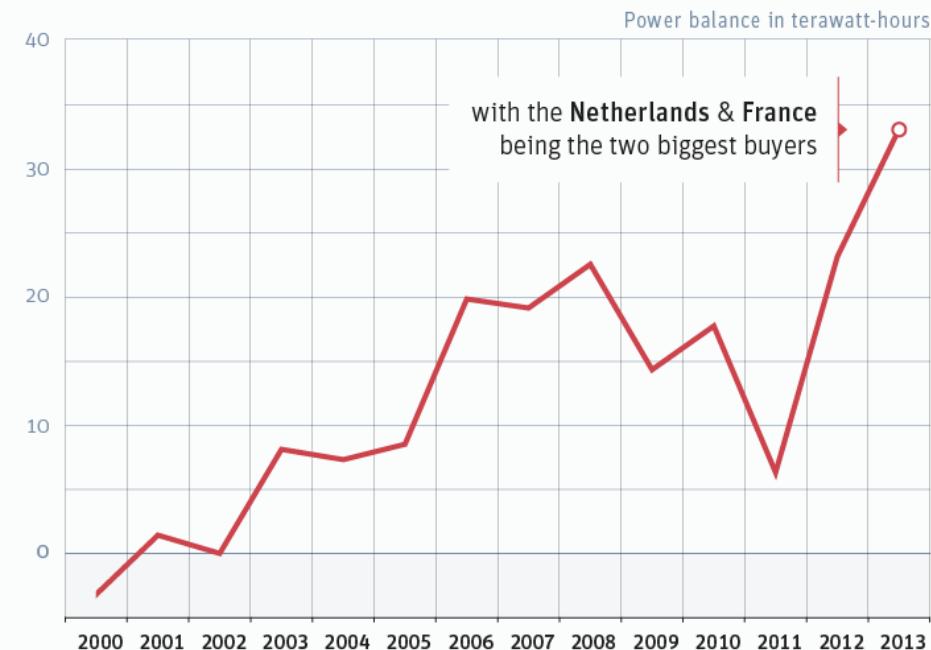


Lack of regional energy generation in the South (internal 'imports' needed)

