

The German Energiewende

Radical approach to renewable energy

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Outline

1. brief introduction of the topic
2. basic characteristics of the Energiewende
3. a major challenges

What does the Energiewende mean?

- the energy transformation to a **low-carbon, nuclear-free** economy
- due to EU energy policies (**Green deal**) is whole topic more complex
- consequences not only for electricity sector but also for industry, transport etc.
- dialogue between **citizens** x **government** x **energy utilities** (+ TSO) + **industrial companies** x **NGOs** x **municipalities**
- shift to **decentralization**

Why is the Energiewende interesting?

- „**laboratory**“ of the energy transition
 - highly industrialized country
 - export oriented country
 - large population
 - a lot of fossil fuels
 - no special geographical conditions
- **if the energy transition succeeds here, it can succeed anywhere**
- affect on the rest of the region and the EU as a whole

Origins of the Energiewende

Two pillars: nuclear phase-out and environmental protection (development of RES)

- long and successful tradition; in 50s and 60s question of prestige
- 1970s: **17 000 MW** of installed capacity in NPP (15 reactors)
- **since 70s anti-nuclear protest**
- Three Mile Island accident in 1979; **Chernobyl accident in 1986**
- important support for nuclear industry by government
- 1998: SPD + Greens in federal government - **plan to gradually withdraw from nuclear**
- 2010: Atomic Energy Act amended
- 2011: **Fukushima accident** – phase out by 2022

Origins of the Energiewende

Two pillars: nuclear phase-out and environmental protection (development of RES)

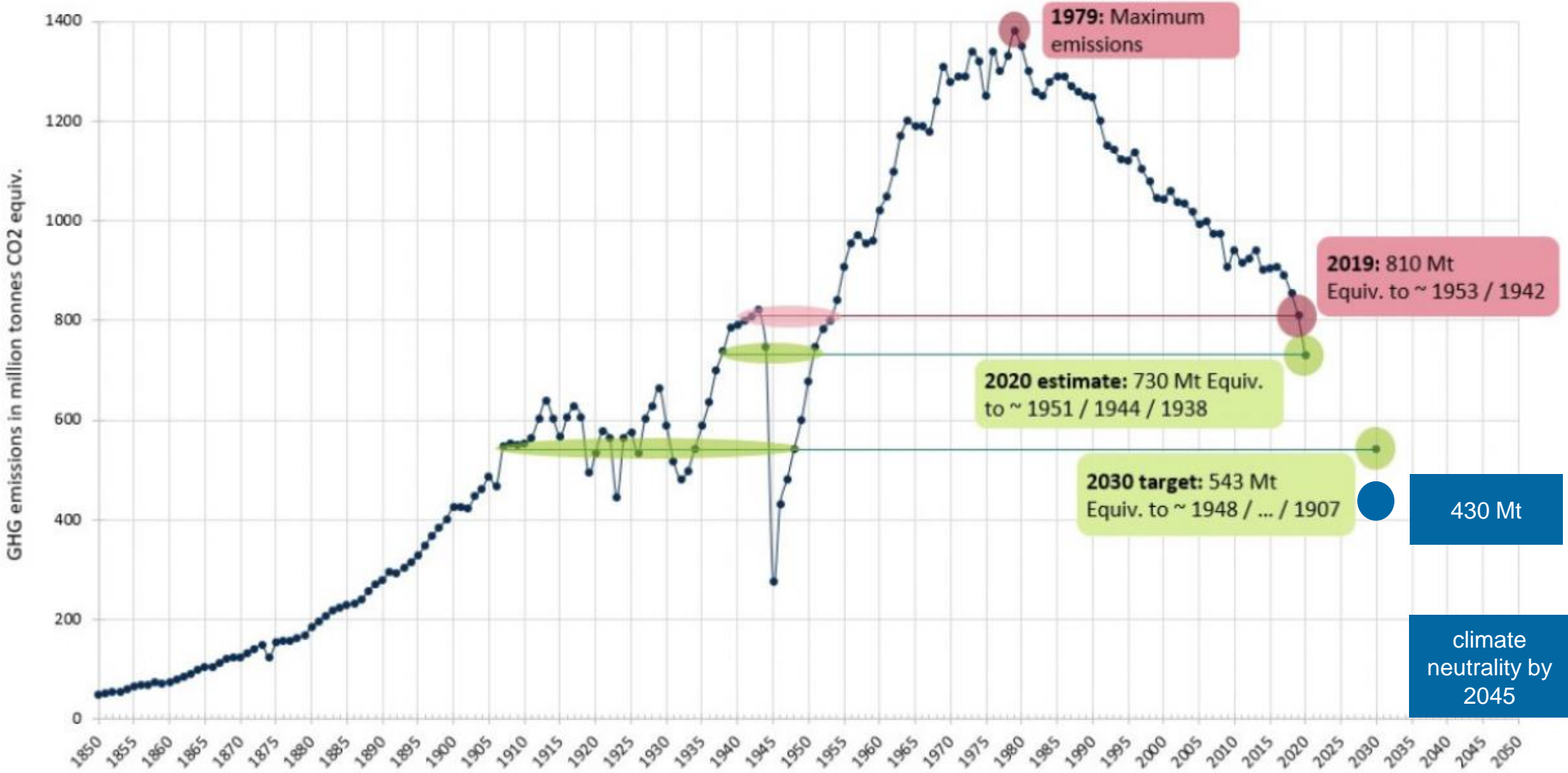
- the idea of energy **transition without oil and radioactive fuels** was born in 70s (as a response for first oil crisis)
- **1974**: first RES subsidy program for solar plants; development of wind energy
- **1990**: Act on the supply of electricity from the RES - **promoting renewable electricity by feed-in tariffs**; the law **obliged grid operators to connect** all RES to grid
- since 2005 first **climate plans**; **RES targets** (20 % by 2020) and **energy efficiency**
- several energy acts; subsidy mechanism; **development of RES high priority**

