

# German energy transition - Energiewende

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# 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

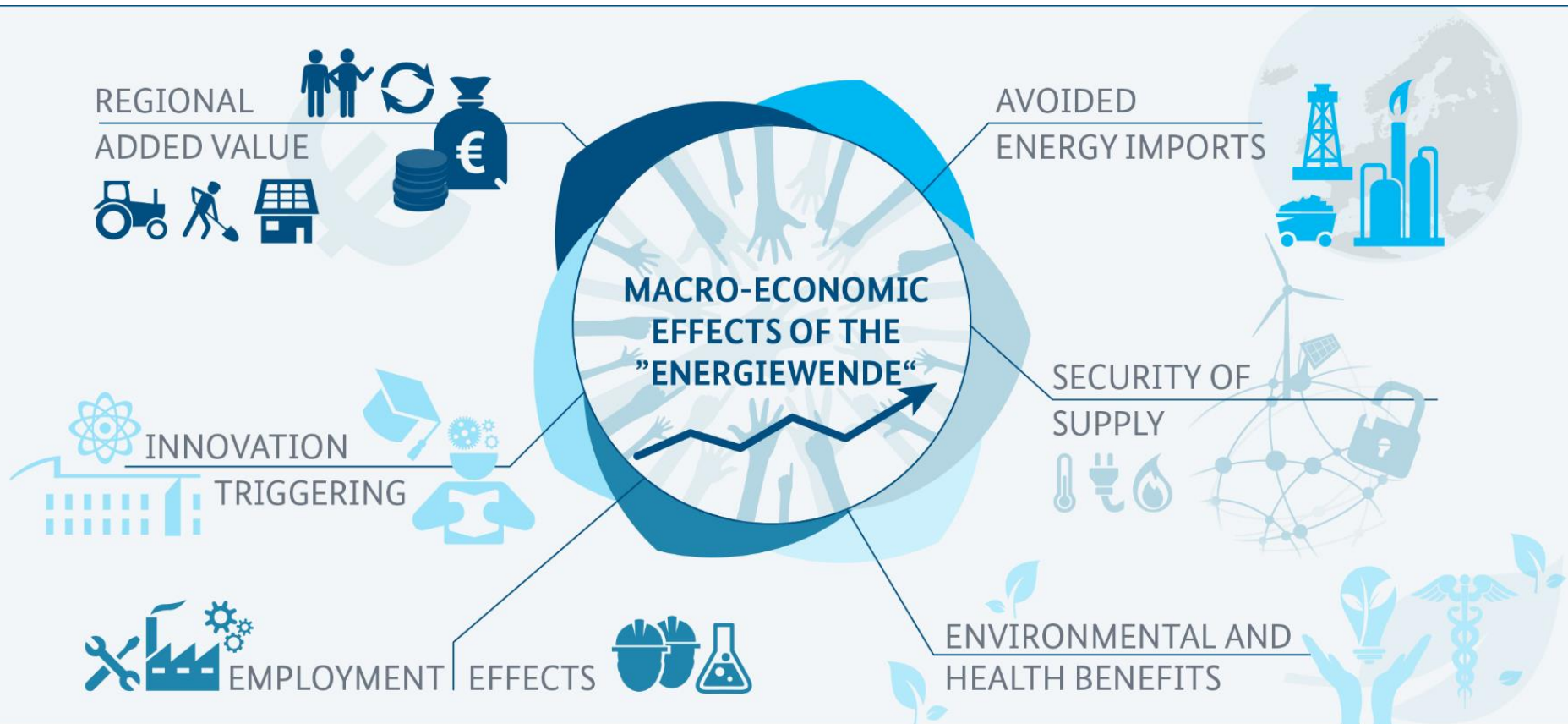
## 2nd pillar: climate protection measures

- 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 energy efficiency.
- 2010 – Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply ->Energiewende

# Targets of the EW

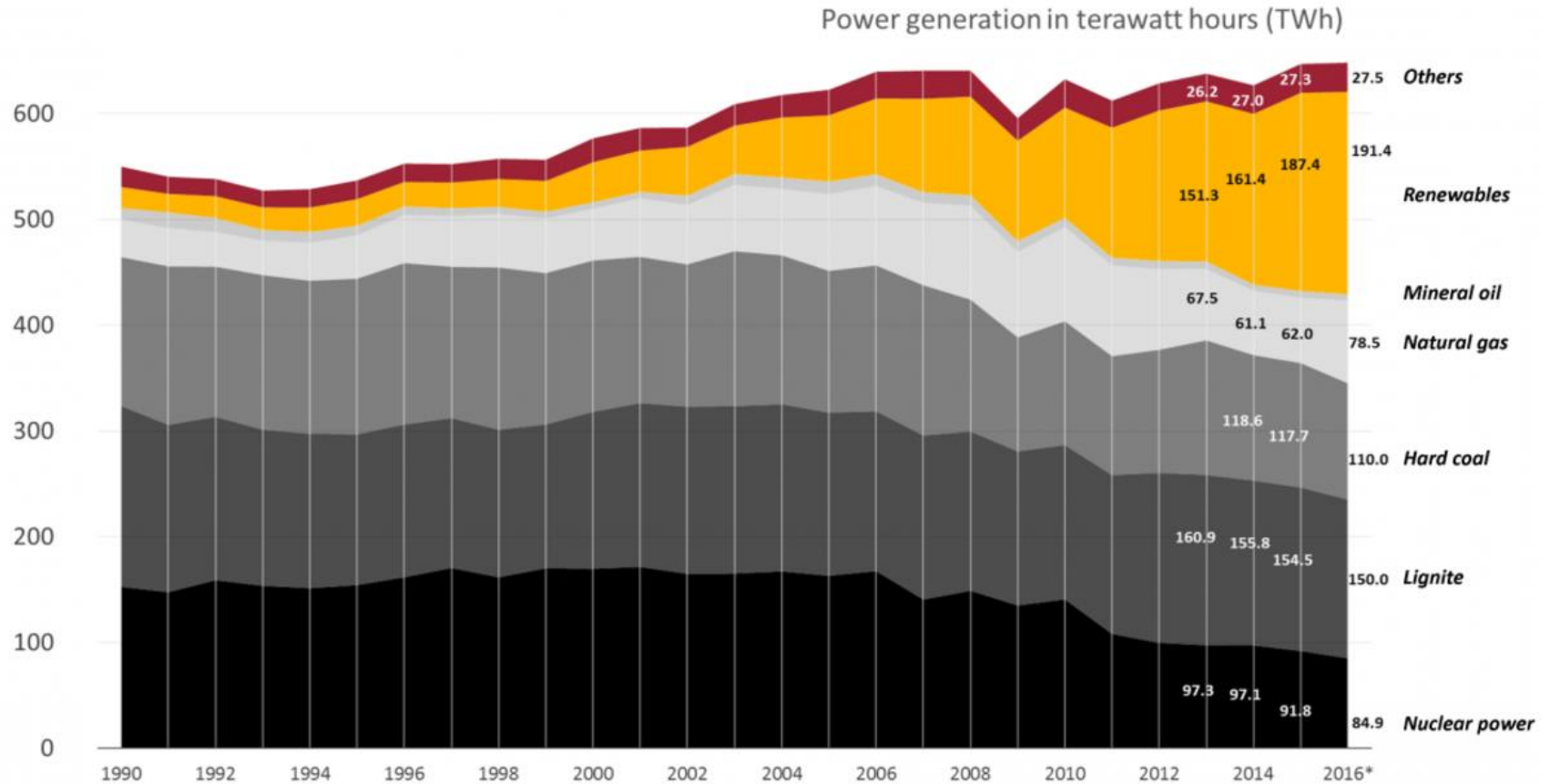
Target/Year	2015*	2020	2030	2040	2050
Decrease in GHG emissions (compared to 1990 levels)	27.2%	40% +	55% +	70% +	80% +
Share of RES in gross final energy consumption	14.9%	18%	30%	45%	60%
Share of RES in gross electricity consumption	31.6%	35% +	50% +	65% +	80% +
Decrease in primary energy consumption (~2008)	7.6%	20%	-	-	50%
Increase in final energy productivity (per year)	1.3%	2.1%	2.1%	2.1%	2.1%
Decrease in gross electricity consumption (~2008)	4.0%	10%	-	-	25%
Decrease in primary energy consumption in buildings (~2008)	15.9%	-	-	-	80%
Decrease in final energy consumption in transportation (~2008)	1.3%	10%			40%