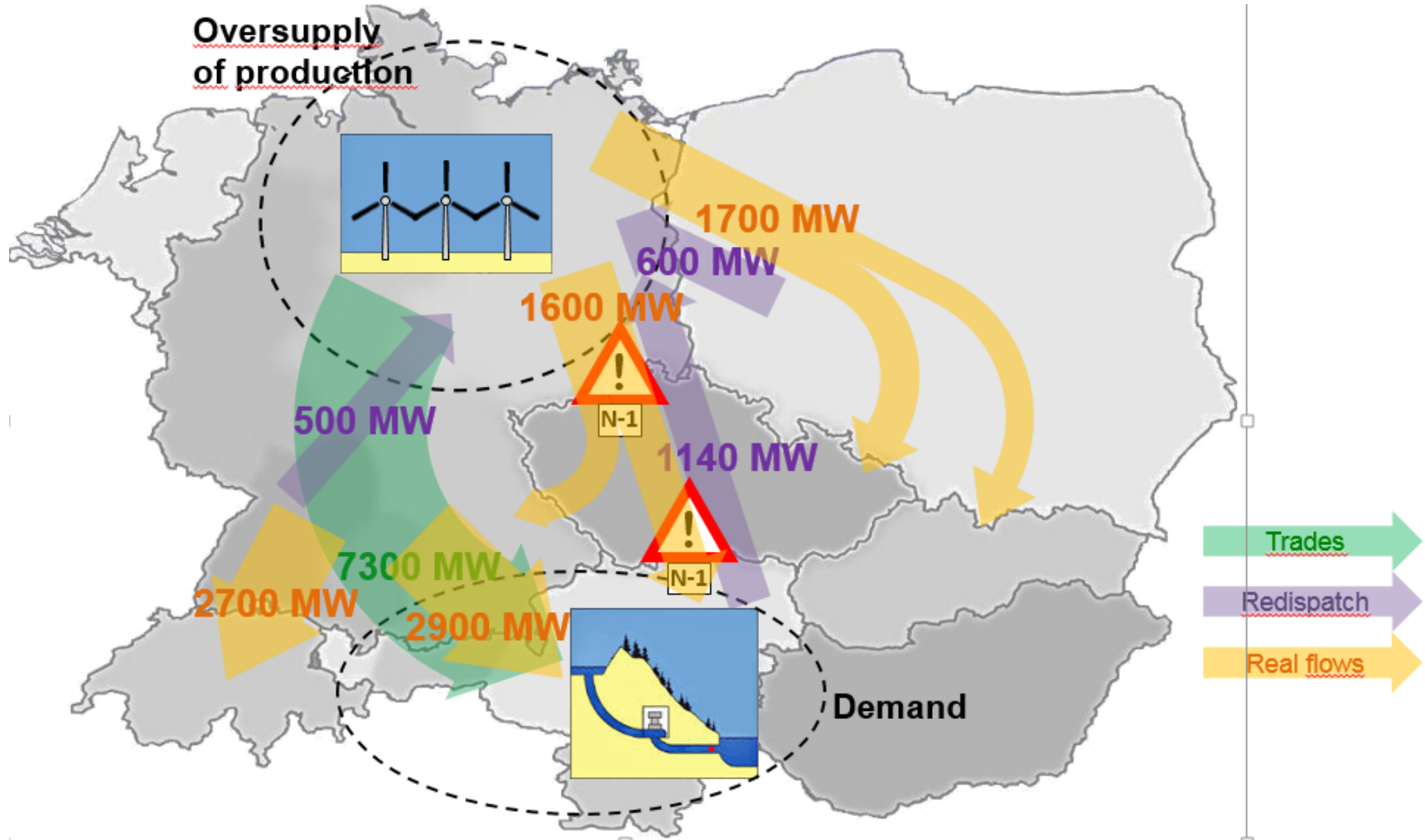
German power exports continue to rise

Net power exports from 2000–2013 in TWh.

Source: Agora Energiewende, AGEB



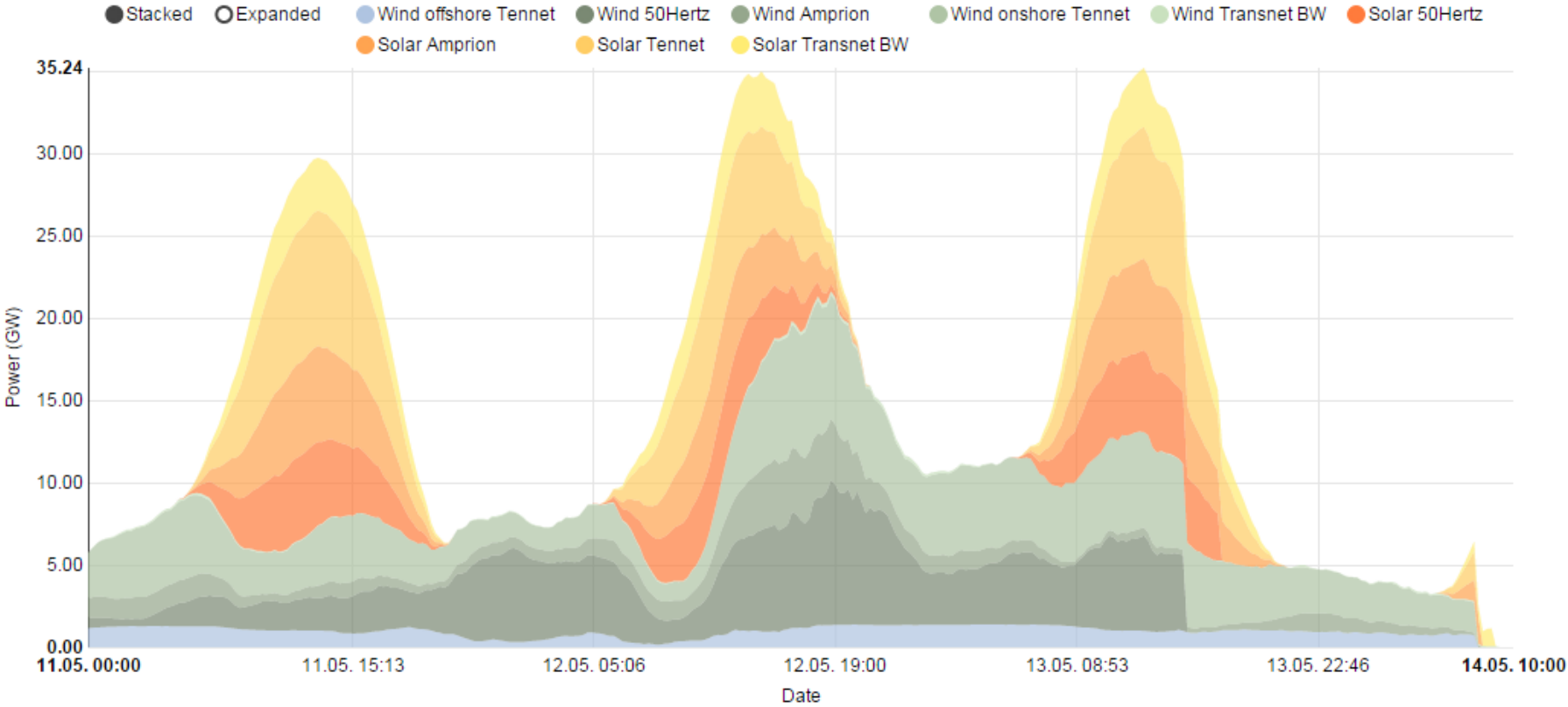
Trades and flow of electricity 2014/2015