basic characteristics of the Energiewende

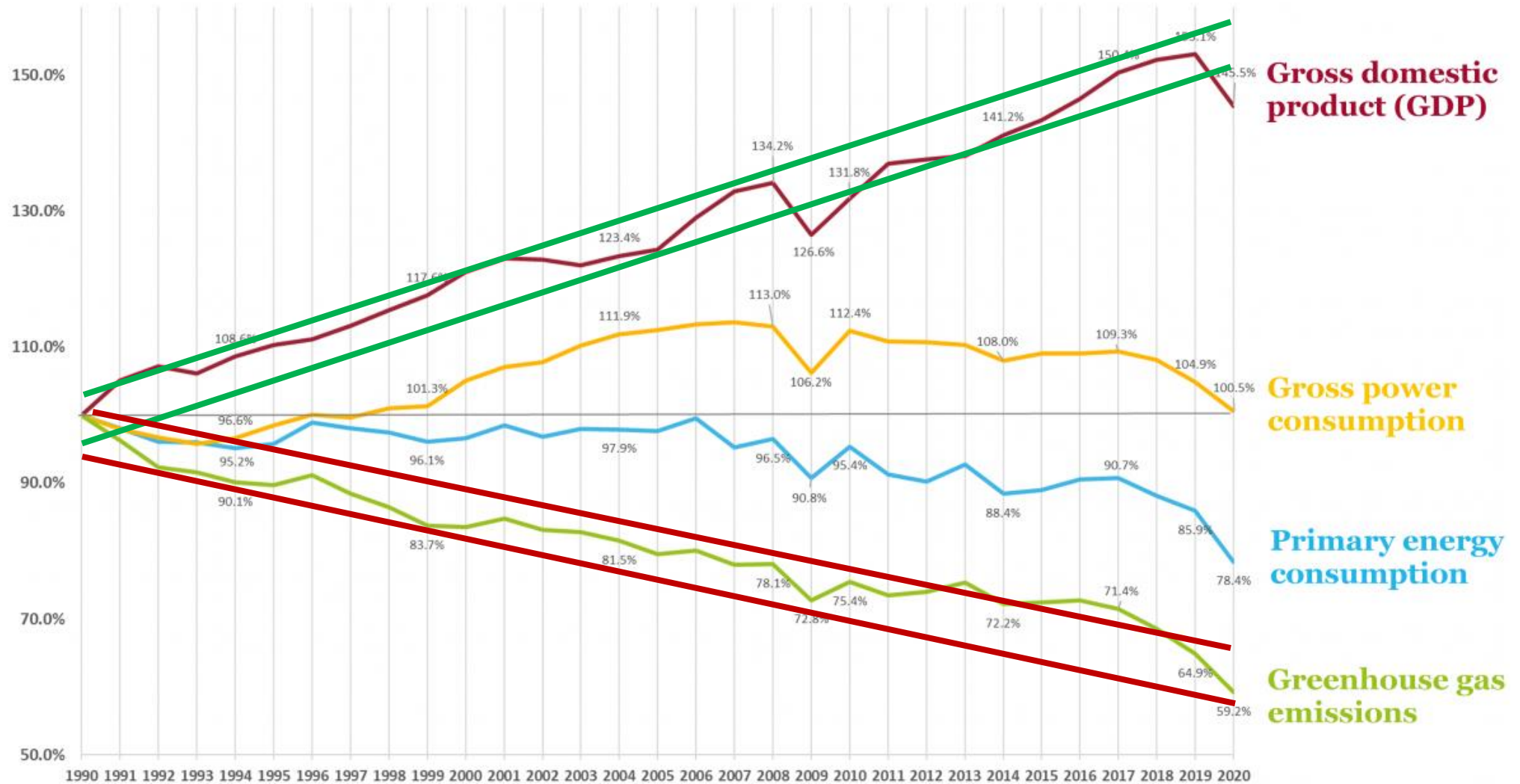
Energiewende basic goals (2018)

	2015	2016	2020	2030	2040	2050
Greenhouse gas emissions						
Greenhouse gas emissions (compared to 1990)	-27.6 %	-27.3 %	minimum -40 %	- 65 %	GHG neutral by 2045	
Increase in share of renewable energy in final energy consumption						
Share in gross final energy consumption	14.7 %	14.8 %	18 %	es. 40 %	45 %	95% ??
Share in gross power consumption	31.5 %	31.6 %	min 35 %	65 %	min 65 % (2040) 55-60 %	100 % ?
Share in heat consumption	13 %	13.2 %	14 %			
Share in transport sector	5.3 %	5.2 %	10 % (EU goal)			
Reduction of energy consumption and increase in energy efficiency						
Primary energy consumption (compared to 2008)	-7.8 %	-6.5 %	-20 %	es. 40 %		-50 %
Final energy productivity	1.4 % per year (2008-2015)	1.1 % per year (2008-2016)		2.1 % per year (2008-2050)		
Gross electricity consumption (compared to 2008)	-3.7 %	-3.6 %	-10 %			-25 %
Primary energy demand buildings (compared to 2008)	-15.6 %	-18.3 %				around -80 %
Heat demand buildings (compared to 2008)	-10.1 %	-6.3 %	-20 %			
Final energy consumption transport (compared to 2005)	1.3 %	4.2 %	-10 %			-40 %