# Declared benefits of the Energiewende

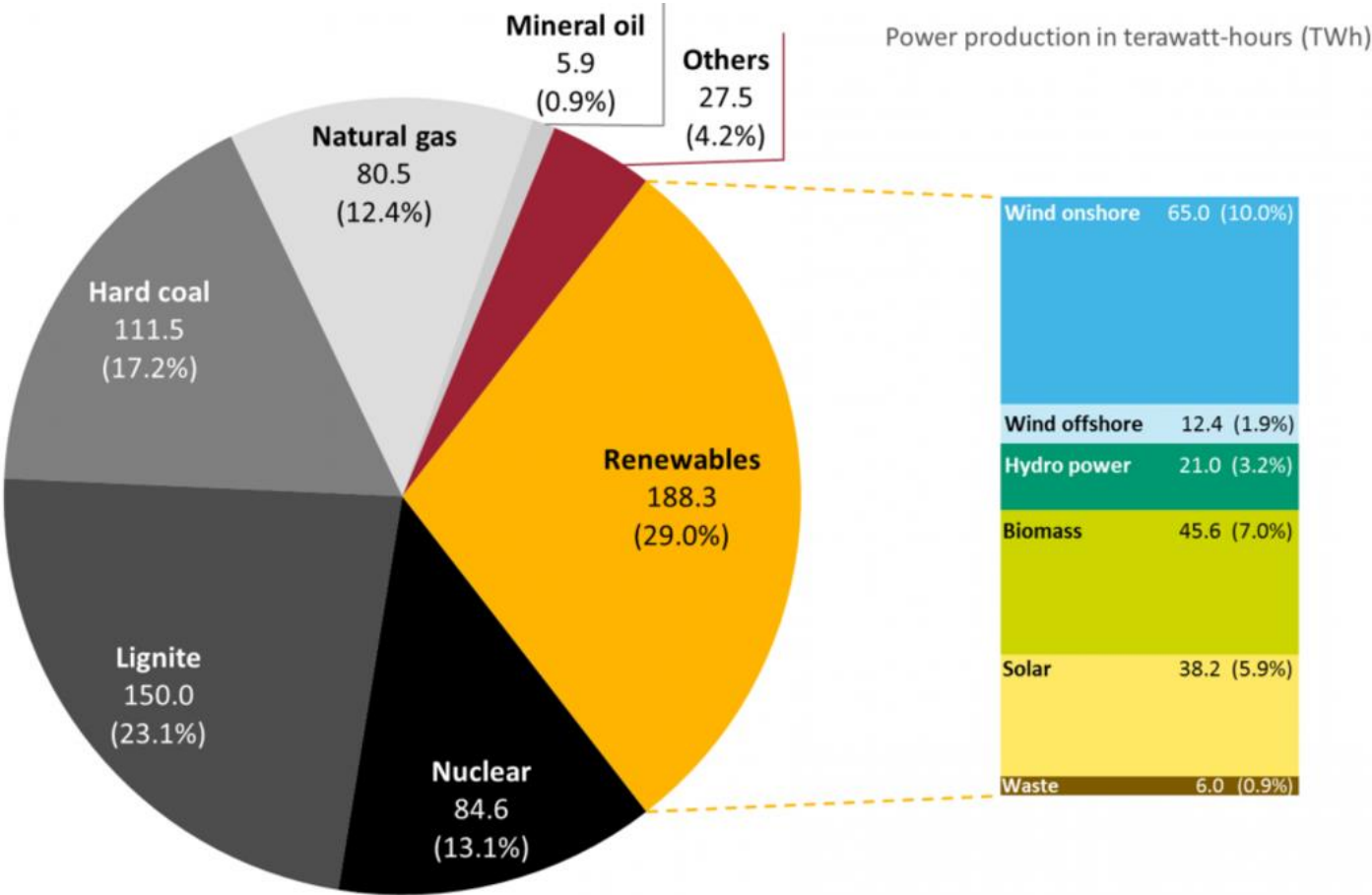


# Performance of German energy sector

# Gross power production in Germany 1990 – 2016 by source, in TWh

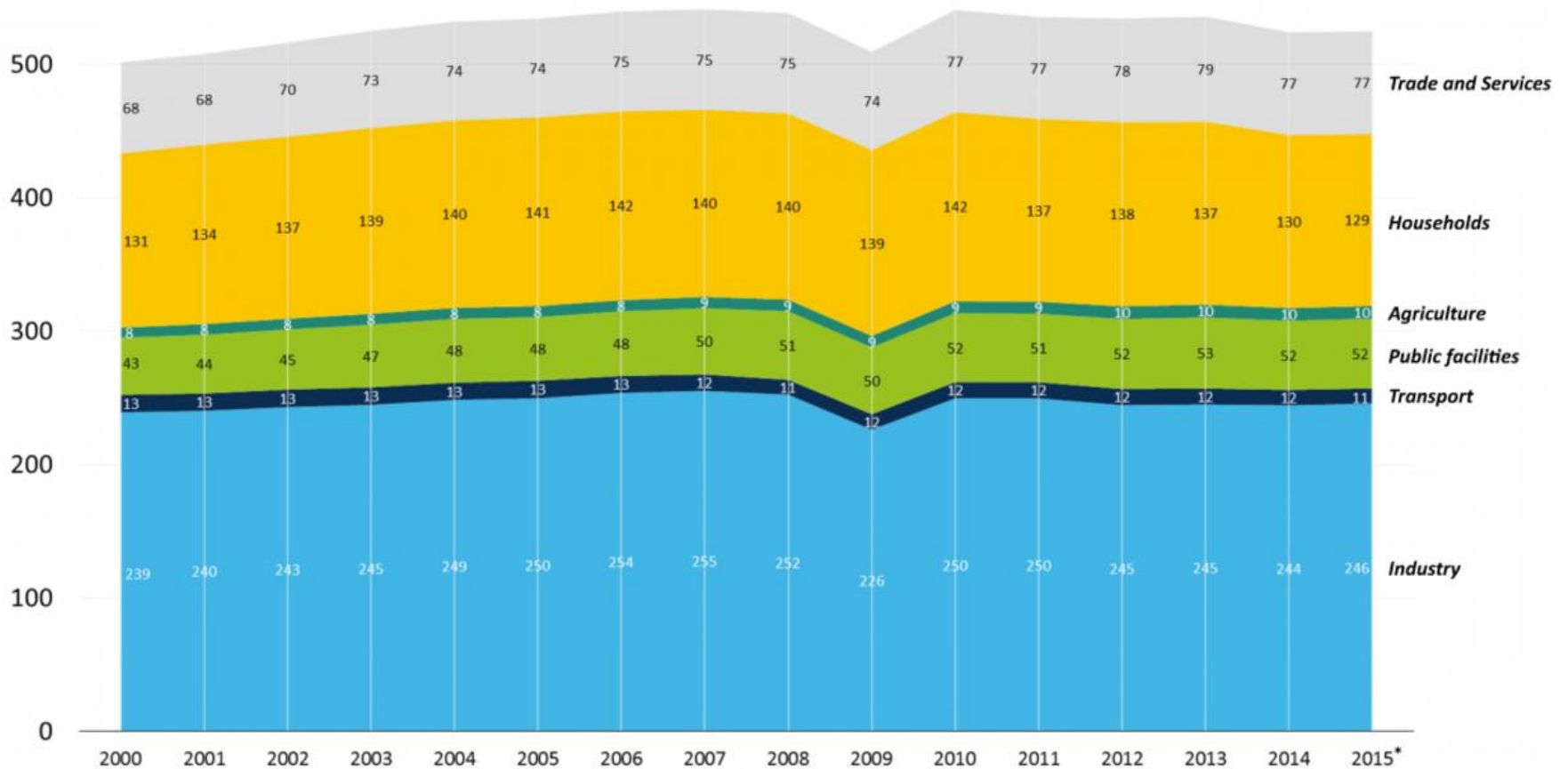


# Share of energy sources in gross power production in 2016 (preliminary data)





# Net power consumption by consumer group 2000 - 2015

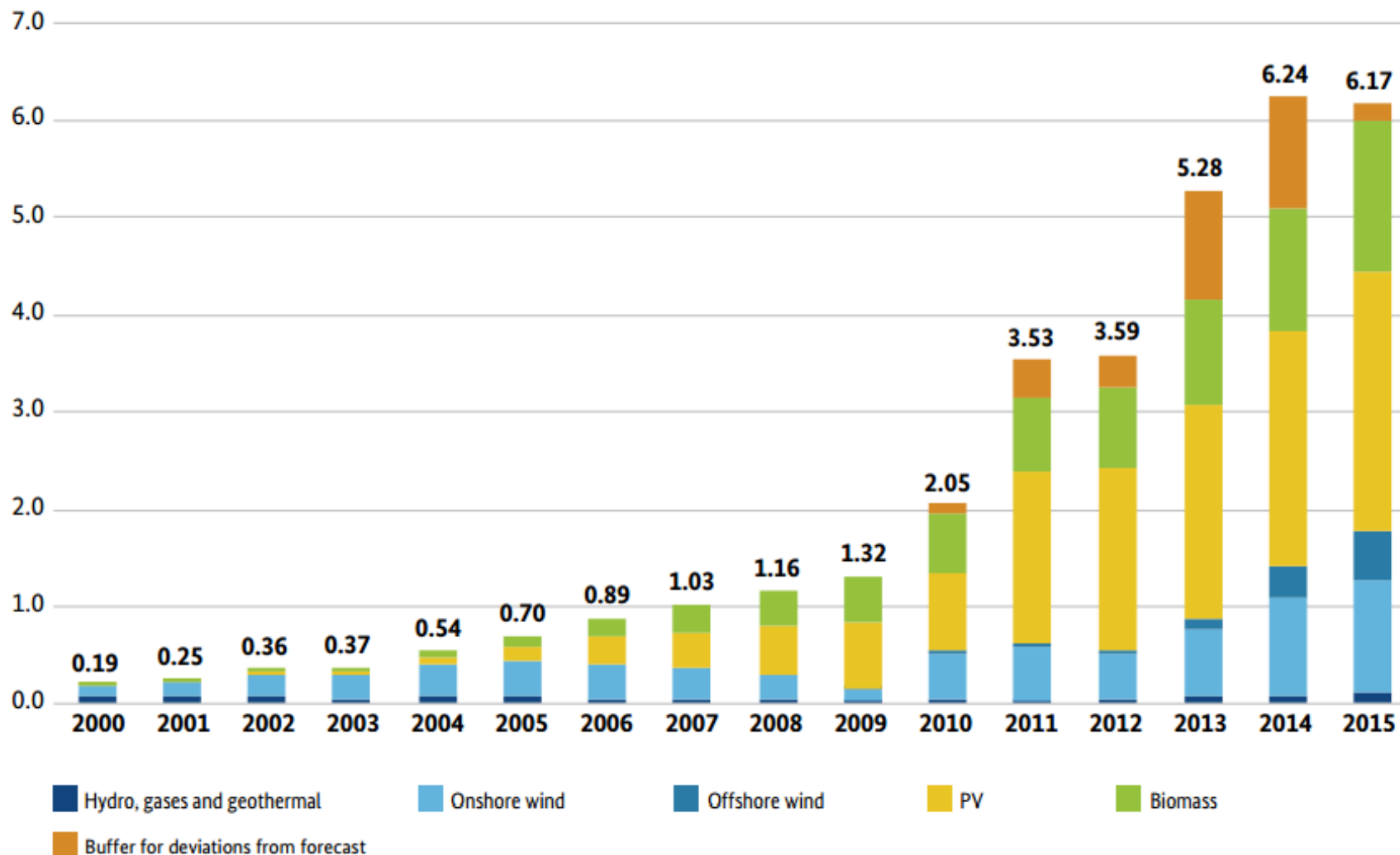


# Major challenges

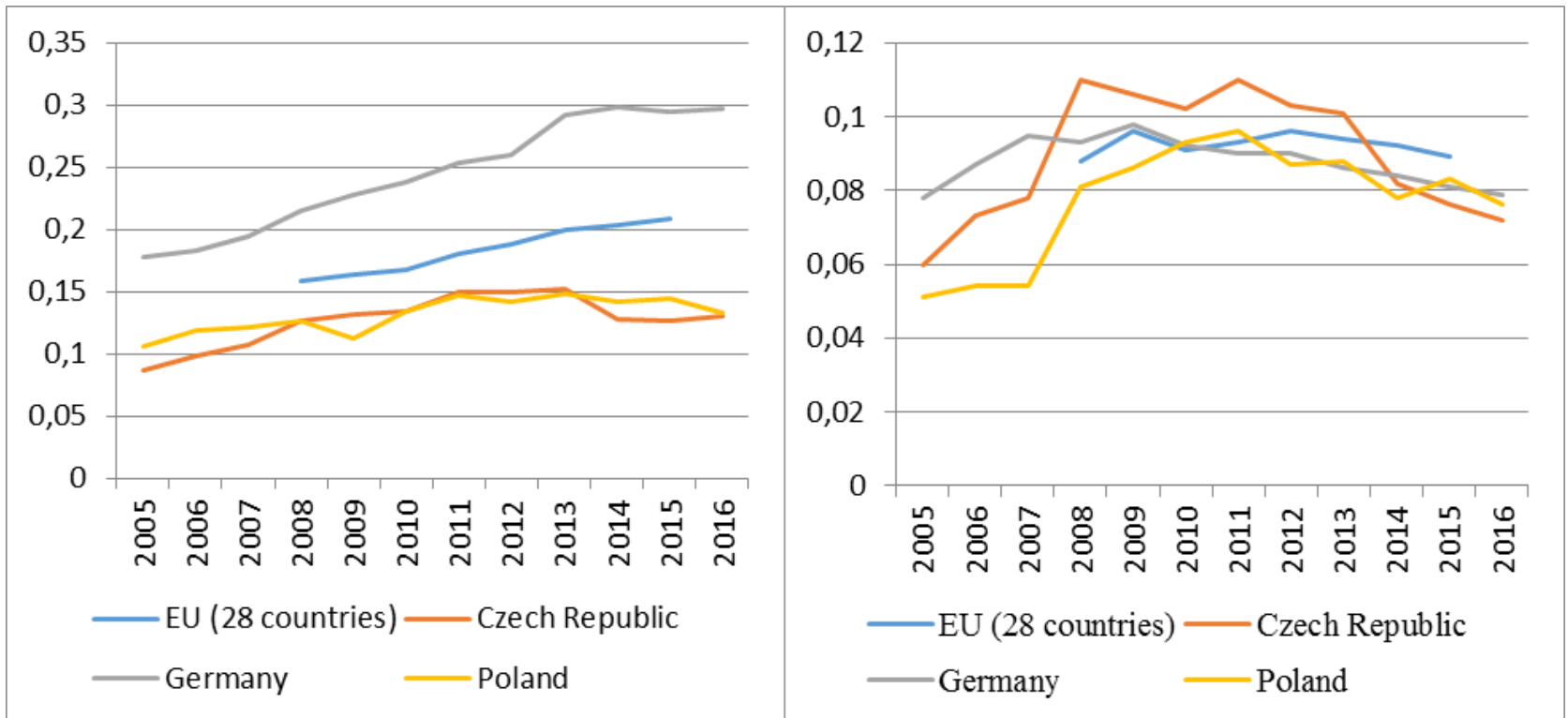
# 1) Costs of EW

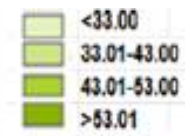