4) Restructuralisation of energy production

- 1) Extensive development of RES at the expense of traditional sources. The resulting proportion of these two productive segments will be based on:
 - Almost zero variable (fuel) costs.
 - Financial support of RES paid by the end user within regulated part of the bill.
 - Expenses associated with maintaining balance and stability of network.
- 2) In present, the costs on support of RES and function of networks exceed the savings from lower commodity prices (= higher costs for society). But competitiveness of RES have been changing.

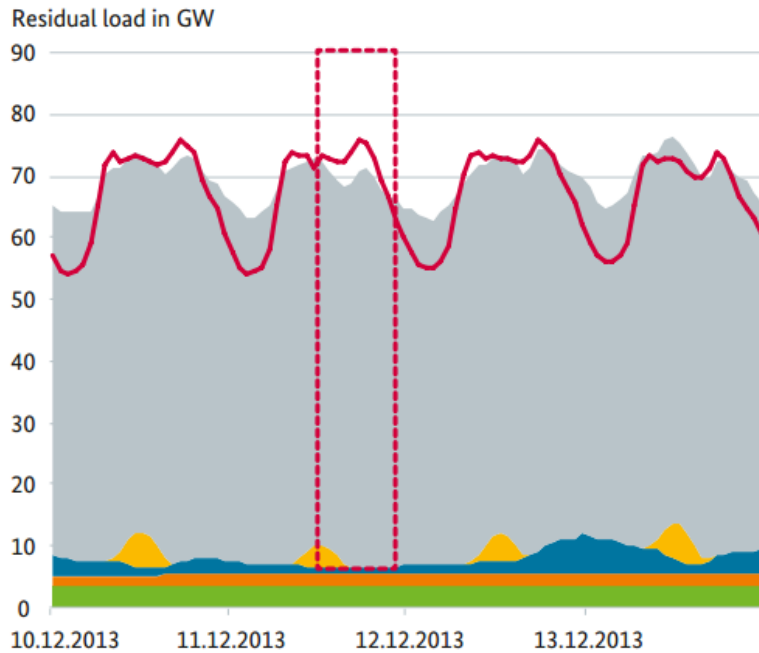
Solar + wind production in Germany in week 20 2015



