German energy transition - Energiewende

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Origins of EW

1st pillar: nuclear phase-out.

- Long and successfull tradition of nuclear industry in Germany – in 70s 17 000MW.
- German anti-nuclear movement – Ausserparlamentarishe Opposition in 60s (leftist students), environmental movements, local oposition.
- 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

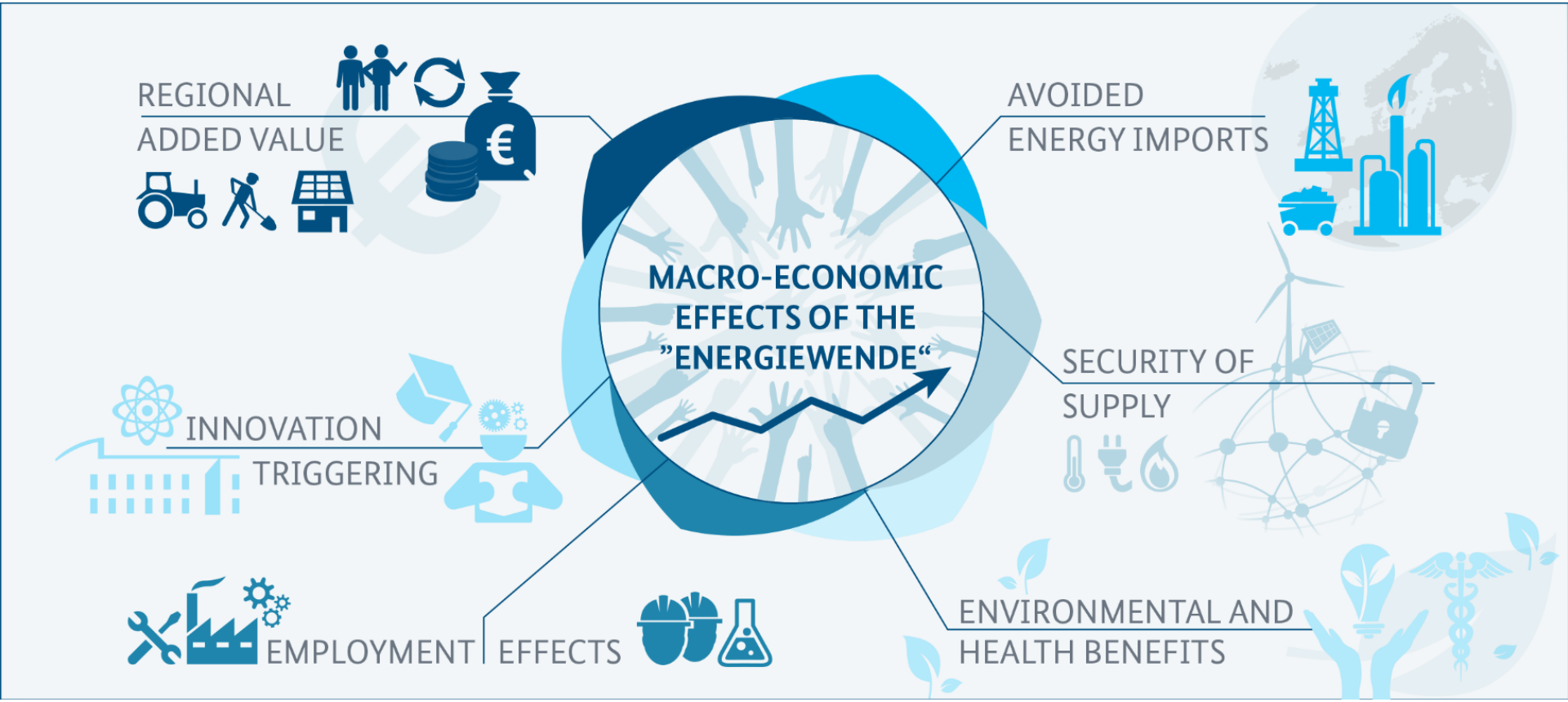
2nd pillar: climate protection measures.

- 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 elektricity supply 80% by 2050.
- Reduction of energy consumption by 50% by 2050 (reference year 2008).
- By 2050, elektricity 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



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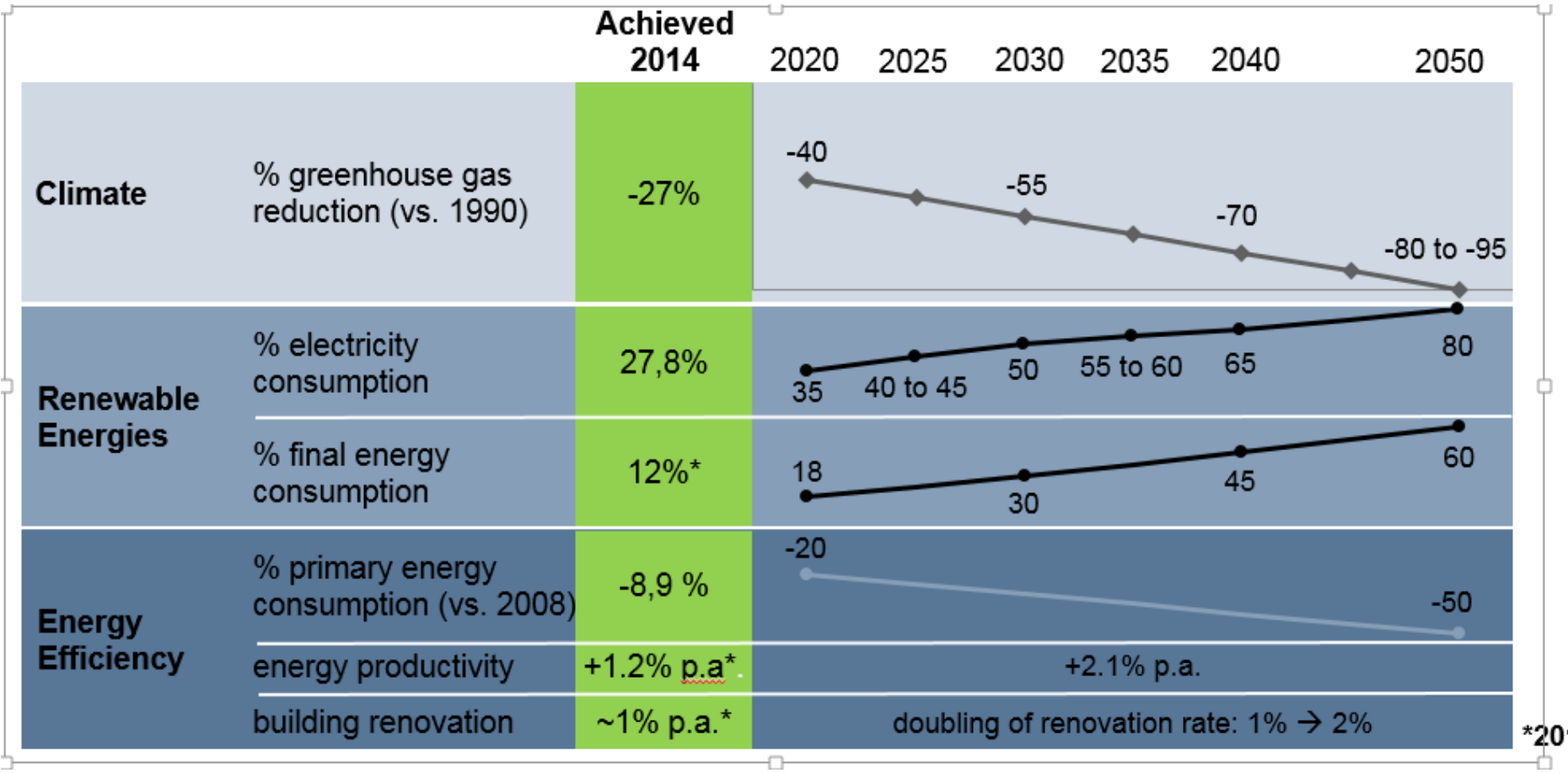
Targets of the EW



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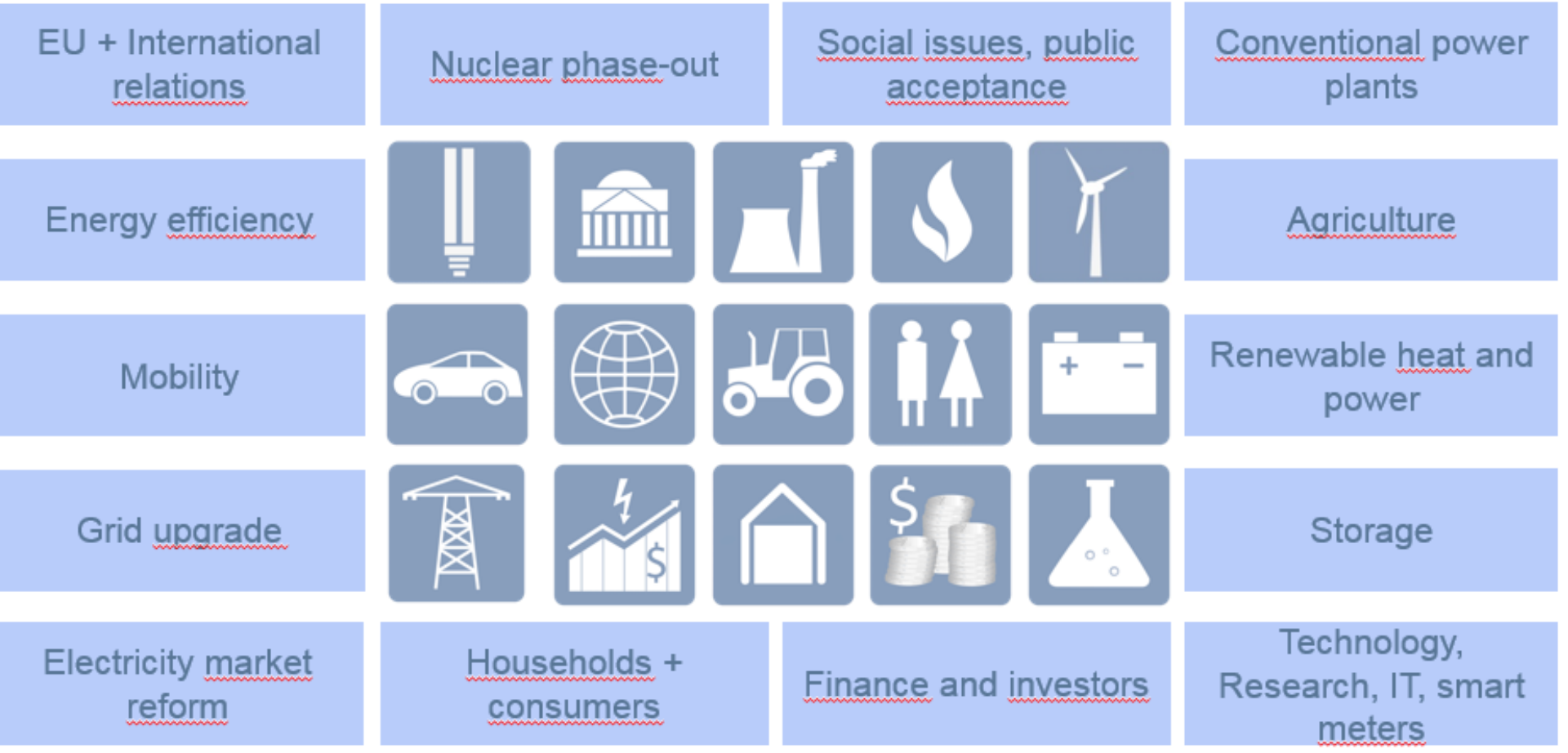
Complexity of EW