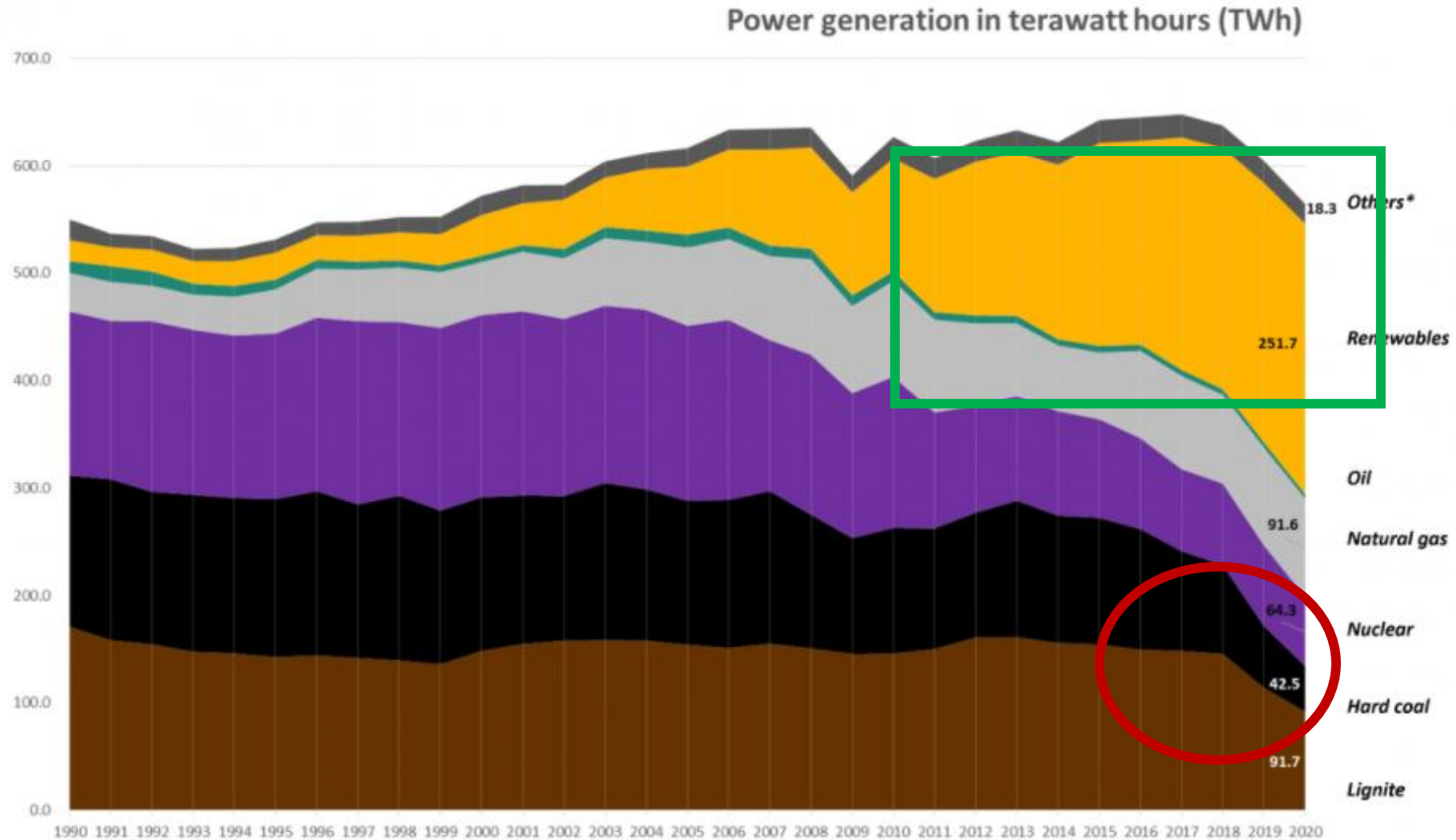
GHG emissions from 1850 to 2020 and future targets