- €550 bn. until 2050 (yearly investments €15bn., or 0,5% of GDP respectively)
  - Costs of Atomausstieg
  - RES surcharges
  - Grid investments and management
  - Additional activities
- Wholesale prices of electricity among the lowest in the EU (this reinforces the competitiveness of industry)
- Households pay one of the highest prices in the EU (regulated component of prices)
- Cost unevenly distributed. Paid mainly by households, companies exempted to some extent.

# EEG surcharge in c/kWh



# Electricity prices: medium-sized households and medium-sized industries (€/kWh)





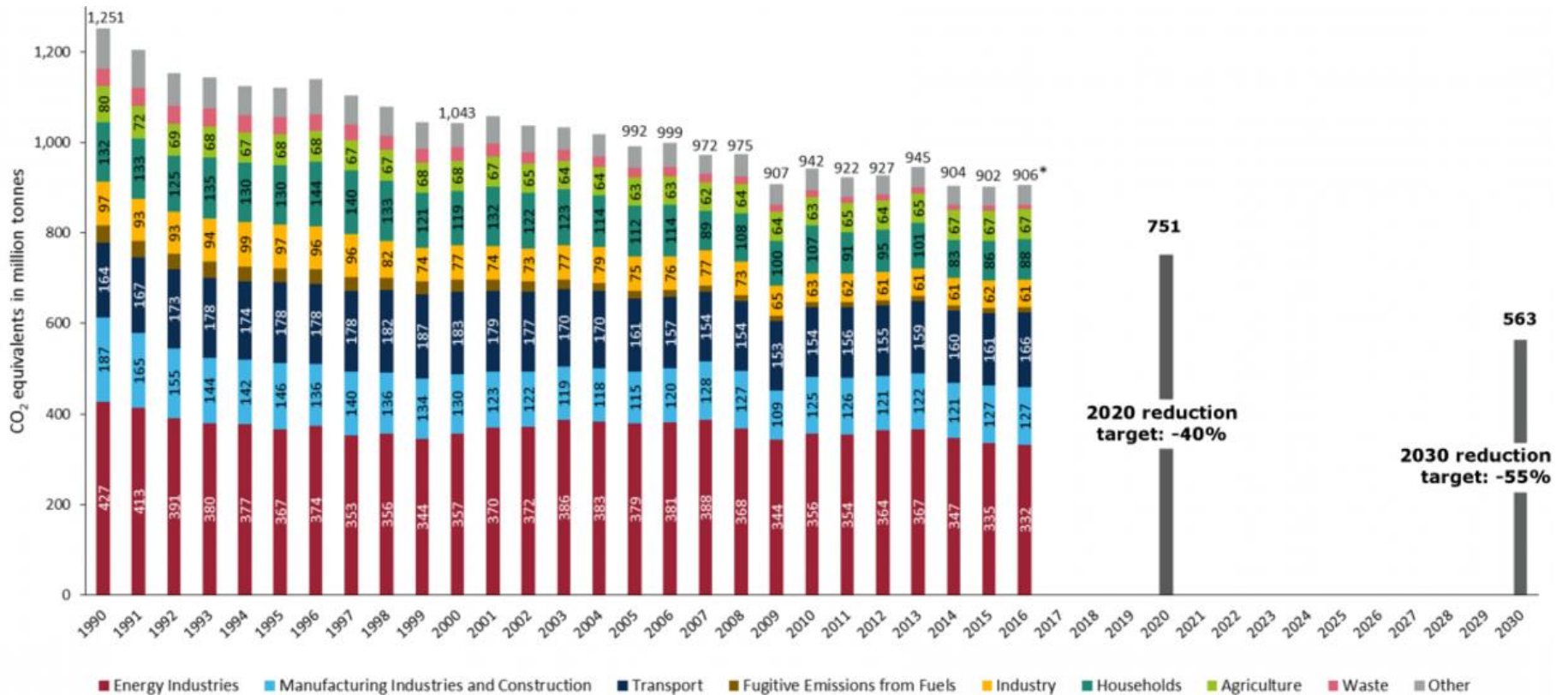
MT: No Data  
Malta

CY: No Data  
Cyprus

## 2) Coal consumption and CO<sub>2</sub> emissions

- 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 CO<sub>2</sub> has been flat/increasing slowly

# Greenhouse gas emission trends in Germany by sector 1990 - 2016



\*First estimates by UBA  
Without emissions from land use, land-use change and forestry (LULUCF)