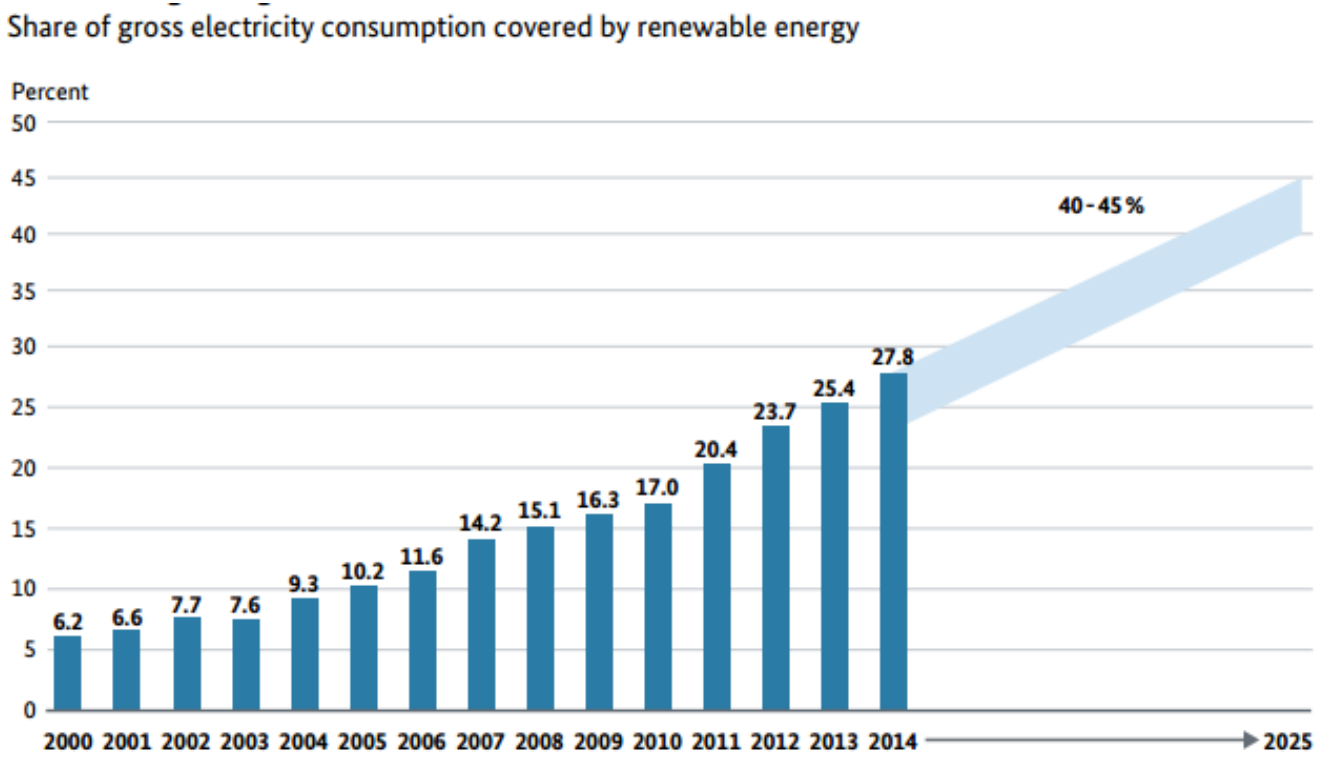
EW is not limited to the power sector only, it is multidimensional restructuring of the supply system



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.



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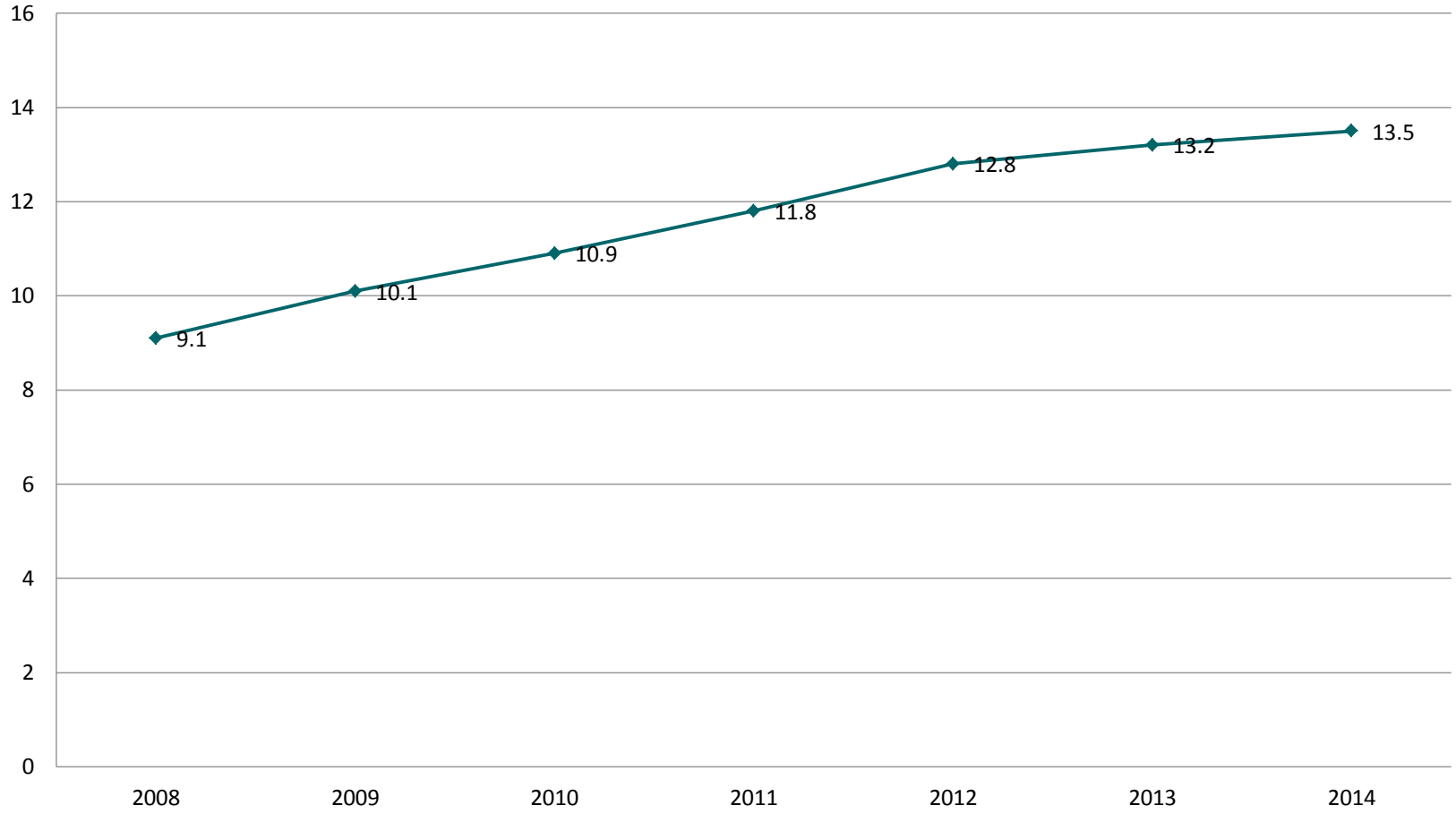
Share of RES in gross final energy consumption (in %)



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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 elektricity production.
- Emissions of CO2 has been increasing slowly.
- The proportion of nuclear power in the primary elektricity consumption decreased from 10,8% to 7,7% between 2010-2013.

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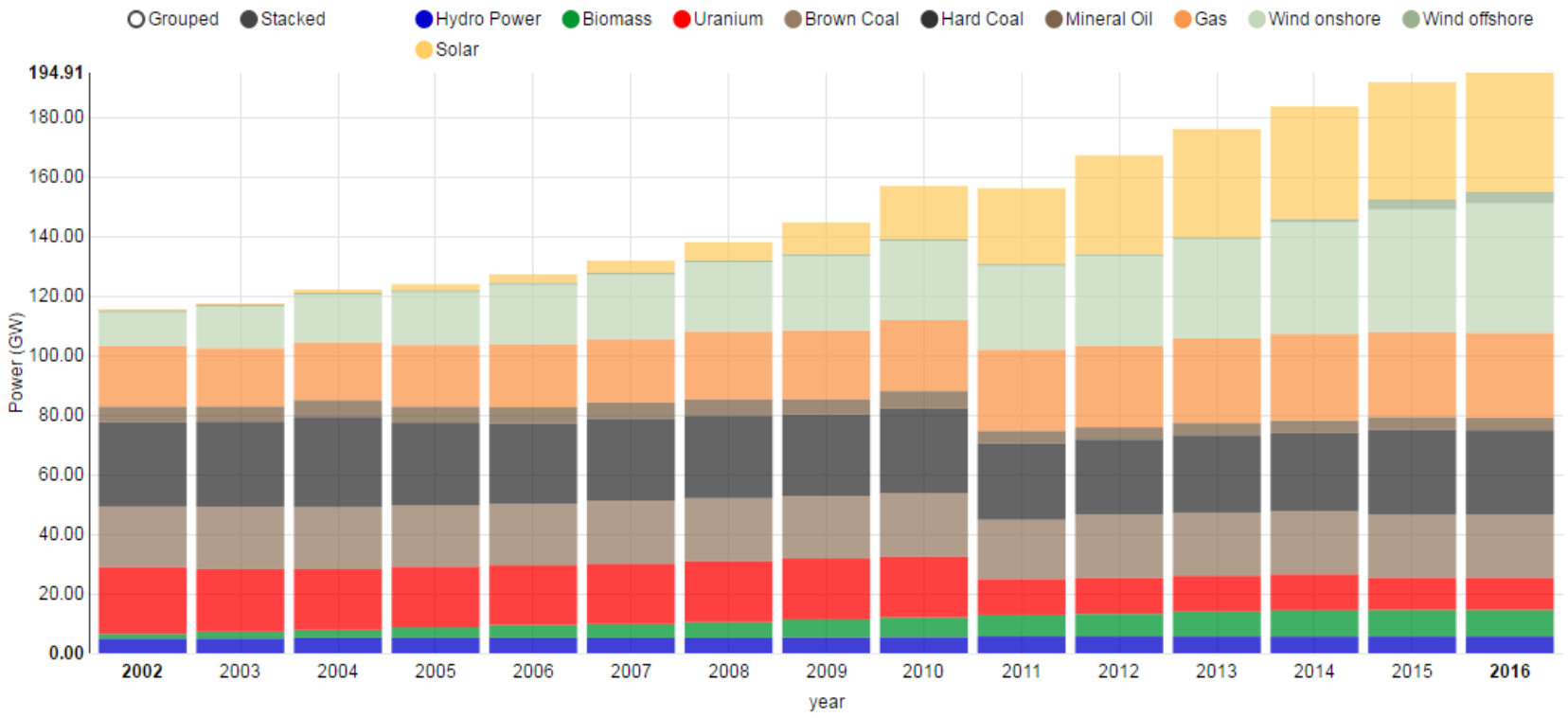
Net installed electricity generation capacity in Germany