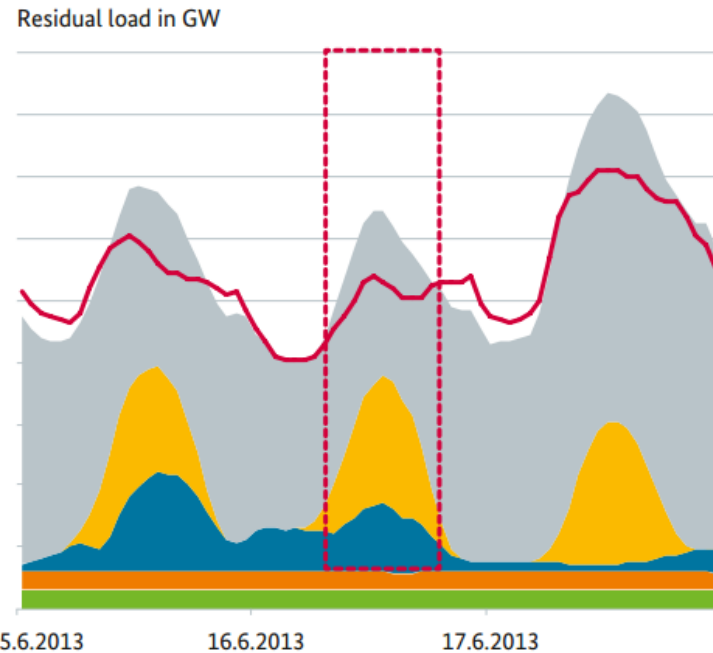
last update: 14 May 2015 10:15

Examples of situations with high and low residual load

High residual load:
high demand for electricity, little wind and solar power



Low residual load:
low demand for electricity, much wind and solar power



— Biomass — ROR — Wind — Solar — Conventional power stations — Electricity consumption

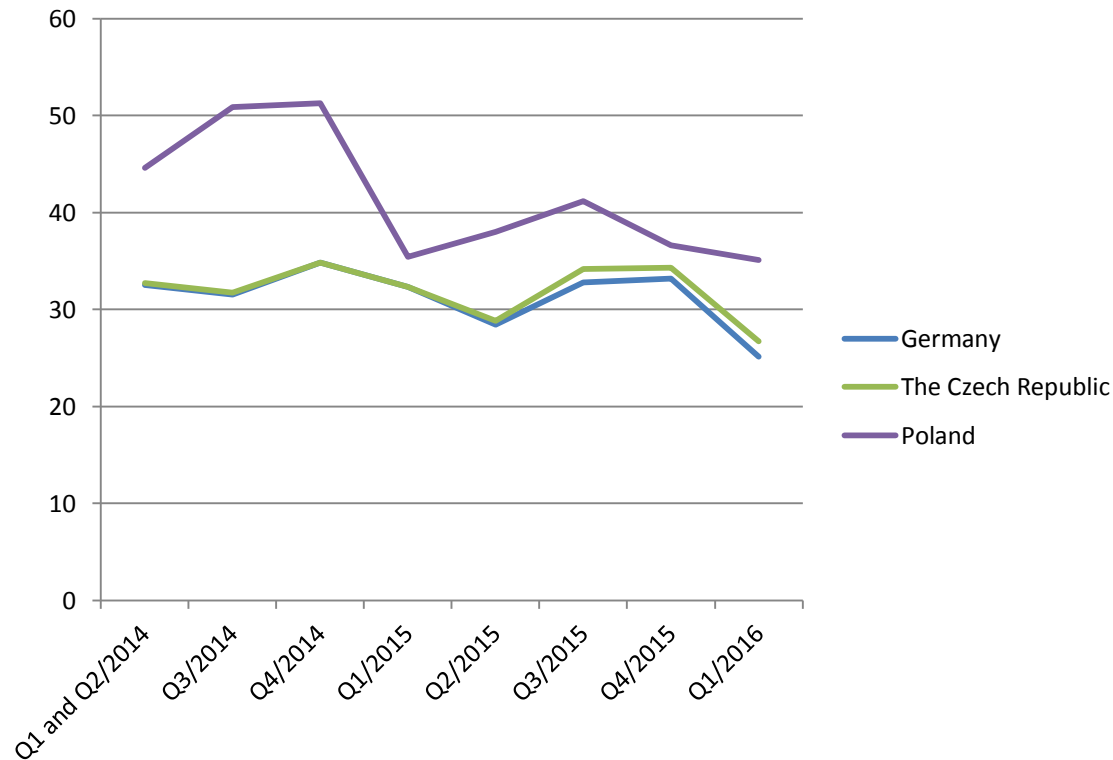
Source: Connect Energy Economics

Source: BMWi, Green paper

Impact of EW on neighbouring countries

Impact of EW on neighbouring countries

- Trade with electricity – price convergence
 - Price volatility
 - Wholesale price of electricity