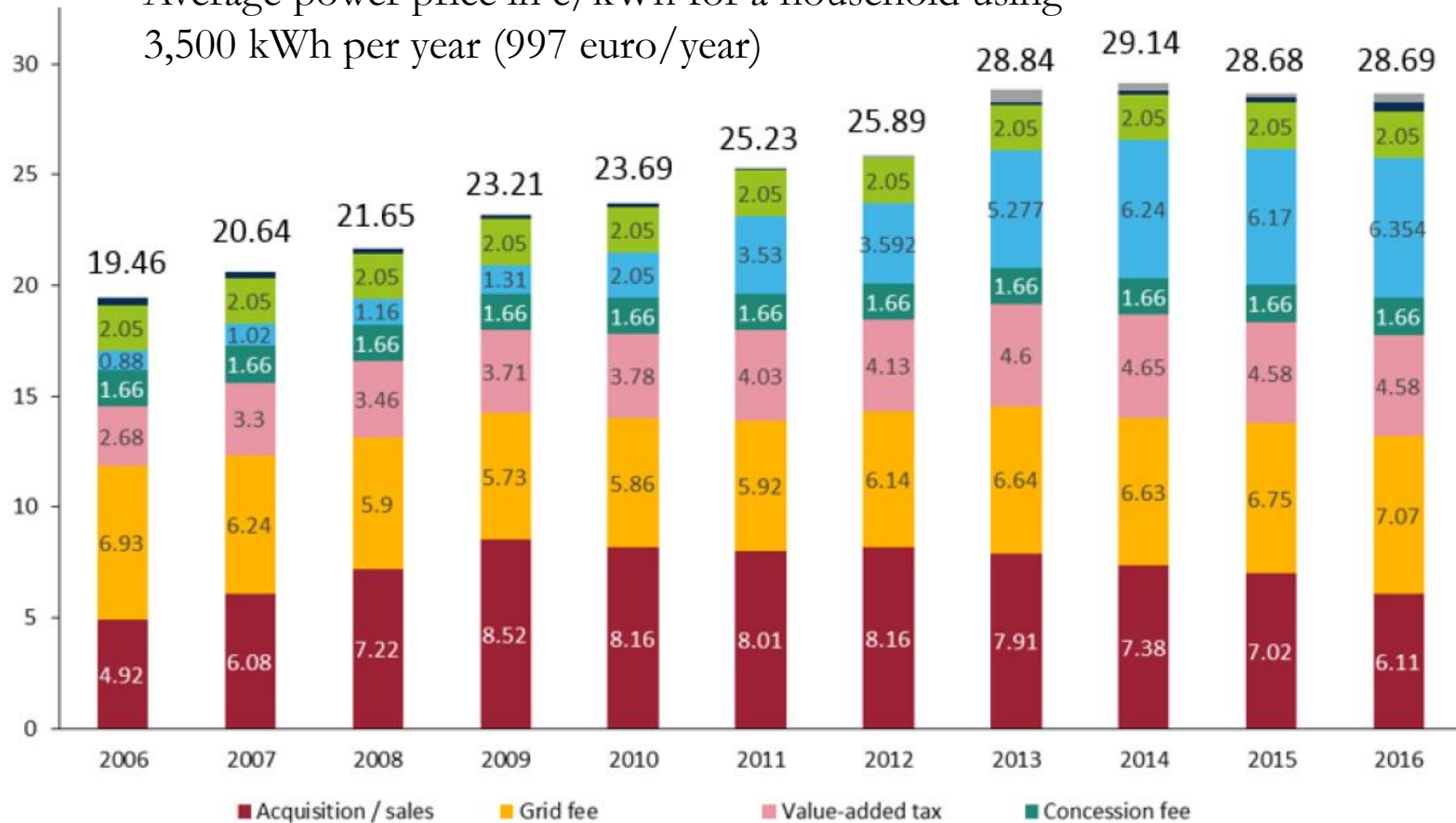


### 3) Public support of EW

- 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

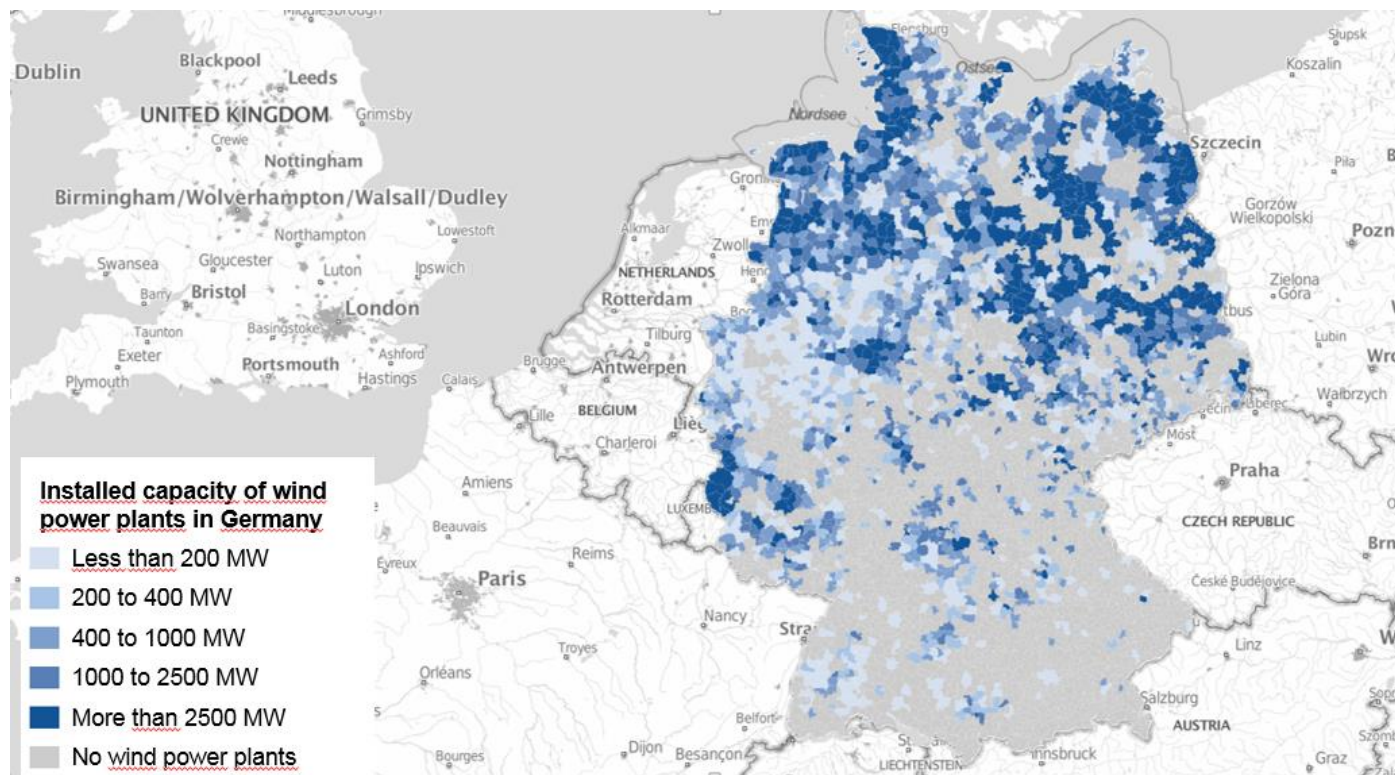
### 3) Public support of EW

Average power price in c/kWh for a household using 3,500 kWh per year (997 euro/year)