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

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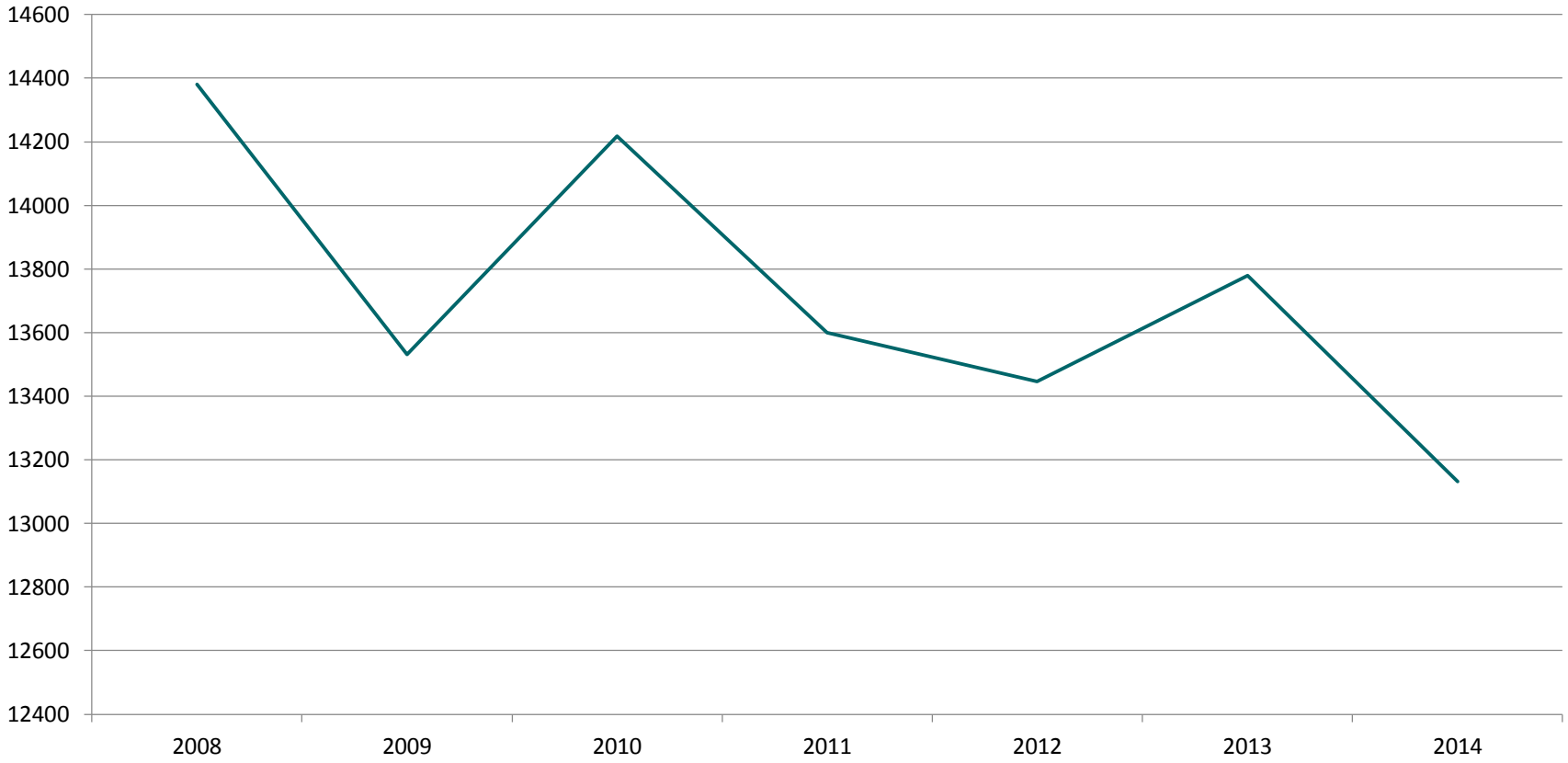
German annual final energy consumption (in PJ)



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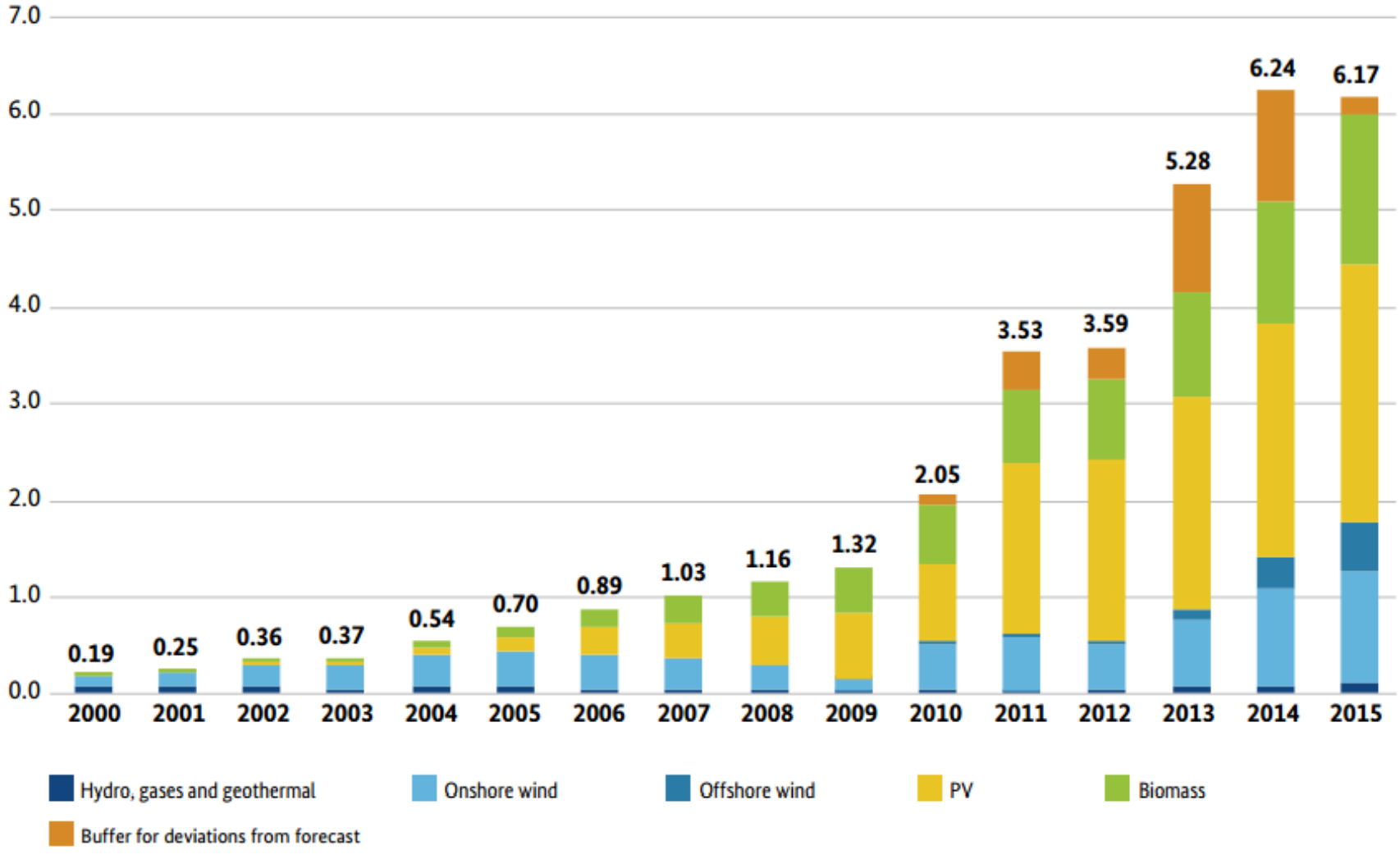
Major challenges

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 extend.

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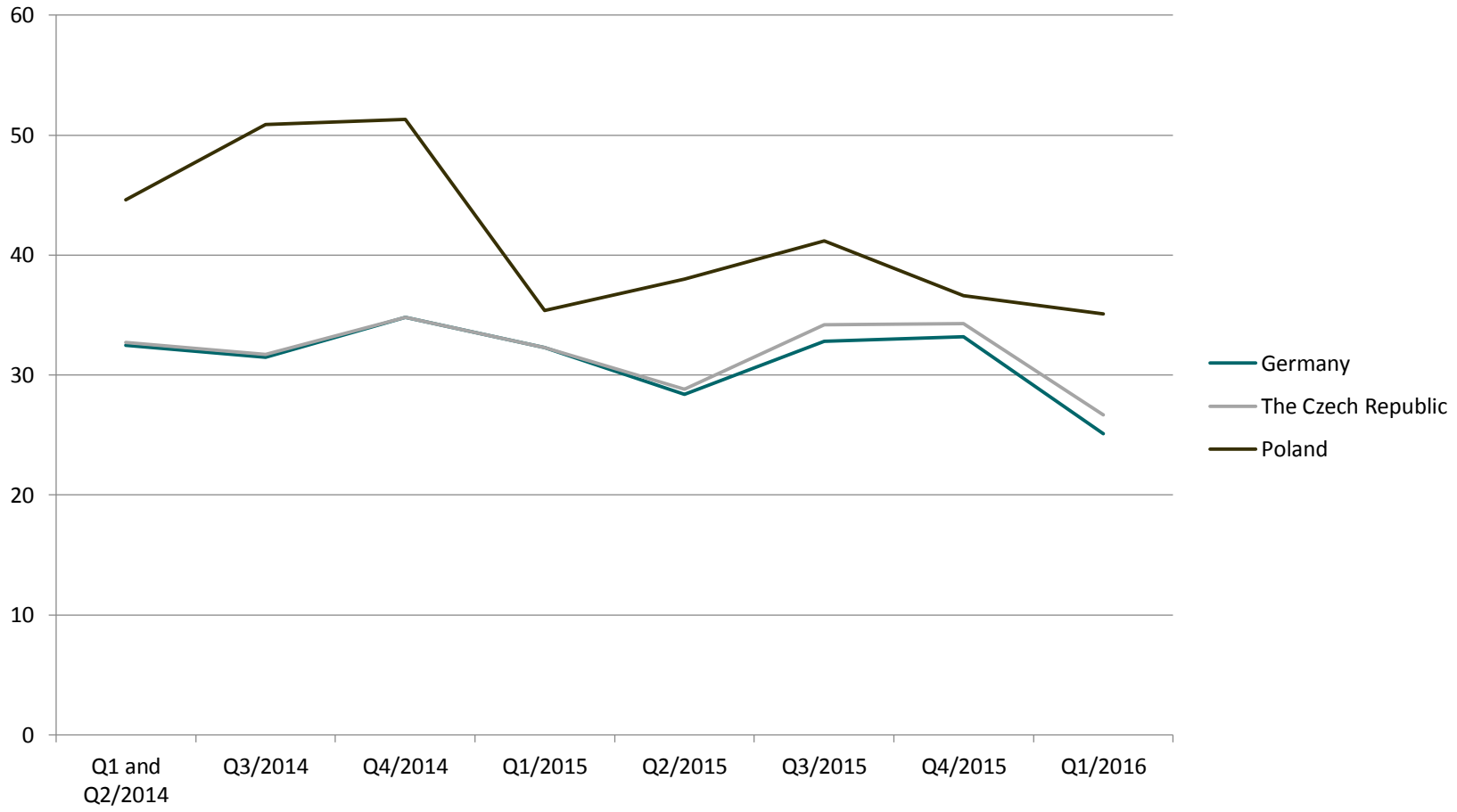
Average wholesale baseload electricity prices (in €/MWh)