Energiewende main indicators

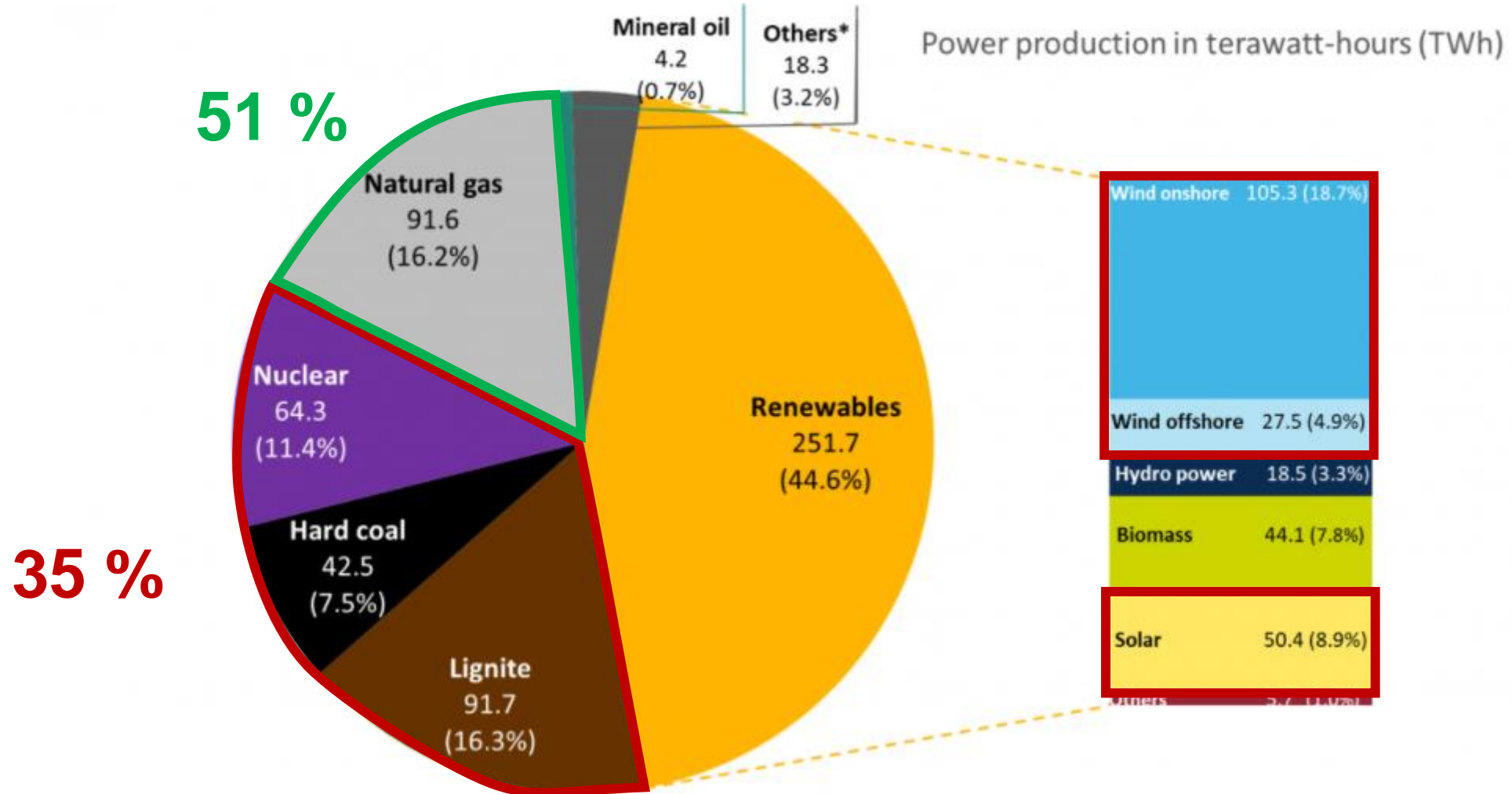


Electricity production in Germany



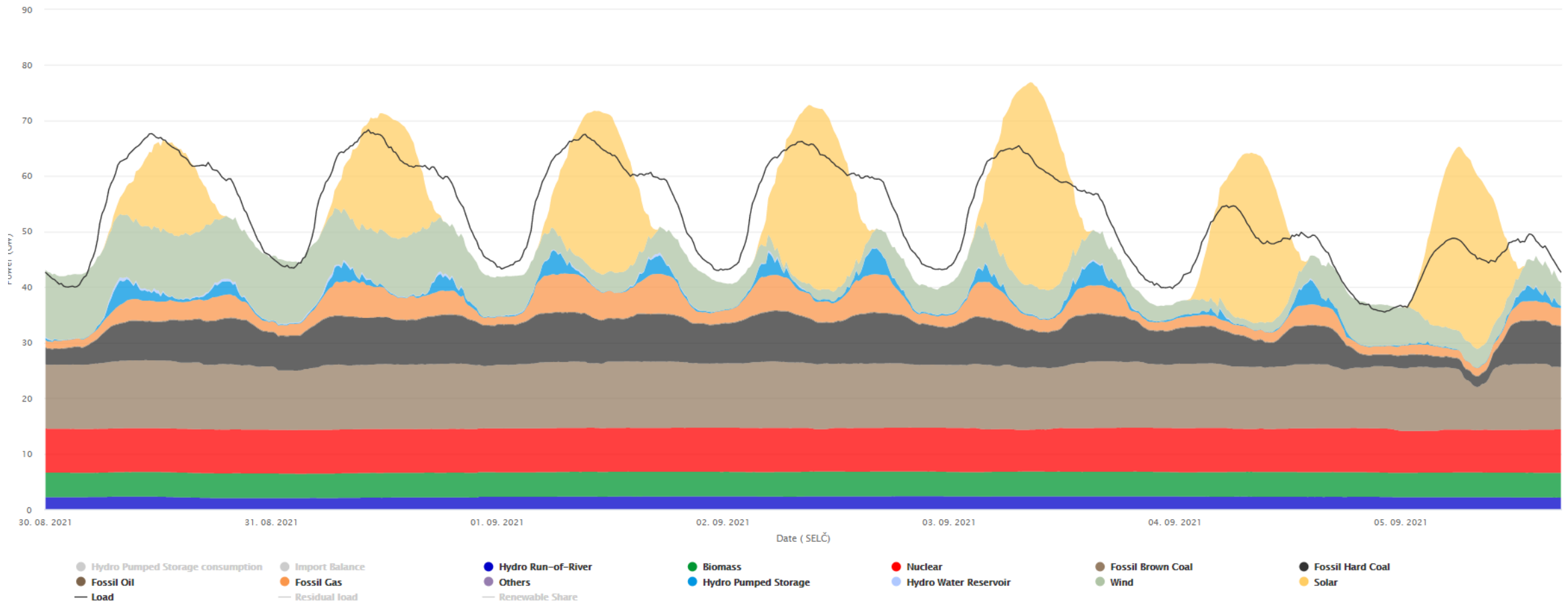
* Without power generation from pumped storage.