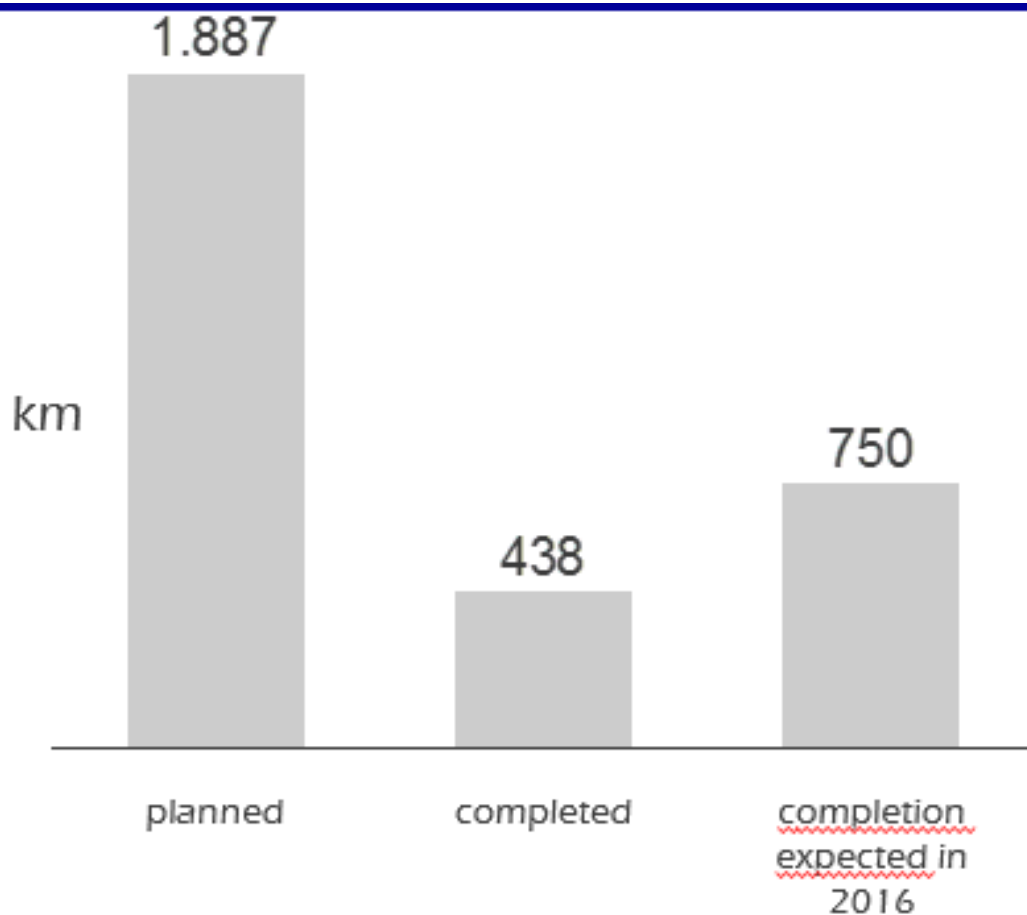
## 4) Grid capacity

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

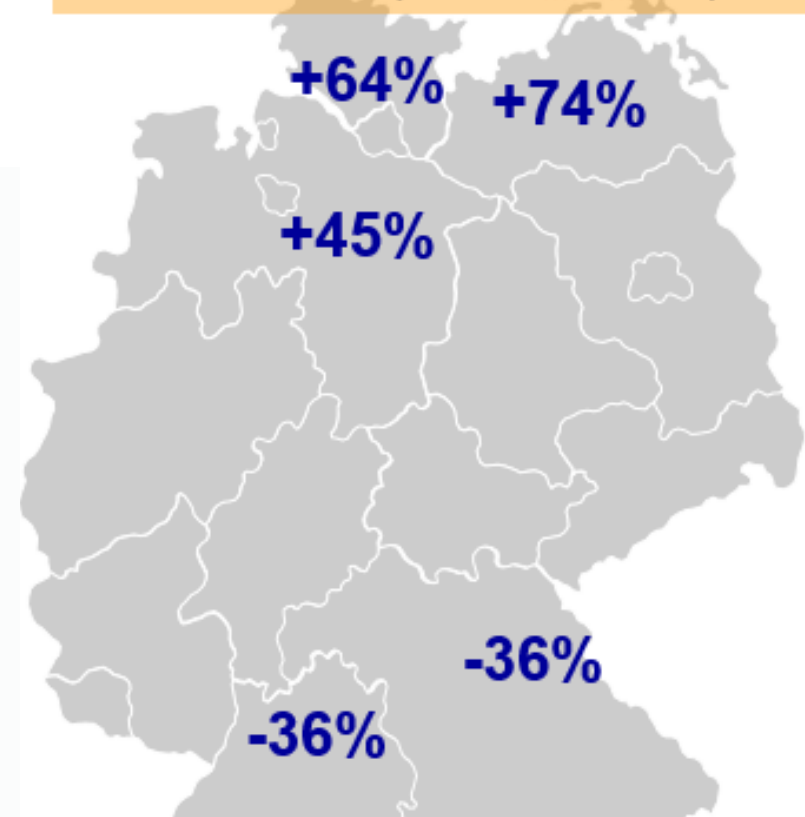


# Building of the grid

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



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

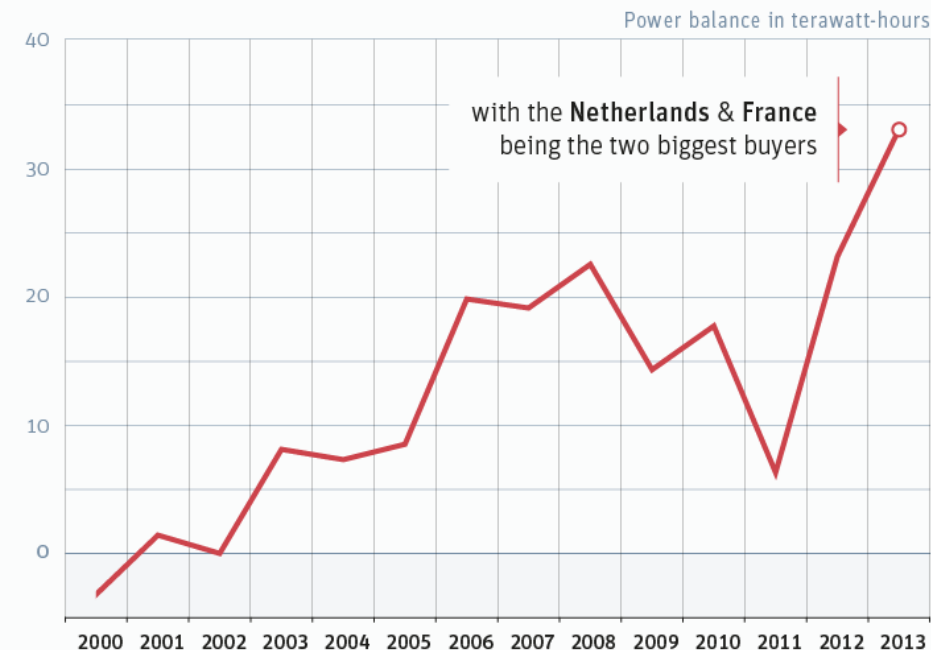


Lack of regional energy generation in the South (internal 'imports' needed)

## German power exports continue to rise

Net power exports from 2000–2013 in TWh.

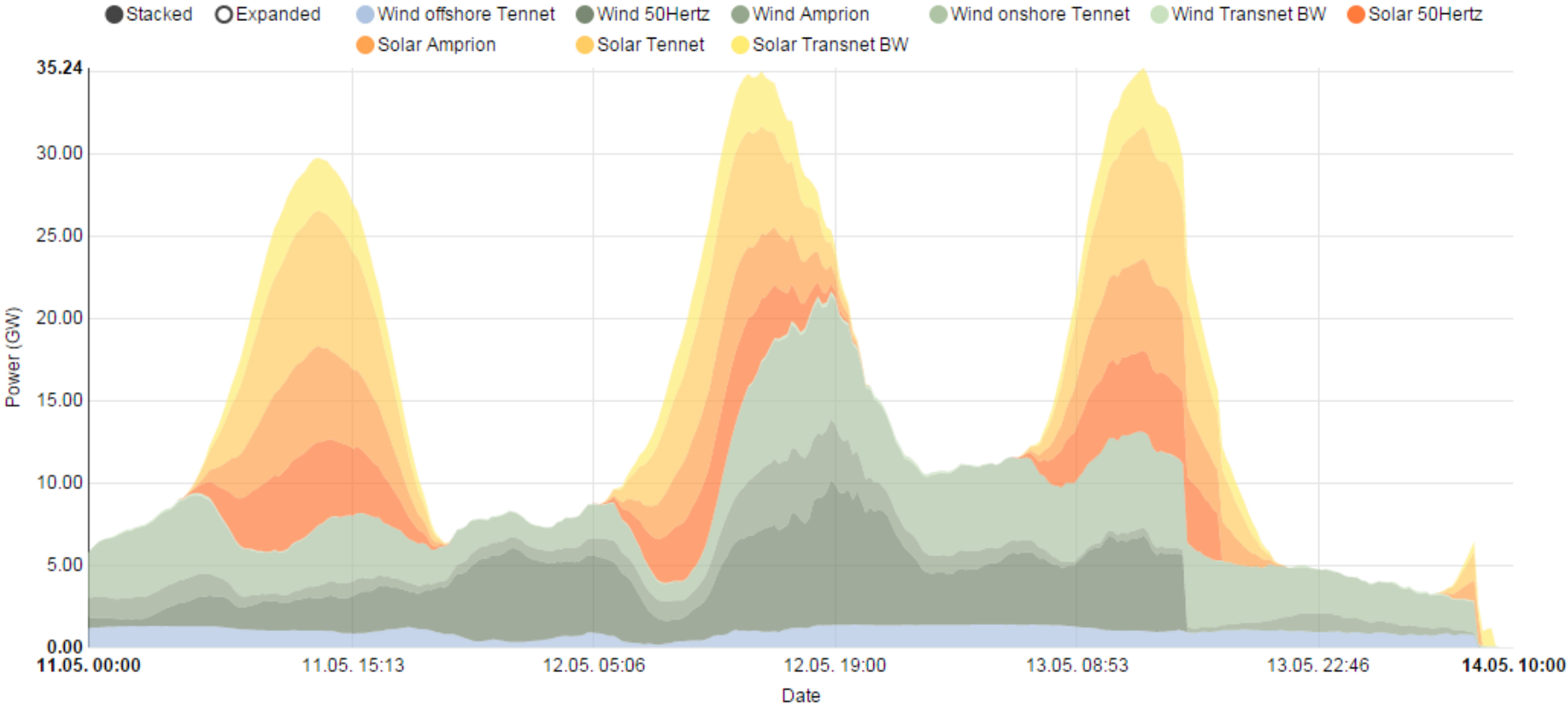
Source: Agora Energiewende, AGEB



## 5) Restructuralisation of energy production

- 1) Extensive development of RES at the expense of traditional source. 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