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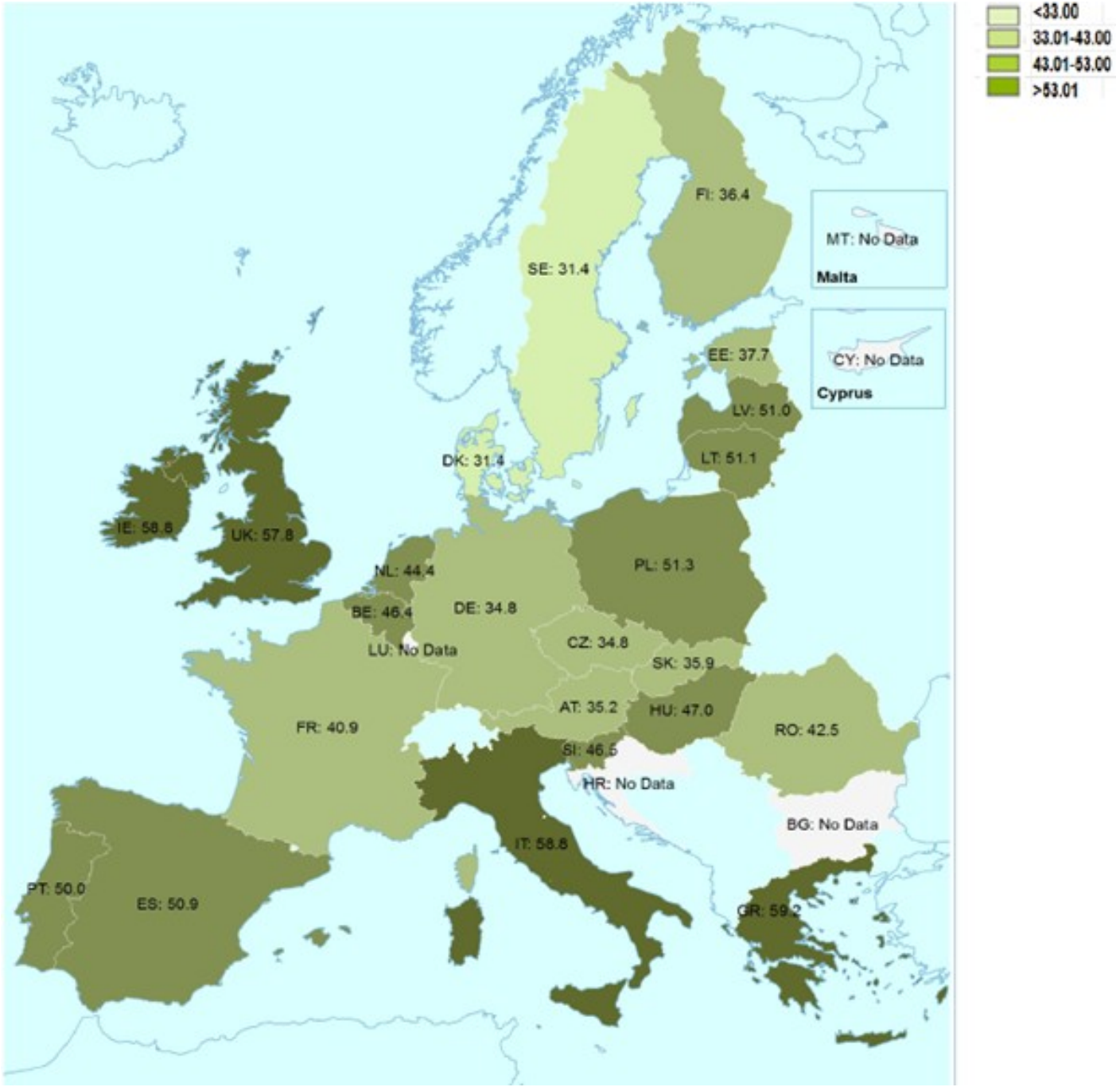

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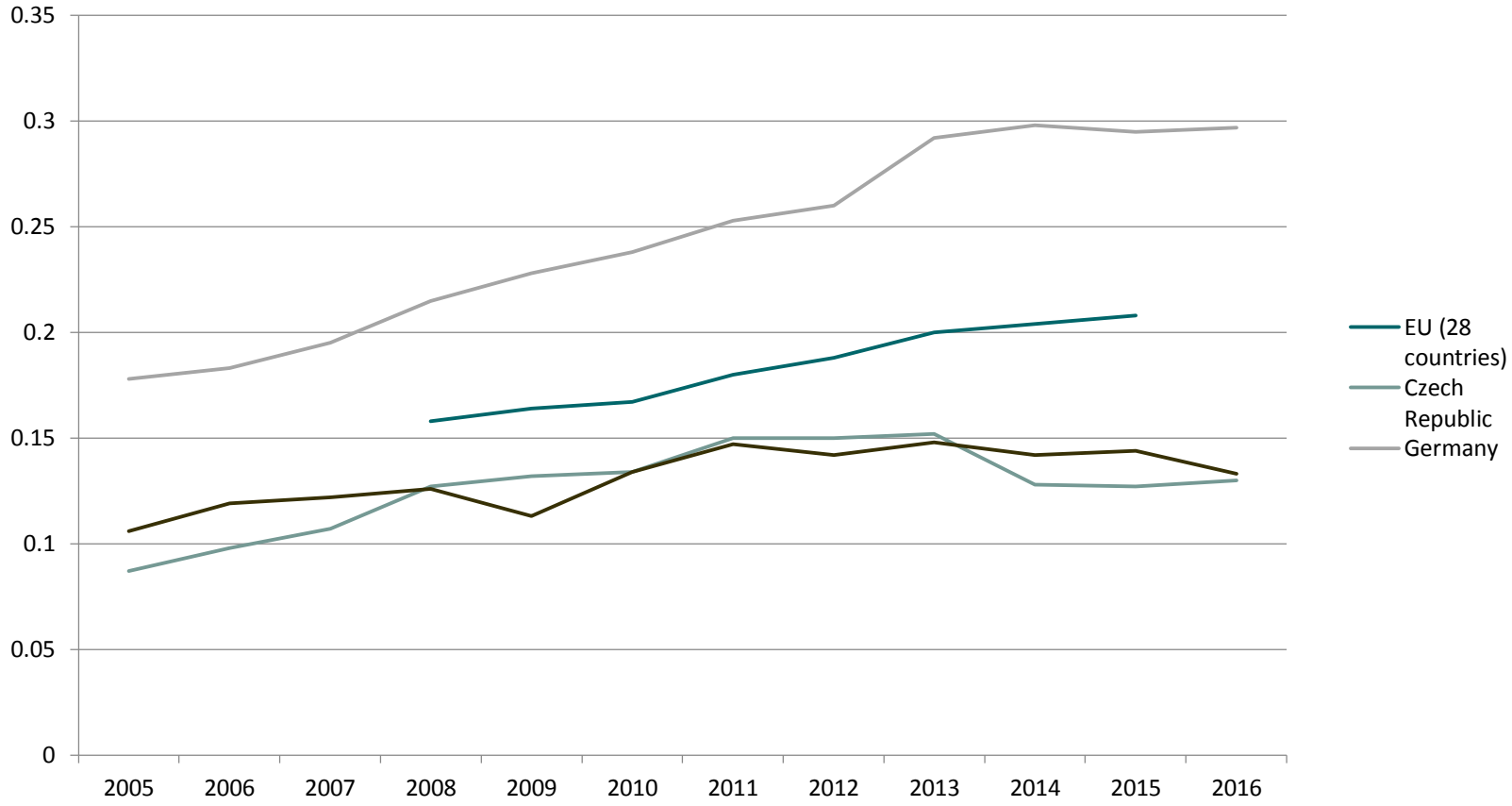
Electricity prices – medium size households (eur/kWh)



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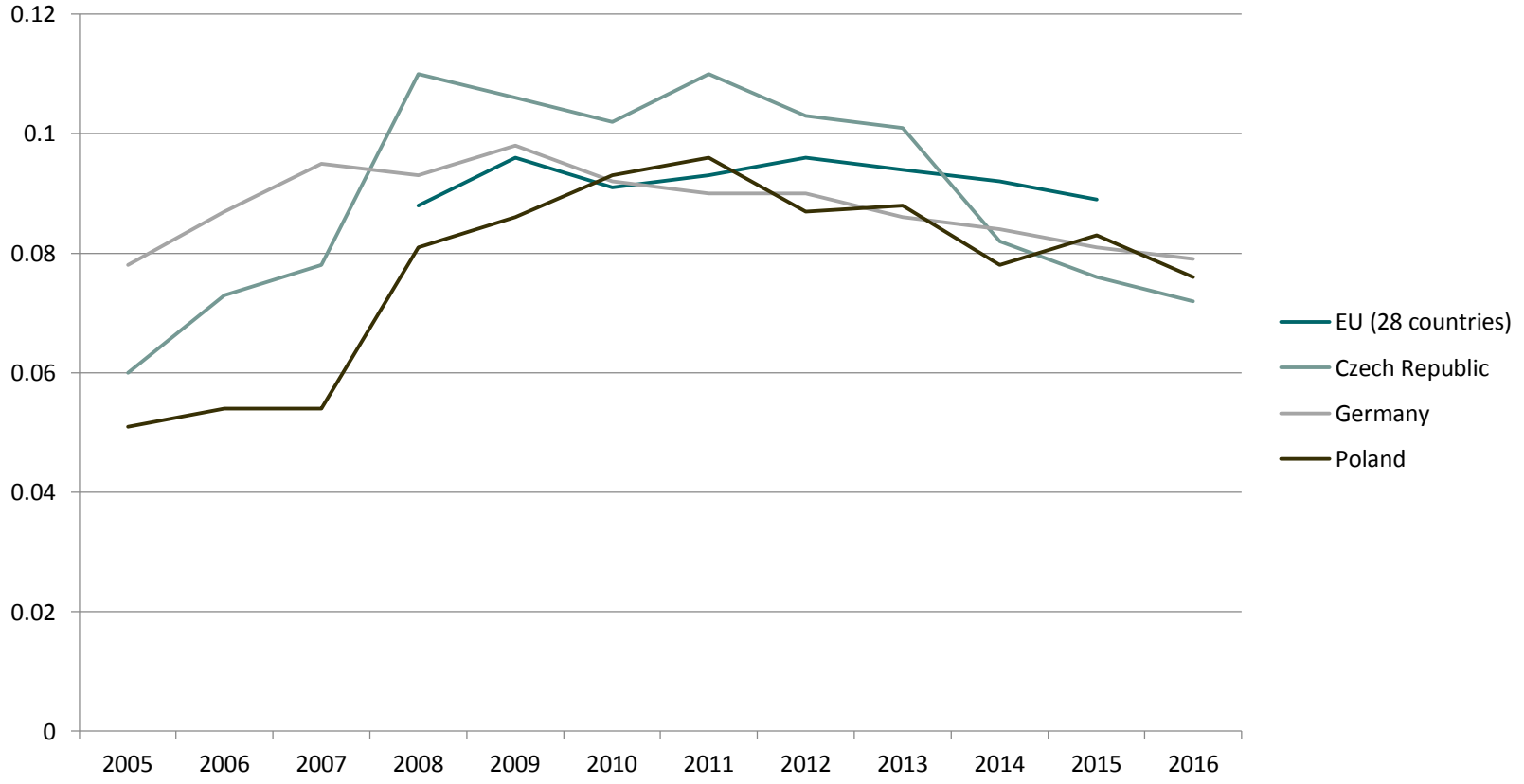
Electricity prices – medium size industries (eur/kWh)



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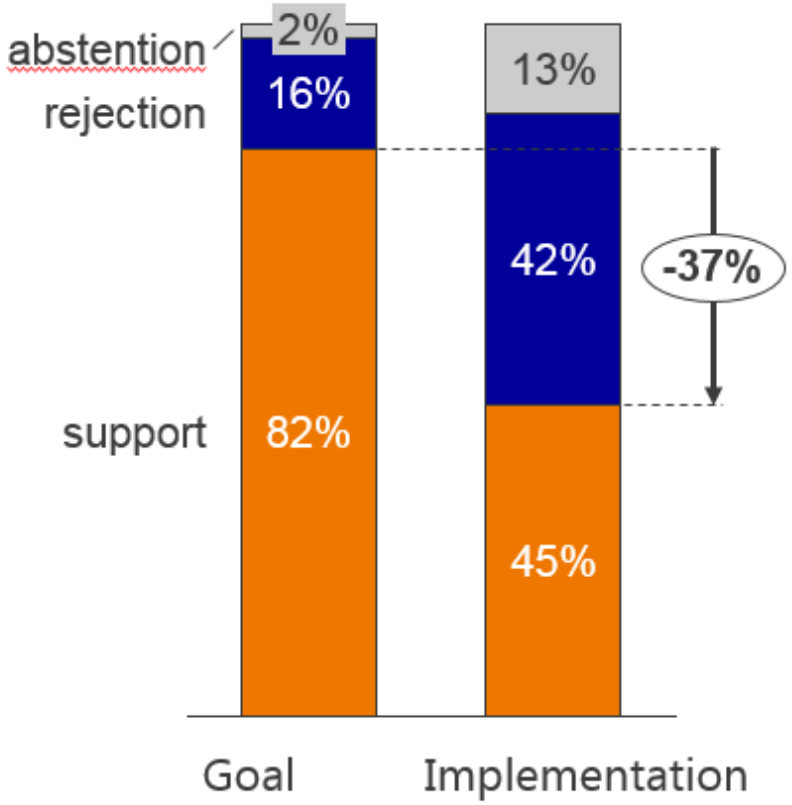
Reform of EEG in 2014

- 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.