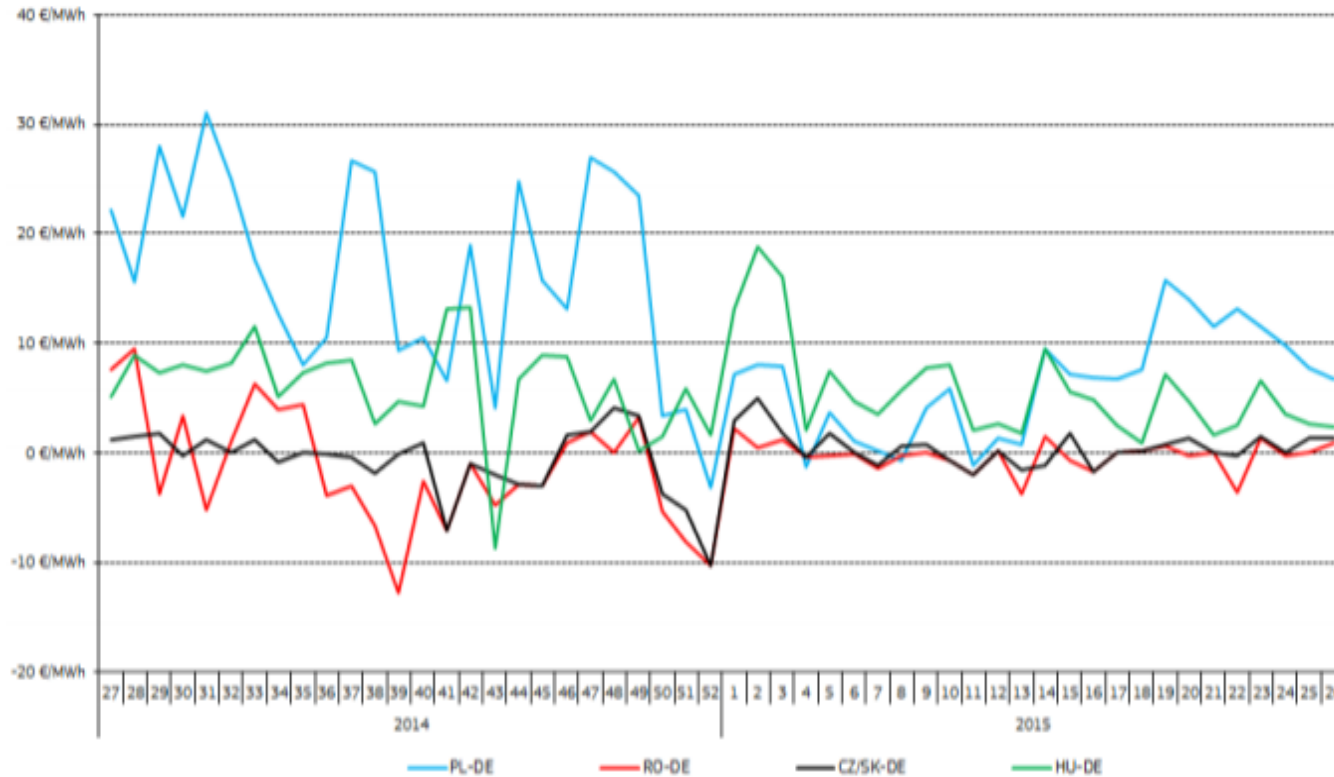


Czech Republic - producers

- Producers face reduced revenues. (EBITDA of ČEZ decreased from €3,5 bn. in 2009 to €2,5 bn. in 2015).
- Low variable cost generation portfolio (nuclear, hydro) – still profitable company.
- 88 % of electricity generated from low-merit or mid-merit sources (coal 50 %, nuclear 30 %, hydro 5,5 %).

Czech Republic - consumers

- Profit from Energiewende – import of cheaper electricity.