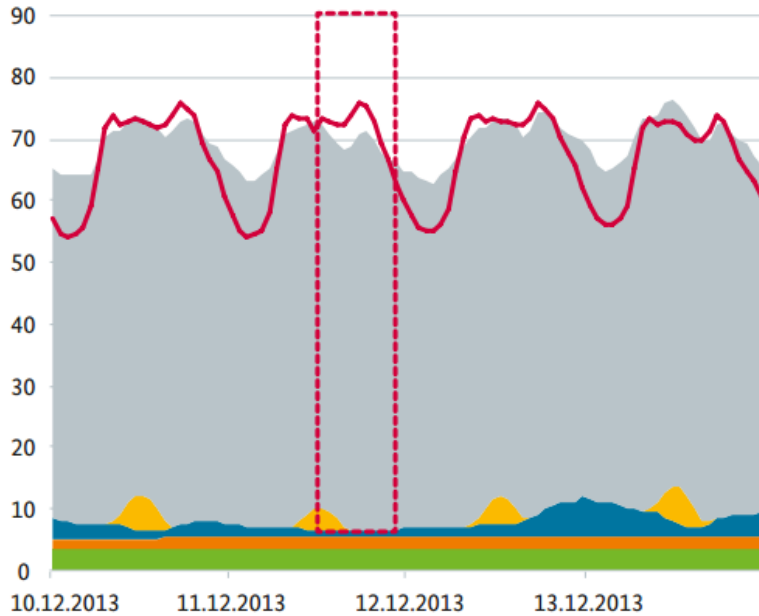


last update: 14 May 2015 10:15

## Examples of situations with high and low residual load

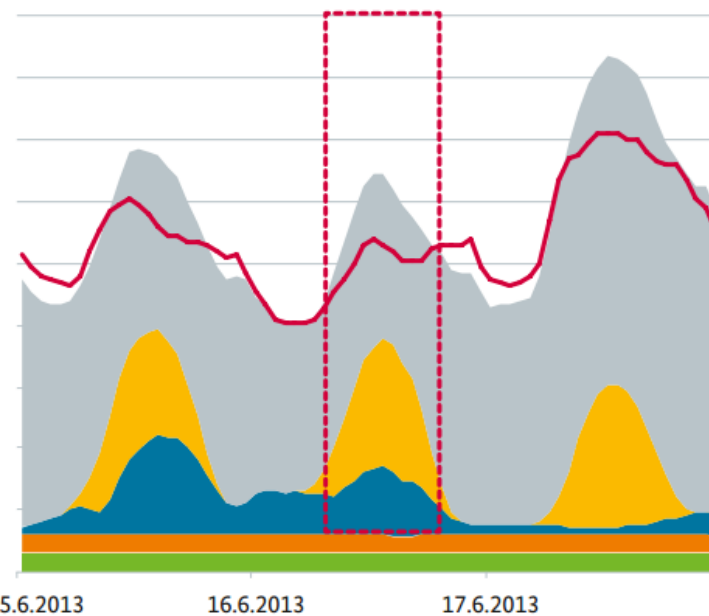
**High residual load:**  
high demand for electricity, little wind and solar power