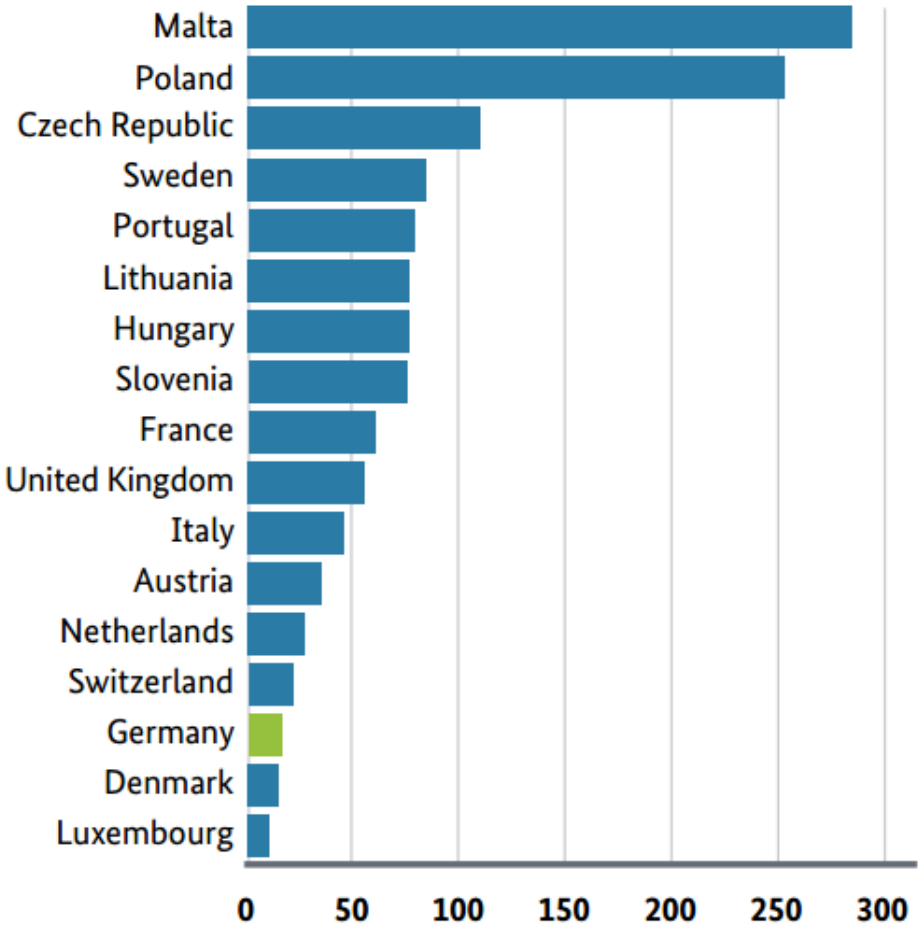
Q: Are you satisfied with goals and implementation of EW?



Quelle: Forsa (2013)

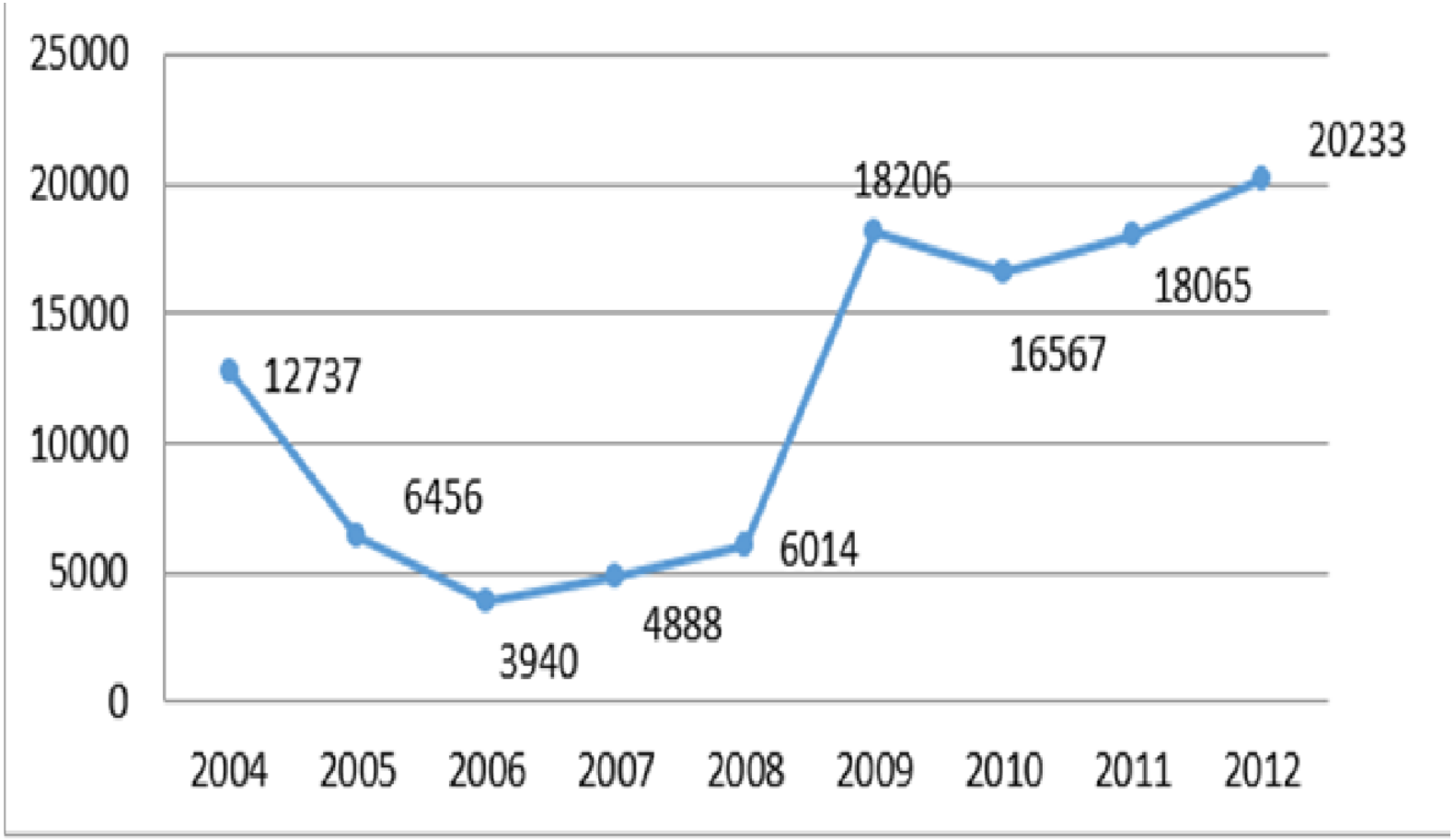
3) Stability of the grid

Unschedulled 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 enegy	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

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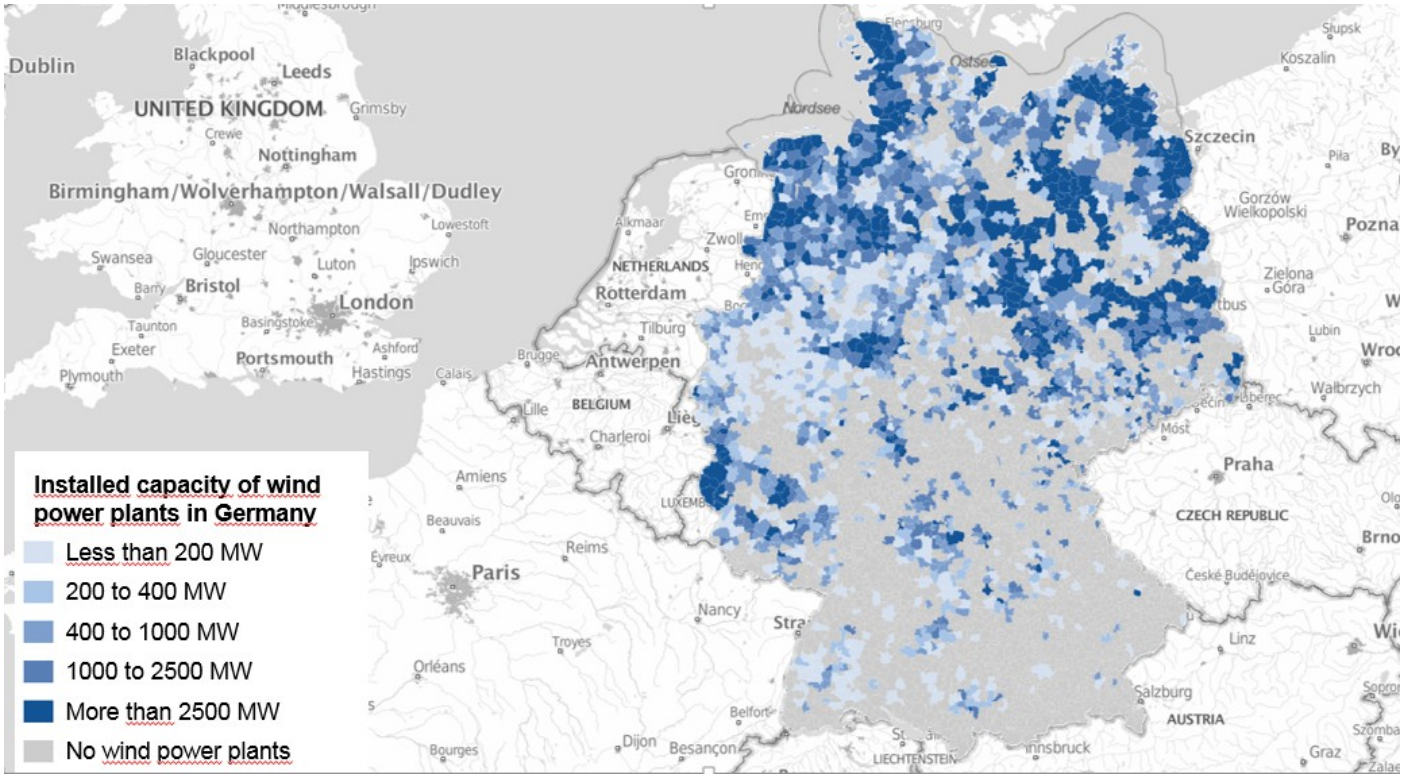
4) Grid capacity

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



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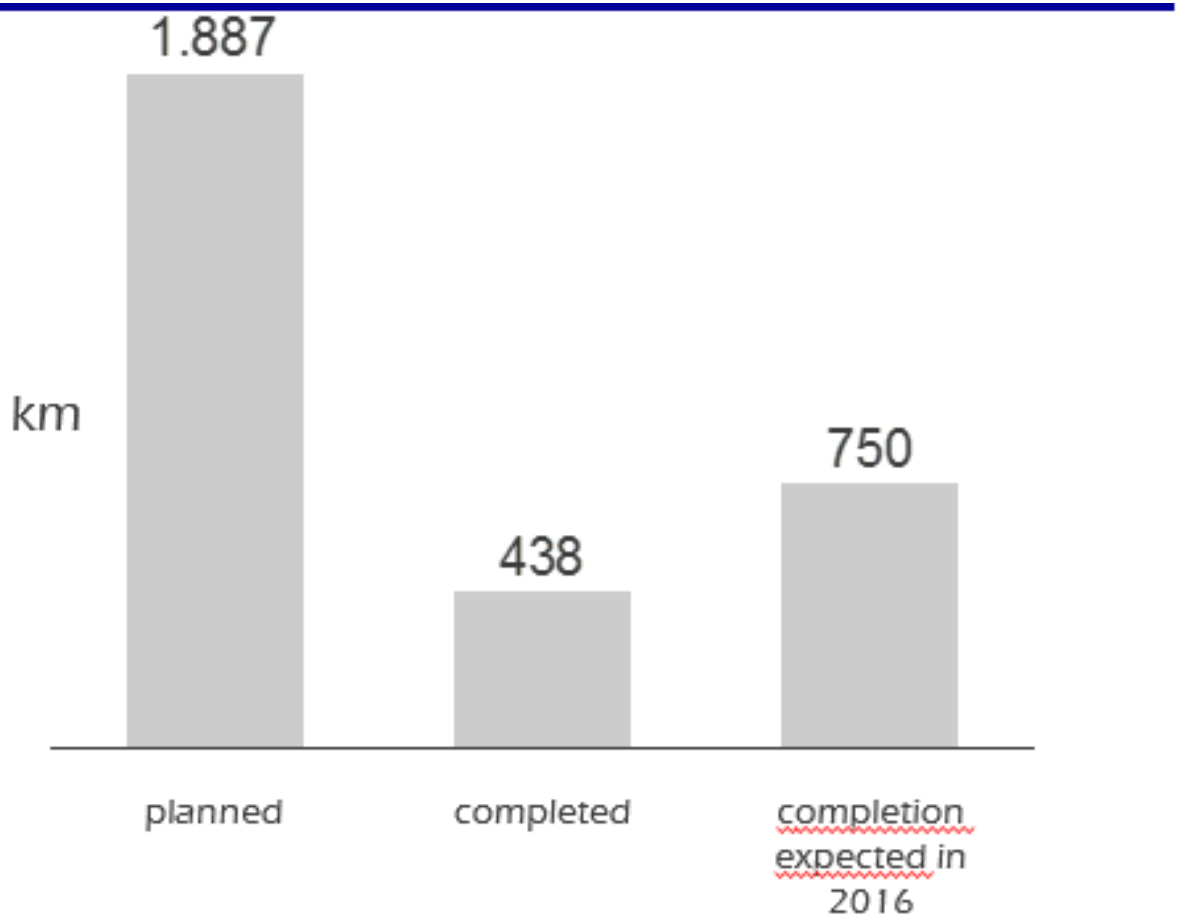
Building of the grid