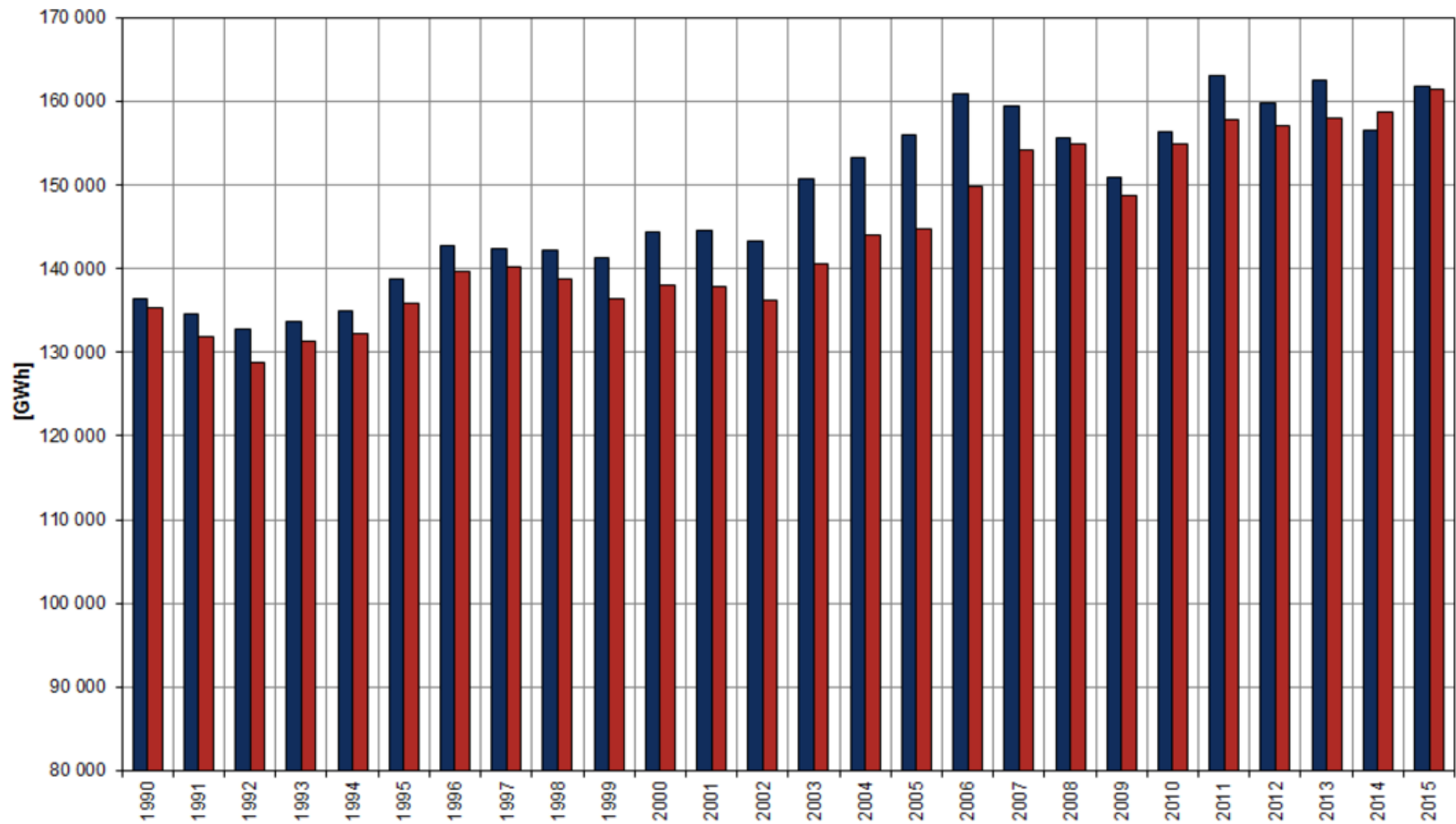
Czech Republic - government

- Nuclear energy as a baseload source of energy questioned.
- Nuclear is planned to replace decommissioning of 14 GW (out of 24 GW total) in 2030.

Poland - producers

- Ageing fleet. 47 % capacity older than 30 years, Older sources have to operate at greater than 50 % capacity = minimum load of app. 10 GW.
- 84 % electricity from coal (decreasing competitiveness in Poland due to the depletion of deposits, low productivity, low global prices).
- Production is not competitive – saved only by restricted imports.