Residual load in GW



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

Residual load in GW



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

Source: Connect Energy Economics

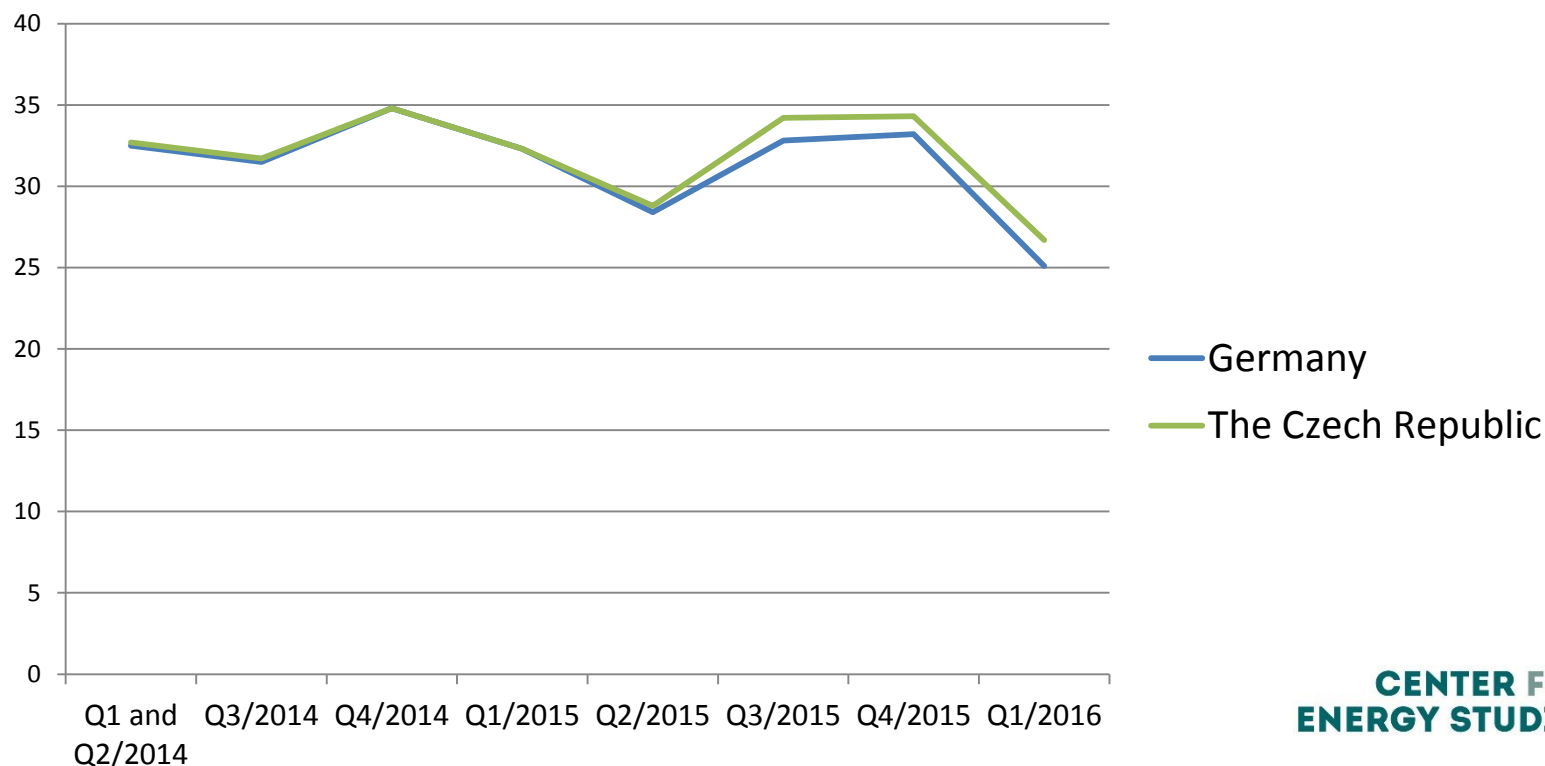
Source: BMWi, Green paper



# Impact of EW on the Czech Republic

# Trading with electricity – price convergence

- Price volatility
- Wholesale price of electricity

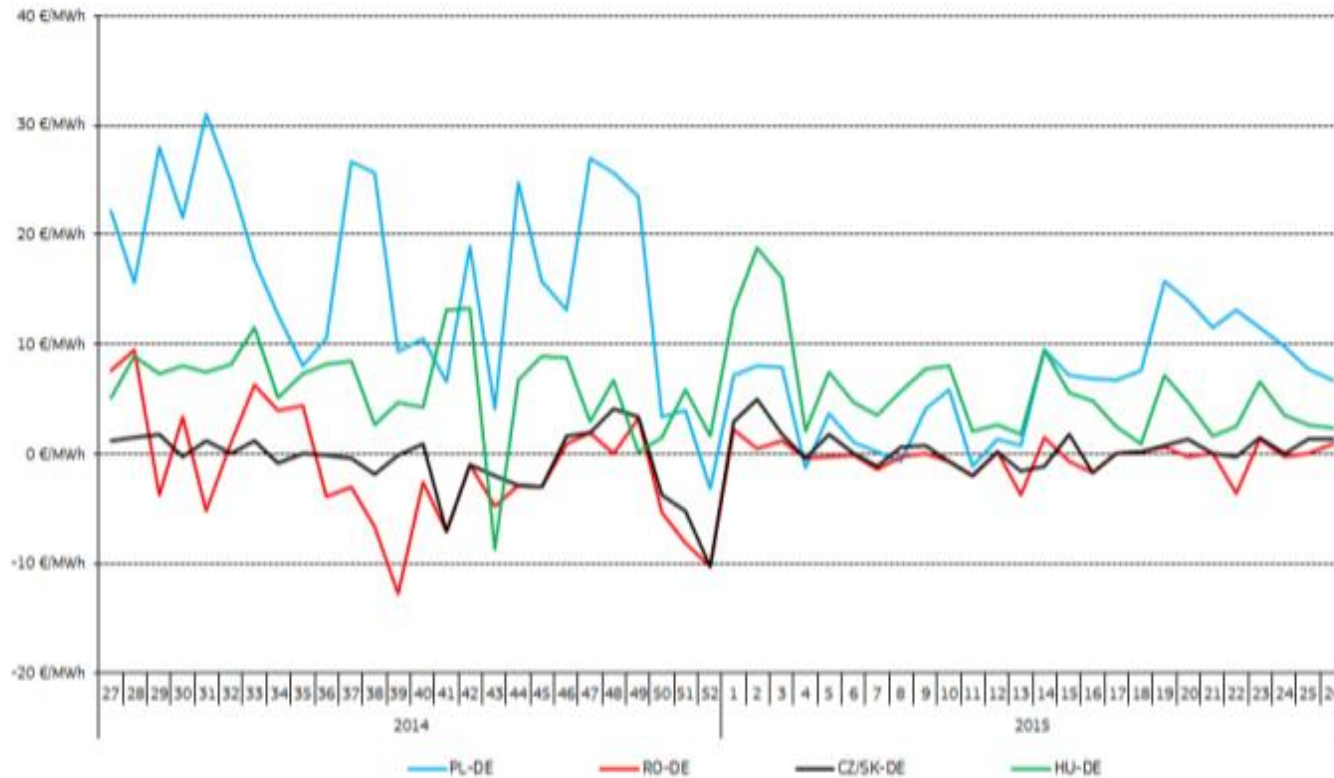


# Impact on Czech producers

- Producers face reduced revenues. (EBITDA of ČEZ decreased from €3,5 bn. in 2009 to €2,5 bn. in 2015, EW one of the reasons).
- 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 %).

# Impact on Czech consumers

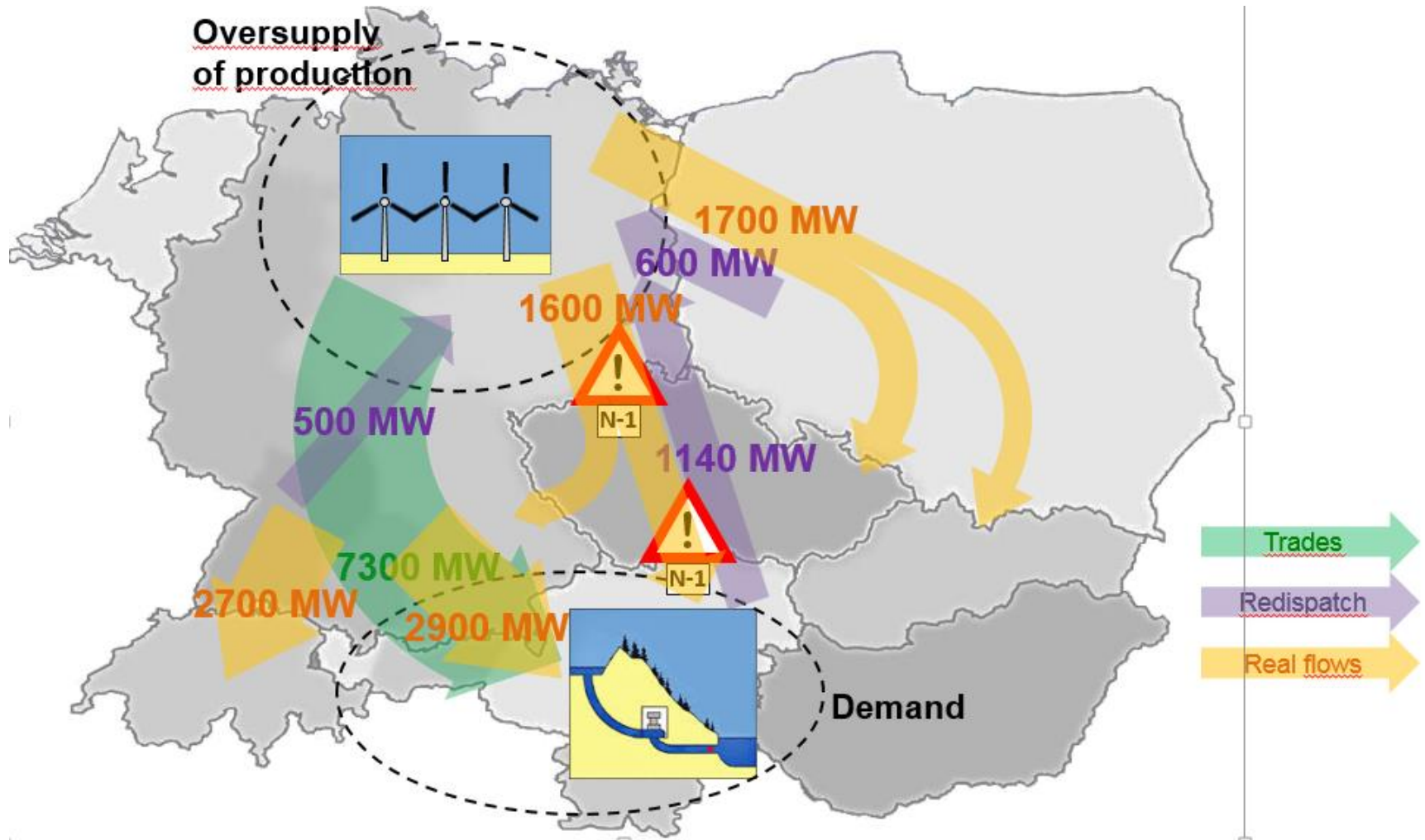
- Profit from Energiewende – import of cheaper electricity.



## Impact on 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.

# Trades and flow of electricity 2014/2015



# Sources

- BMWi (2015): Making a success of the energy transition.
- Clean Energy Wire
- Černoch et.al.(2017): Energiewende and the Energy Security of the Czech Republic and Poland