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



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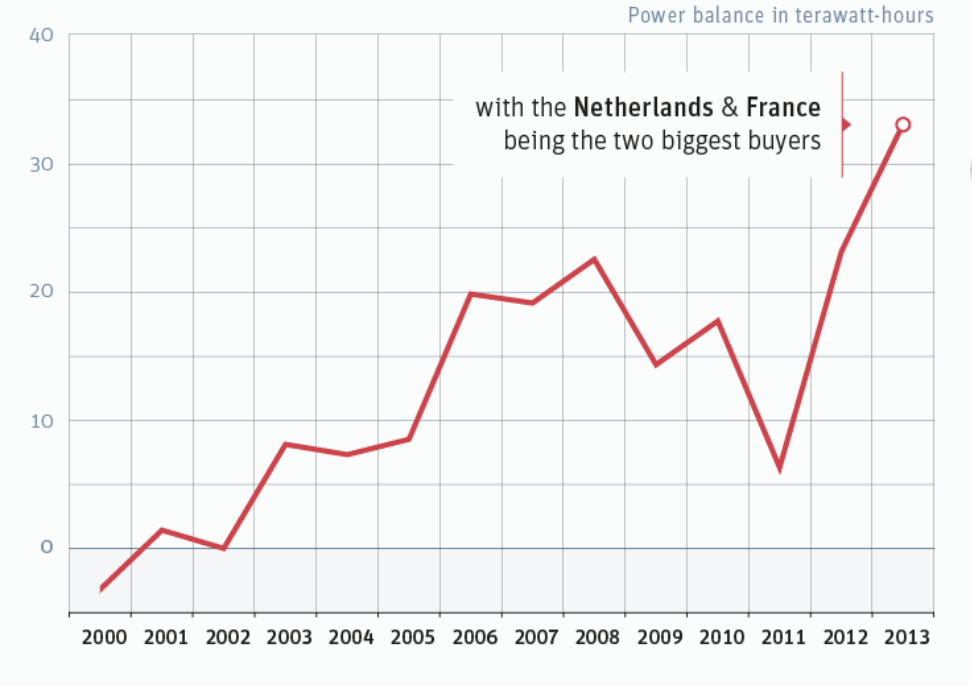
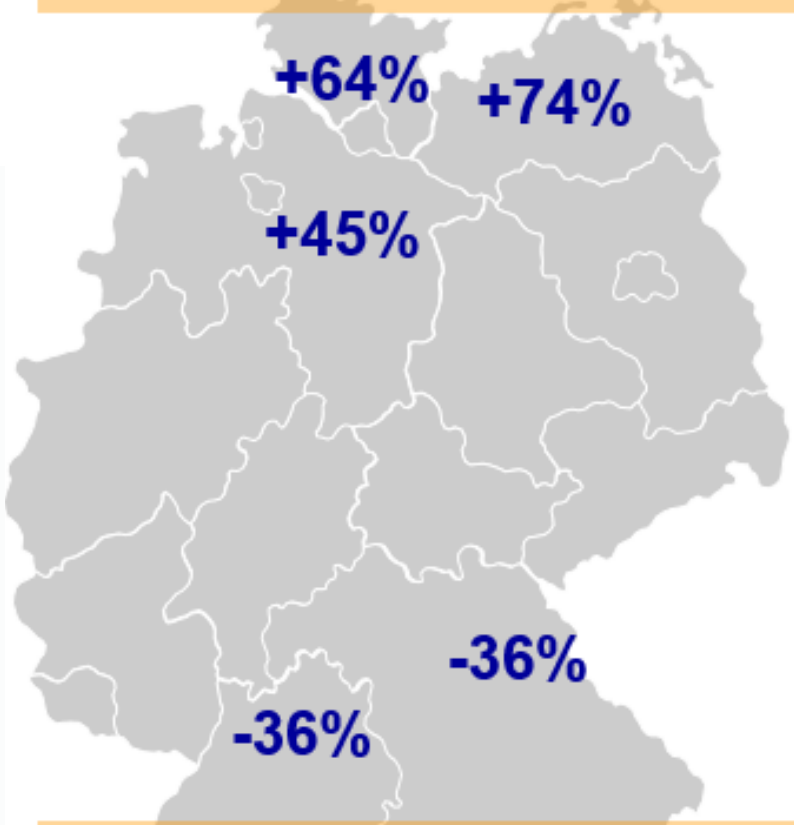
German power exports continue to rise

Net power exports from 2000–2013 in TWh.

Source: Agora Energiewende, AGEB

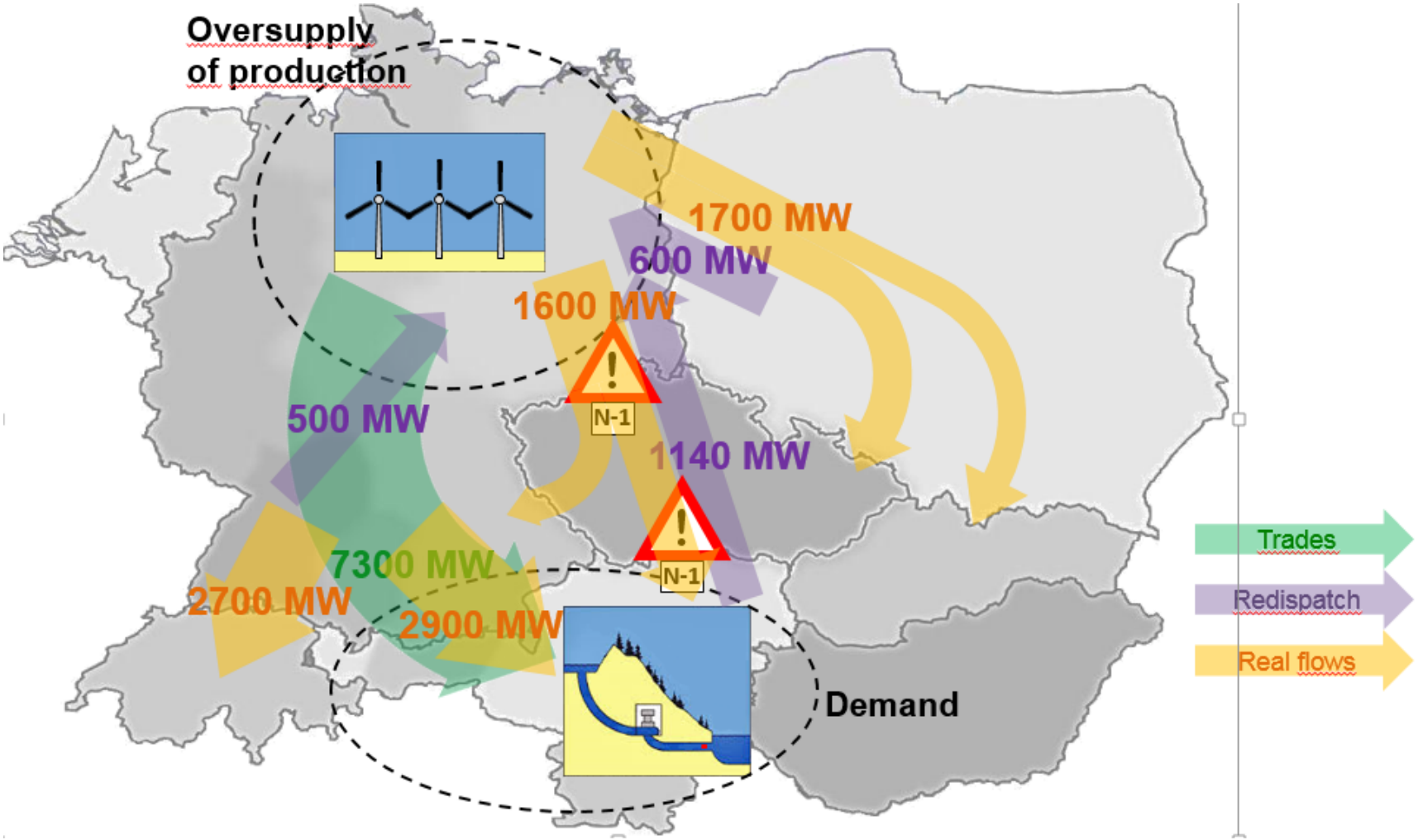


Surplus energy quantities in the North (Wind feed-in)



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

Trades and flow of electricity 2014/2015



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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 funciton of networks exceed the savings from lower commodity prices (= higher costs for society). But competitivenes of RES have been changing.

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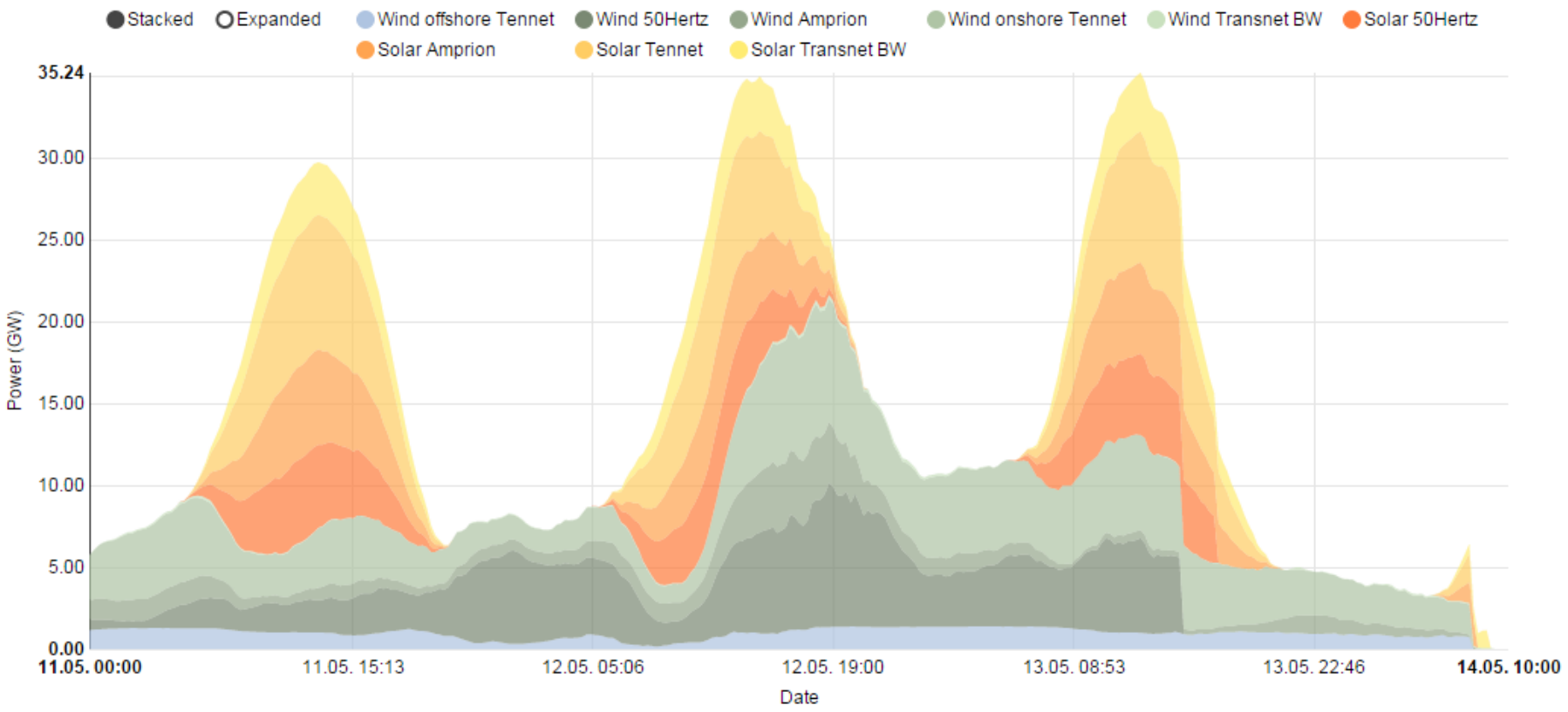
Solar + wind production in Germany in week 20 2015