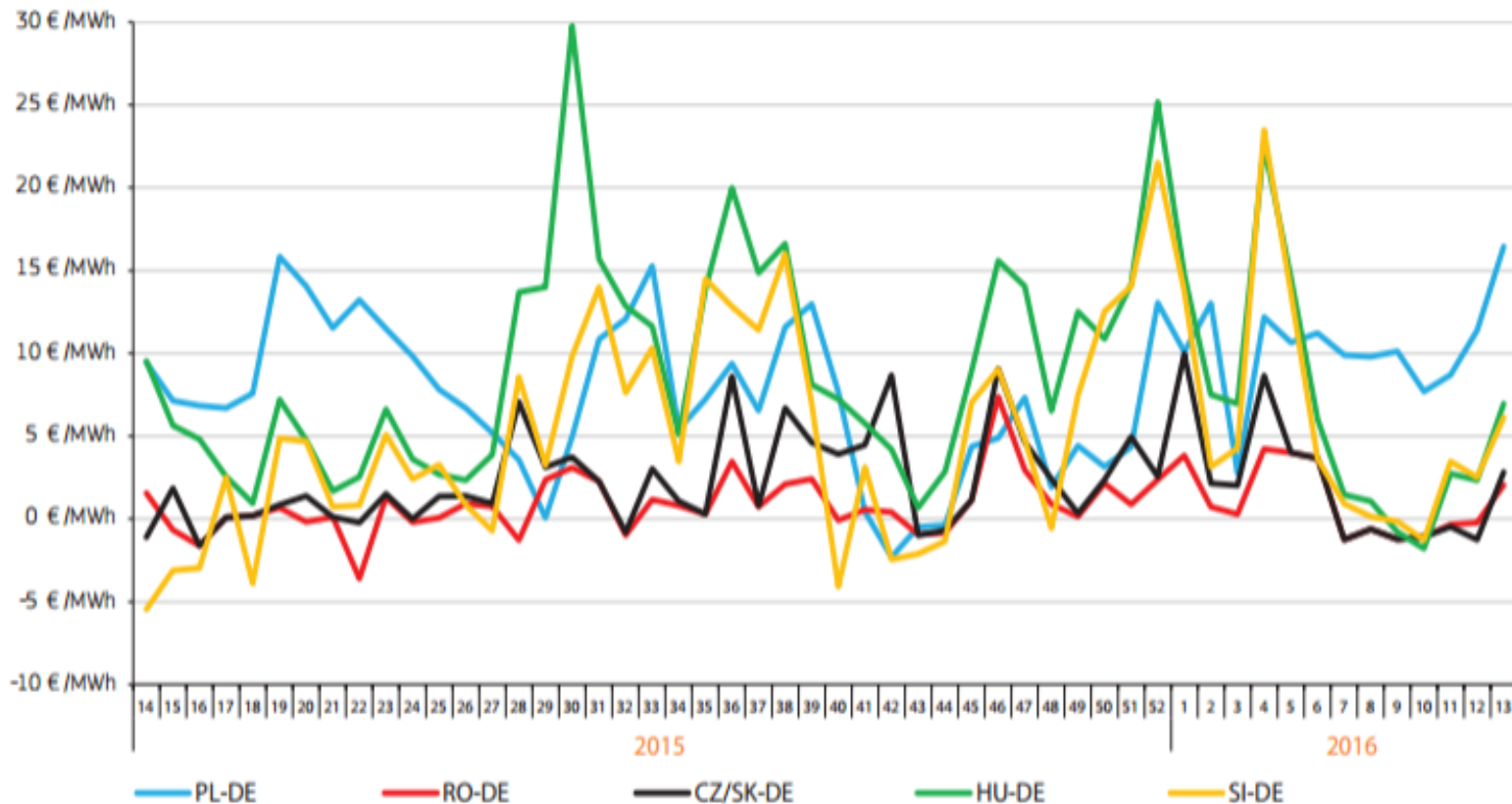
Production and consumption of energy, 1990 - 2015



Poland - consumers

- Unable to profit from low wholesale prices.
- Resource adequacy – not using import to shave peak demand Poland needs to finance high security margin (18 % above peak load).