Detailed electricity production in Germany (2020)

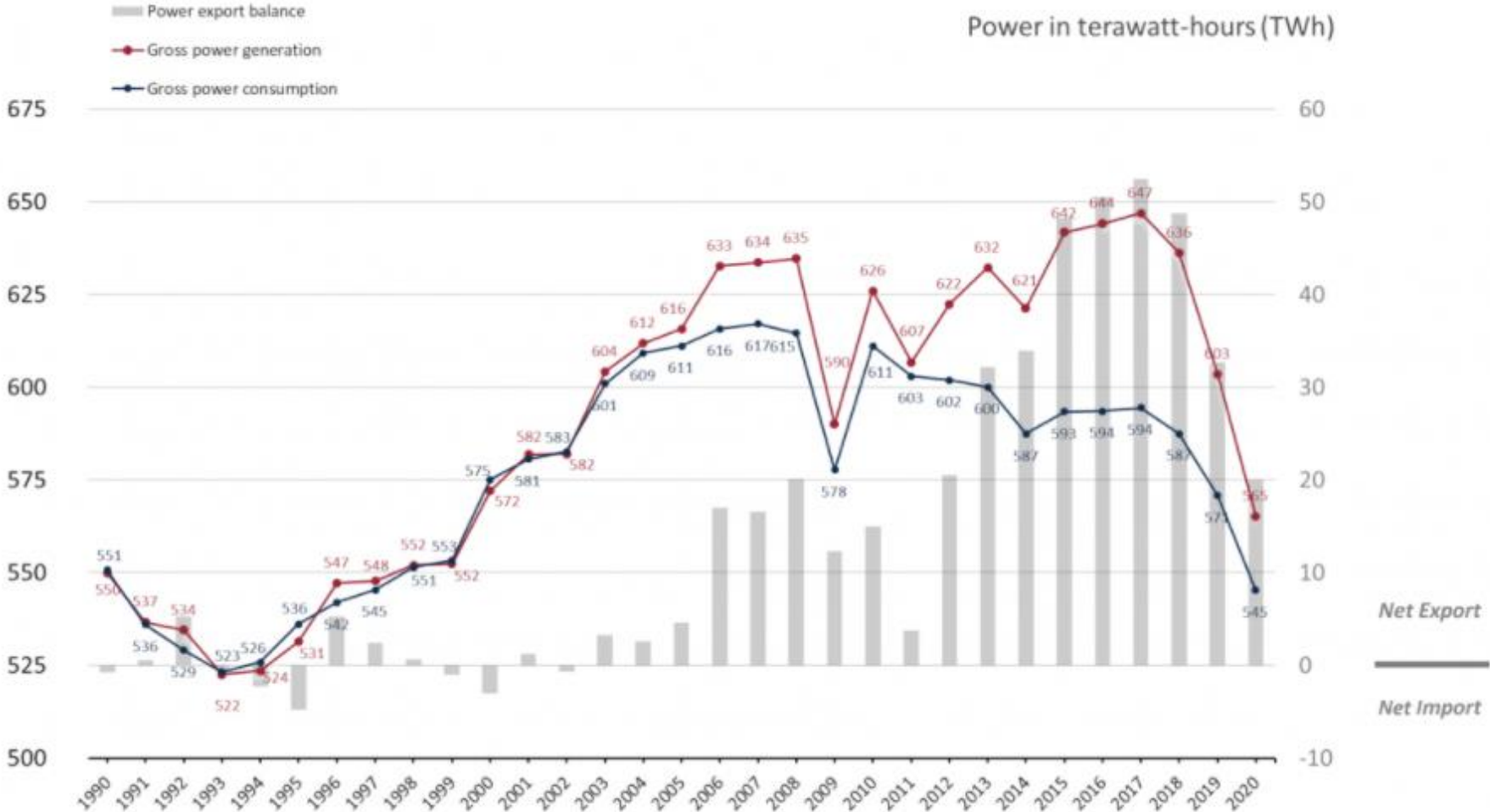


*Without power generation from pumped storage

Illustration of electricity production – 35th week in 2021

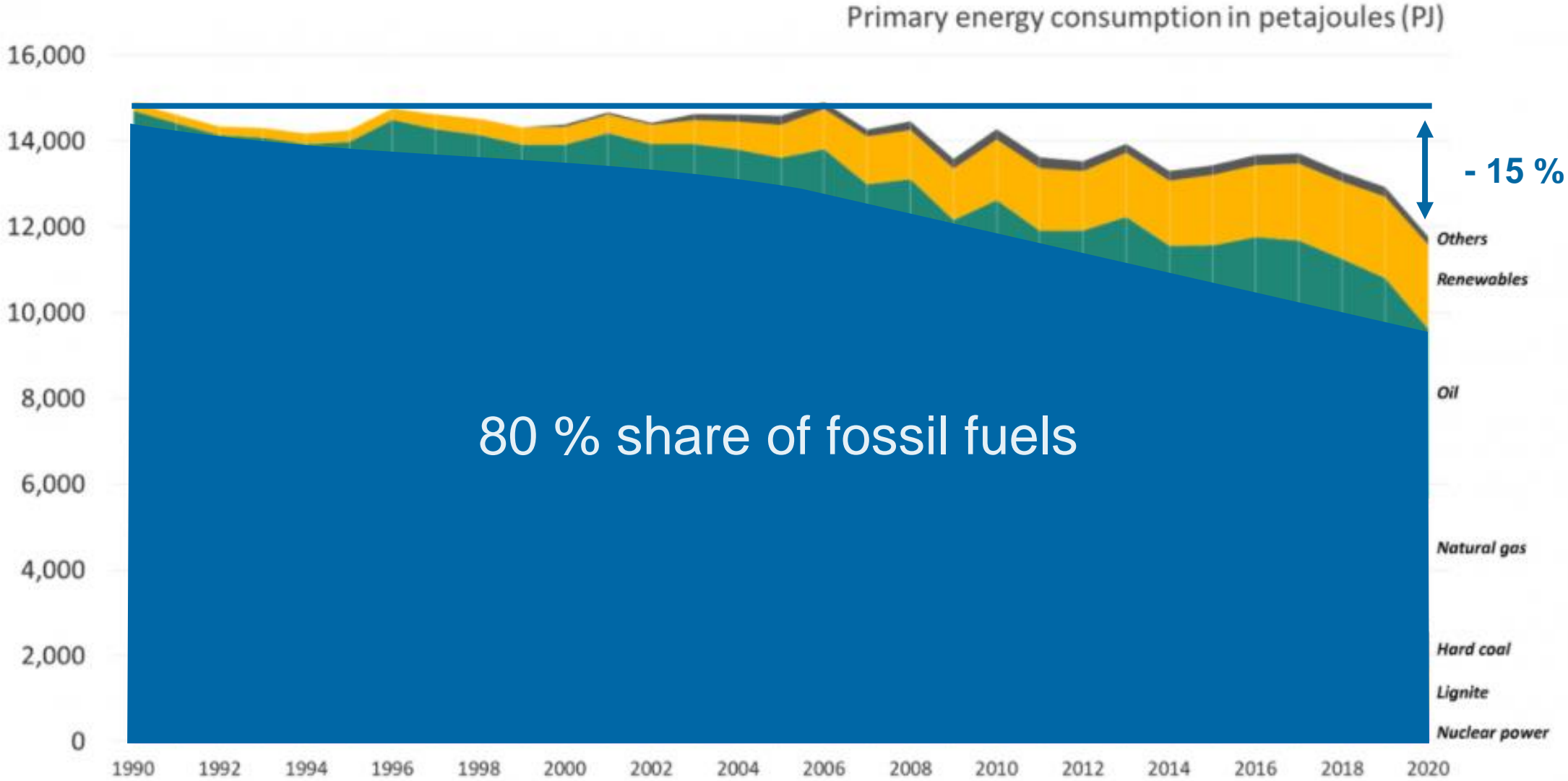


Electricity export balance of Germany

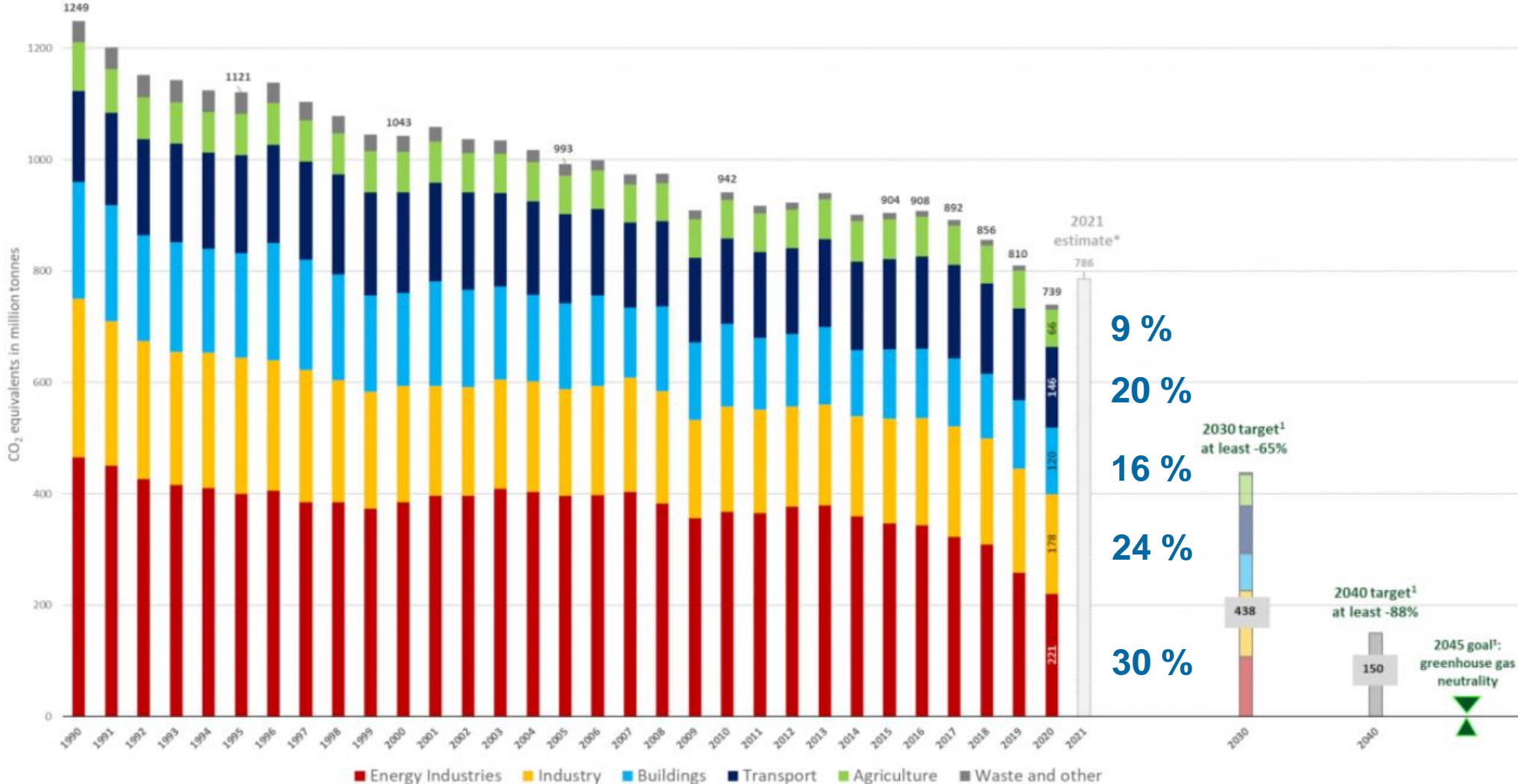


Note: Without power generation from pumped storage.

Germany primary energy consumption



GHG emissions in Germany by sector



Major challenges of Energiewende

Costs of Energiewende

- **impossible to measure reasonably**; investments in **hundreds of billions** of EUR by 2030s