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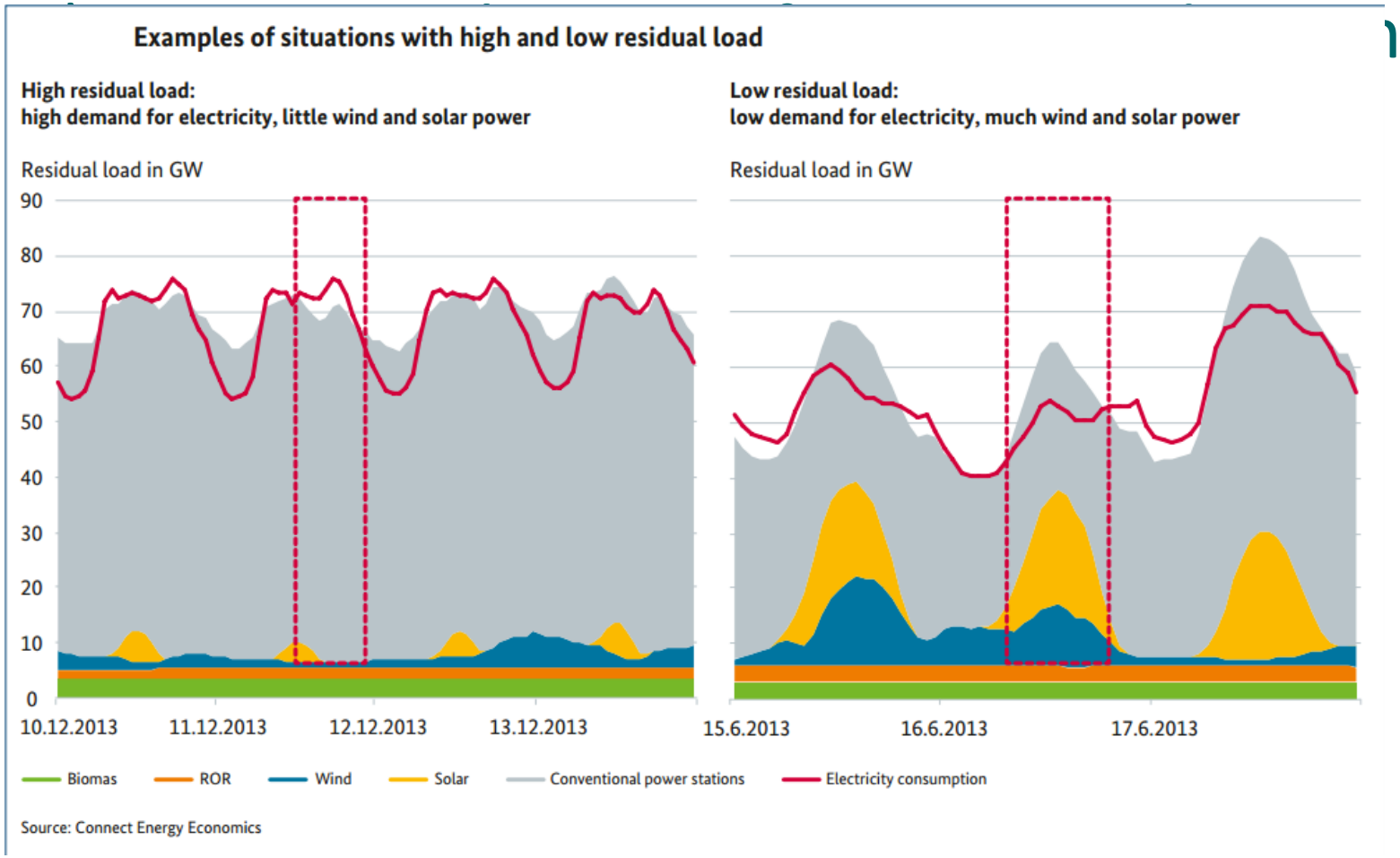

Source: BMWi, Green paper

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Impact of EW on neighbouring countries

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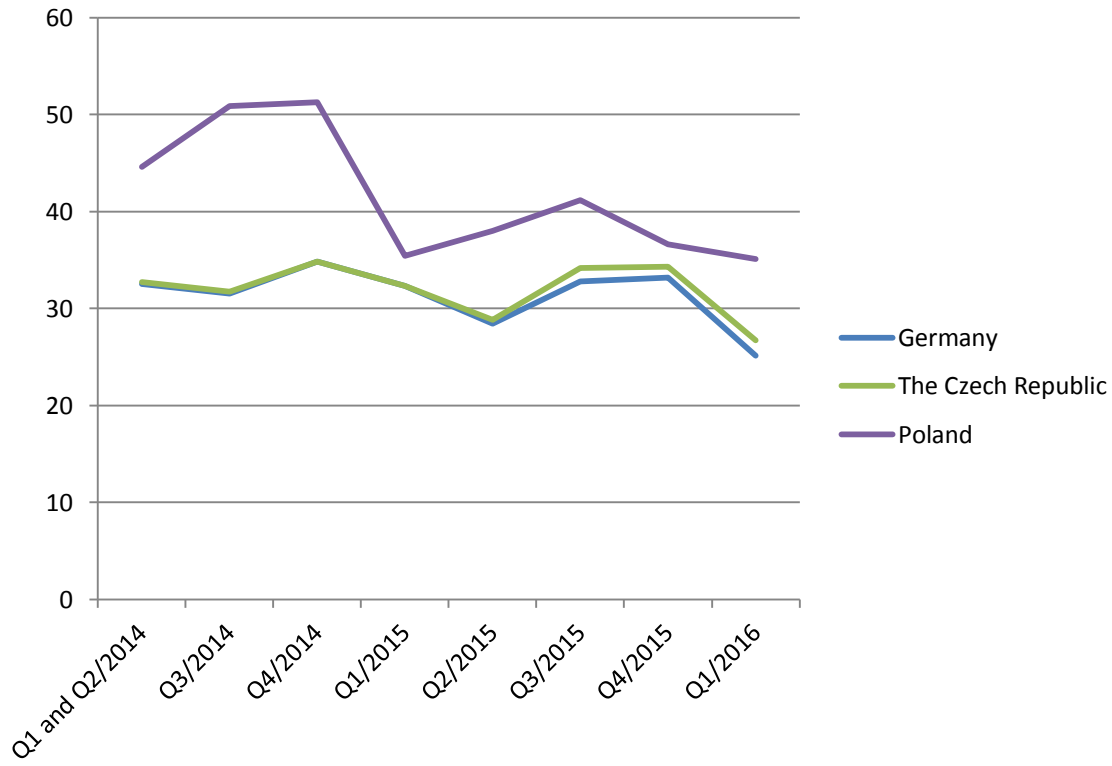
Impact of EW on neighbouring countries

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



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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 %).

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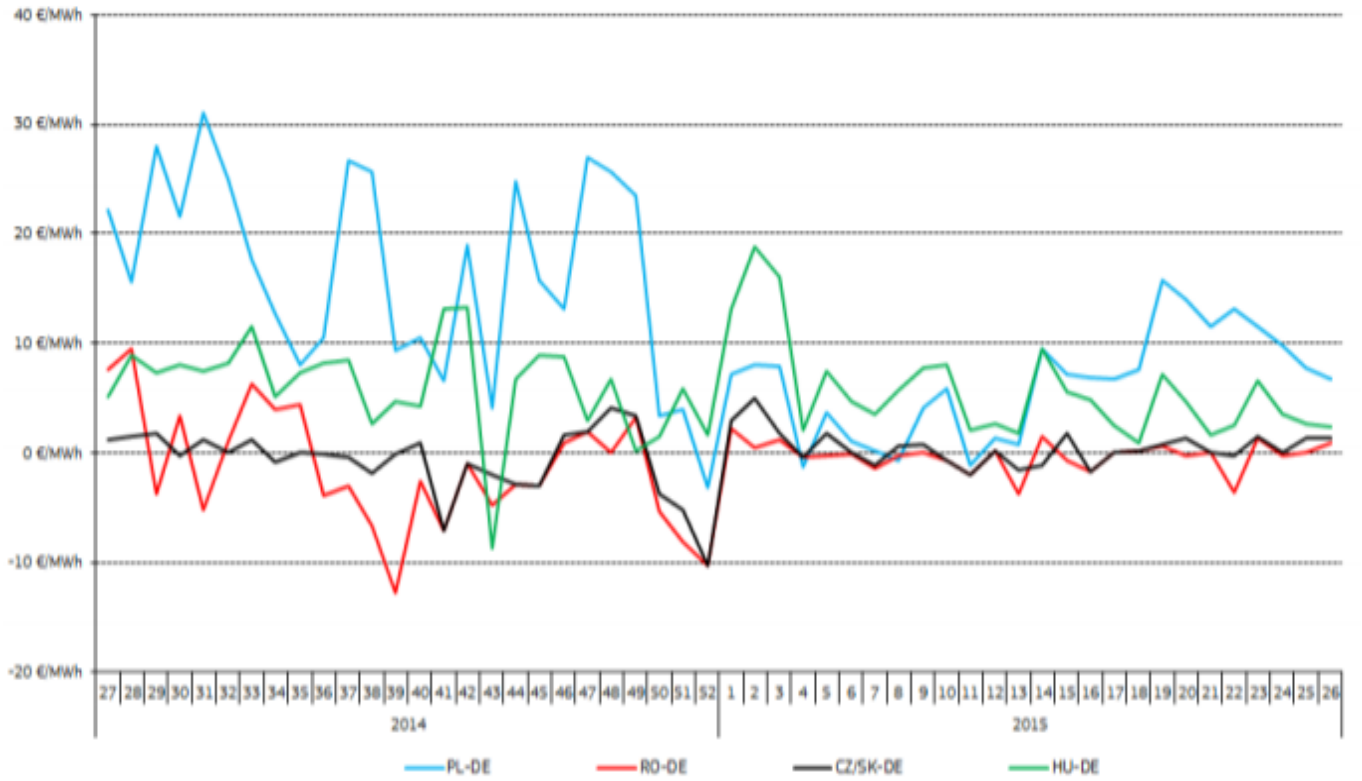
Czech Republic - consumers

- Profit from Energiewende – import of cheaper electricity.



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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 depletition of deposits, low productivity, low global prices).
- Production is not competitive – saved only by restricted imports.