Regional weekly baseload price premiums or discounts to the German market, 3-4Q 2015



Poland – government

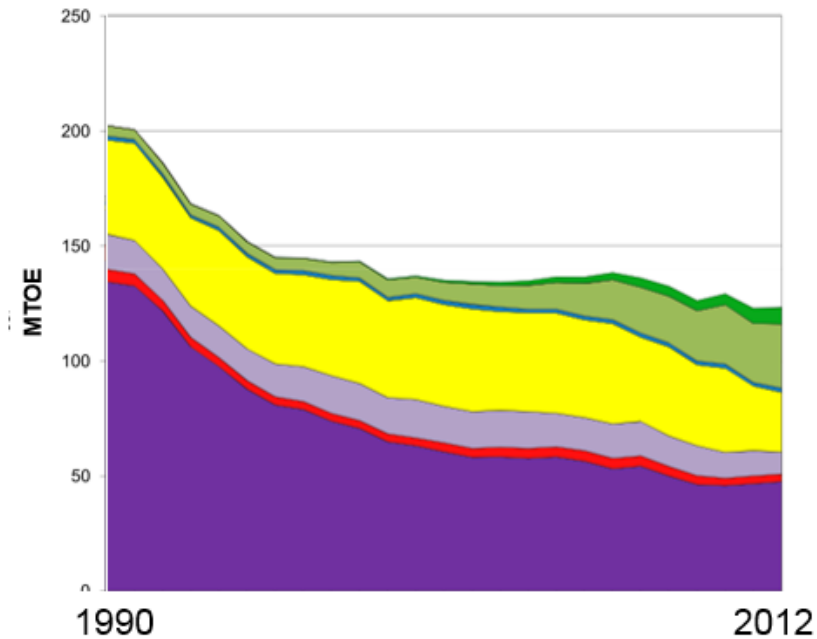
- Strong position in the sector, justified primarily by security of supply concerns.
- Emphasis on coal – for security and social reasons.
- Achieving multiple governmental goals (dominant role of the coal in the system, its economic sustainability, participation on IEM, compliance to the EU energy and climate policy).

Sources

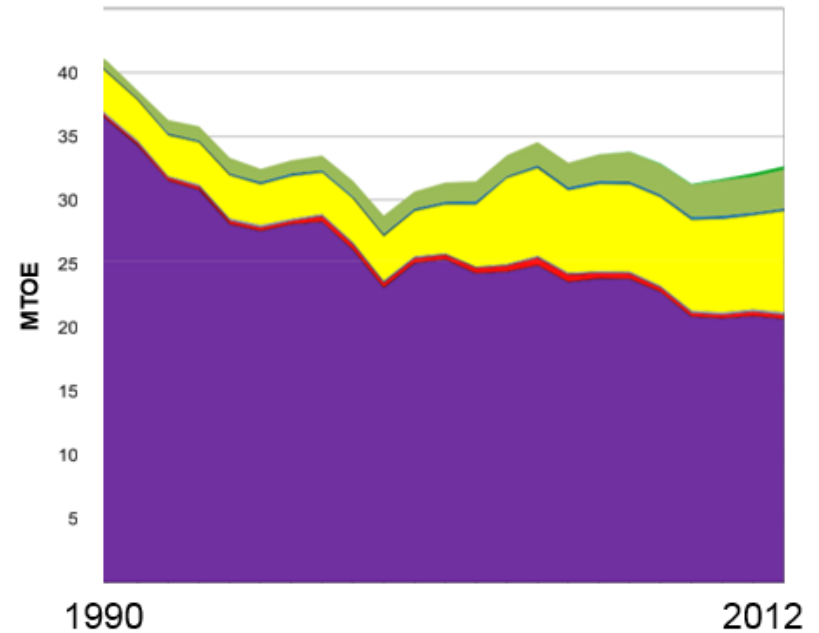
- BMWi (2015): Making a success of the energy transition.

Energy supply in Germany and Czech Rep.

Energy production in Germany (in Mtoe)



Energy production in the Czech Republic (Mtoe)



■ Coal* ■ Oil ■ Natural gas ■ Nuclear ■ Hydro ■ Biofuels/waste ■ Geothermal/solar/wind