 - nuclear decommissioning and coal phase out
 - RES surcharges: approximately **25 bn. EUR** per year
 - cost for industry about **45 bn. EUR** per year (effort to reduce emissions and EE)
 - grid investments (**110 bn. EUR** for investment by 2050)
 - **benefits: 20 bn. EUR** for **oil** per year and **20-25 bn. EUR** for **natural gas**
 - lower payments for EUA
- **households pay highest price in EU** (taxes and surcharges)
- industry pays lower price than households (EUA)
- negative price of electricity

Electricity price for households in EU (first half of 2021)

(EUR per kWh)



Nuclear phase-out

- 2019: **71 TWh** (14 %); 2020: **61 TWh** (13 %)
- **public meaning** (majority of Germans still agree with decommissioning)
- operators rejects call to keep running plants longer
- compensation for NPP operators: **2,4 bn. EUR** (lawsuits and other complains)
- decommissioning costs: **38 bn. of EUR saved for this purpose** – may not be enough
- an opportunity for the decommissioning industry
- question of **nuclear waste** – potential permanent waste storage facilities in **Gorleben**

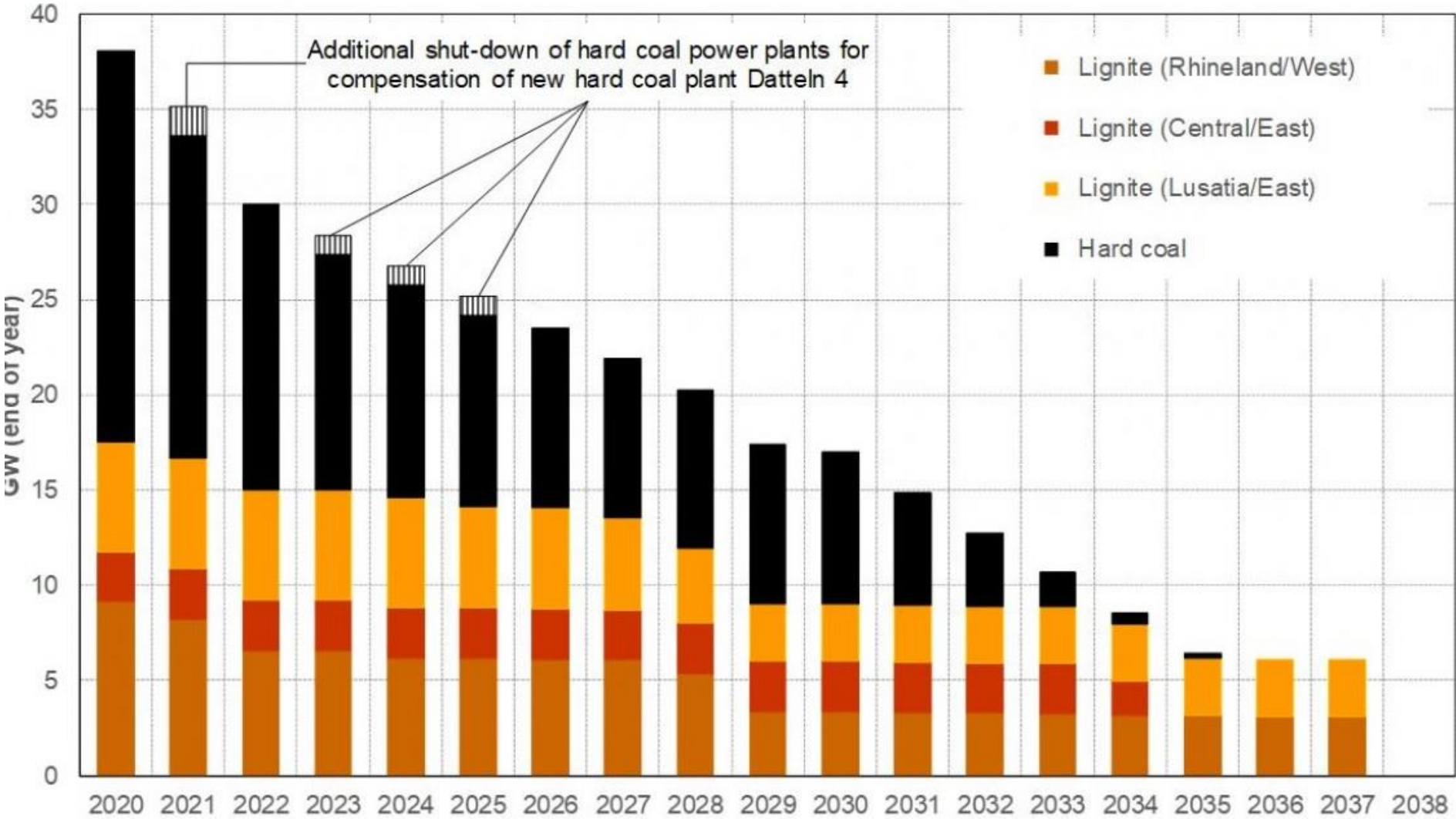
Locations and decommissioning dates for German NPP