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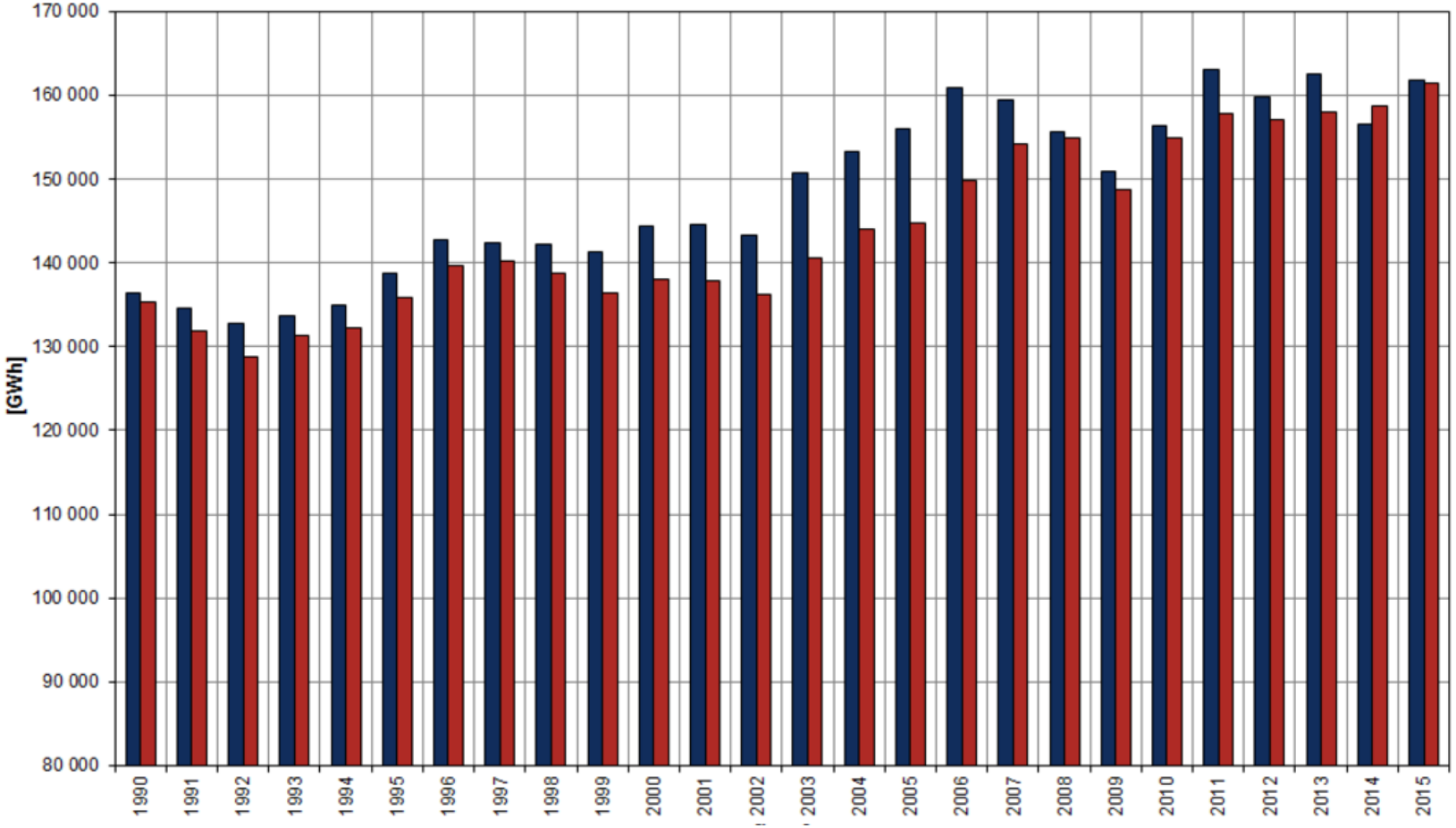
Production and consumption of energy, 1990 - 2015



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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).

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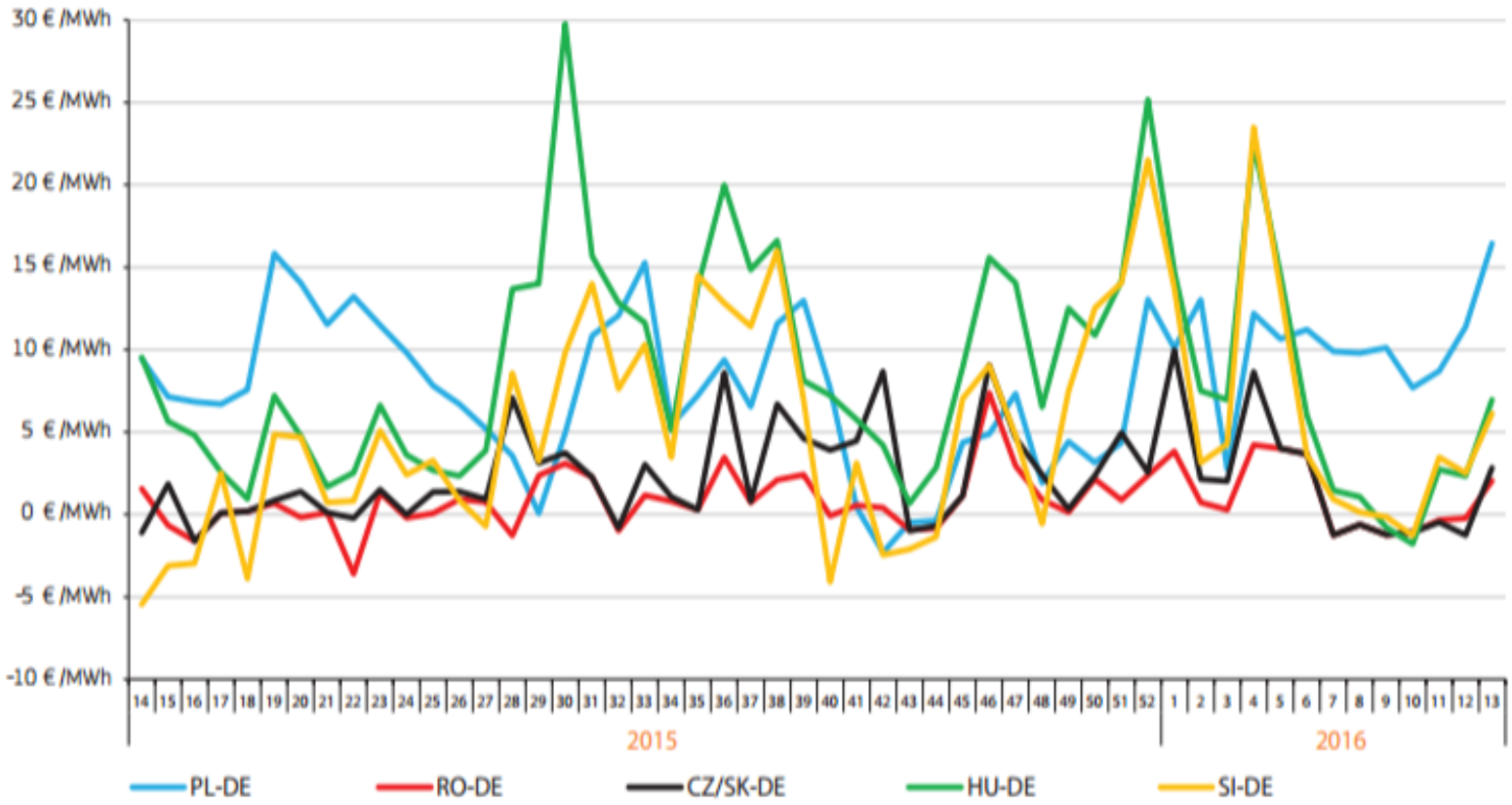
Regional weekly baseload price premiums or discounts to the German market, 3-4Q 2015



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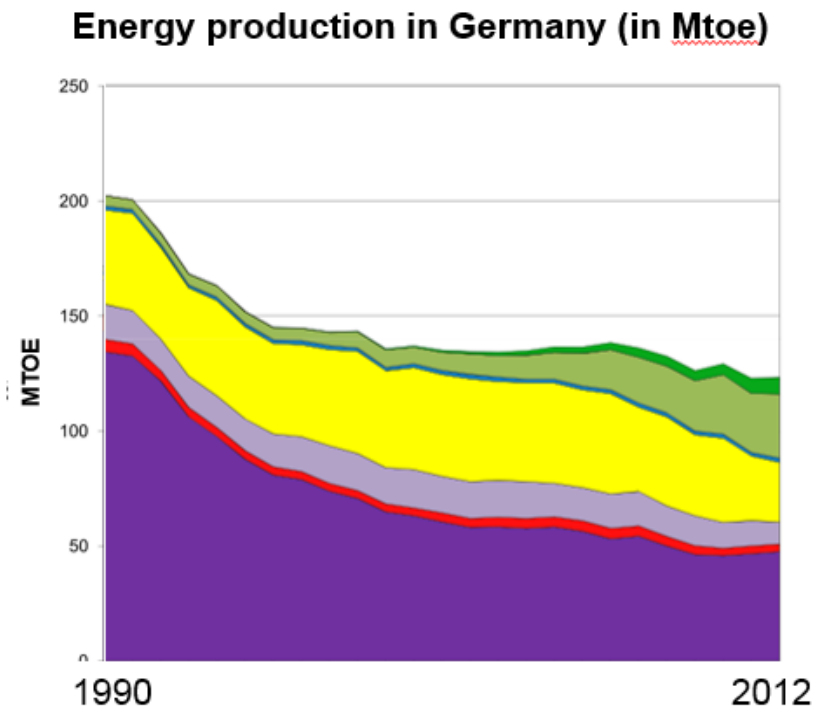
Poland – government

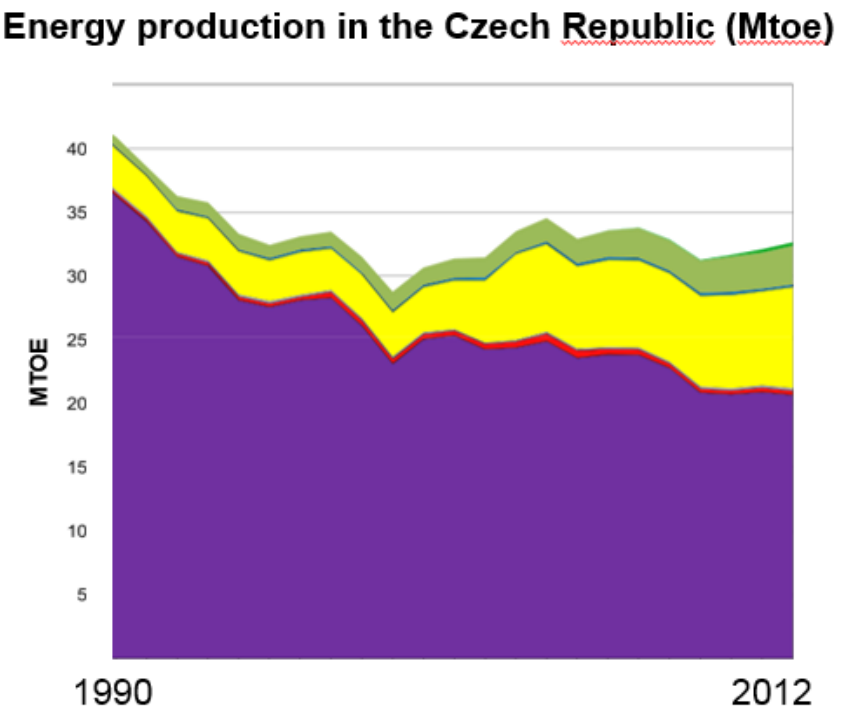
- Strong position in the sector, justified primarily by security of supply concerns.
- Emphasis on coal – for security and social reasons.
- Achieving multiple governmental goals (dominant role of the coal in the system, its economic sustainability, participation on IEM, compliance to the EU energy and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

Sources

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

Energy supply in Germany and Czech Rep.





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

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