Coal phase-out

- 2019: **102 TWh + 50 TWh** (30 %); 2020: **82 TWh + 35 TWh** (25 %)
- long tradition and sentiment
- **coal phase-out act** approved in July 2020; **no coal after 2038** (2035)
- by the end of 2022: 30 GW in operation; 2030: 17 GW (8 GW hard coal, 9 GW lignite)
- compensations for lignite **4,35 bn** of EUR (agreement with operators)
- **auctions** of hard coal to **2026** – first round in 2020 (**66 000 EUR** per MW)
- case of Datteln and Moorburg power plant

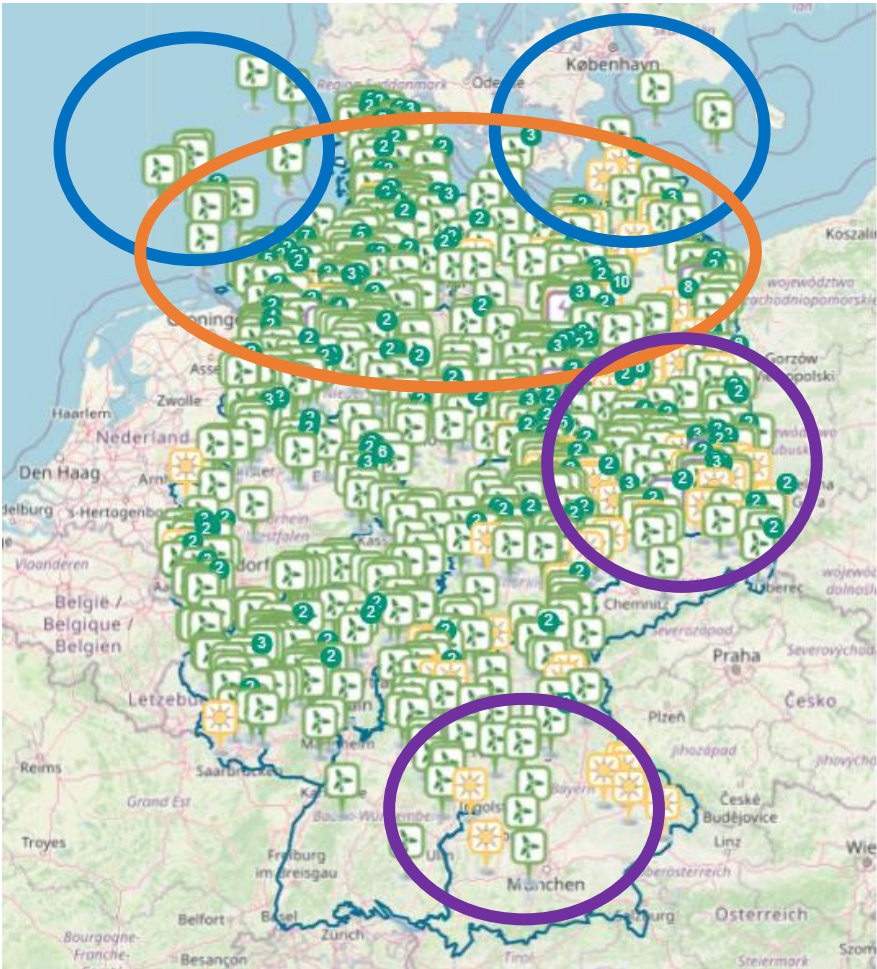
Coal phase-out timeline



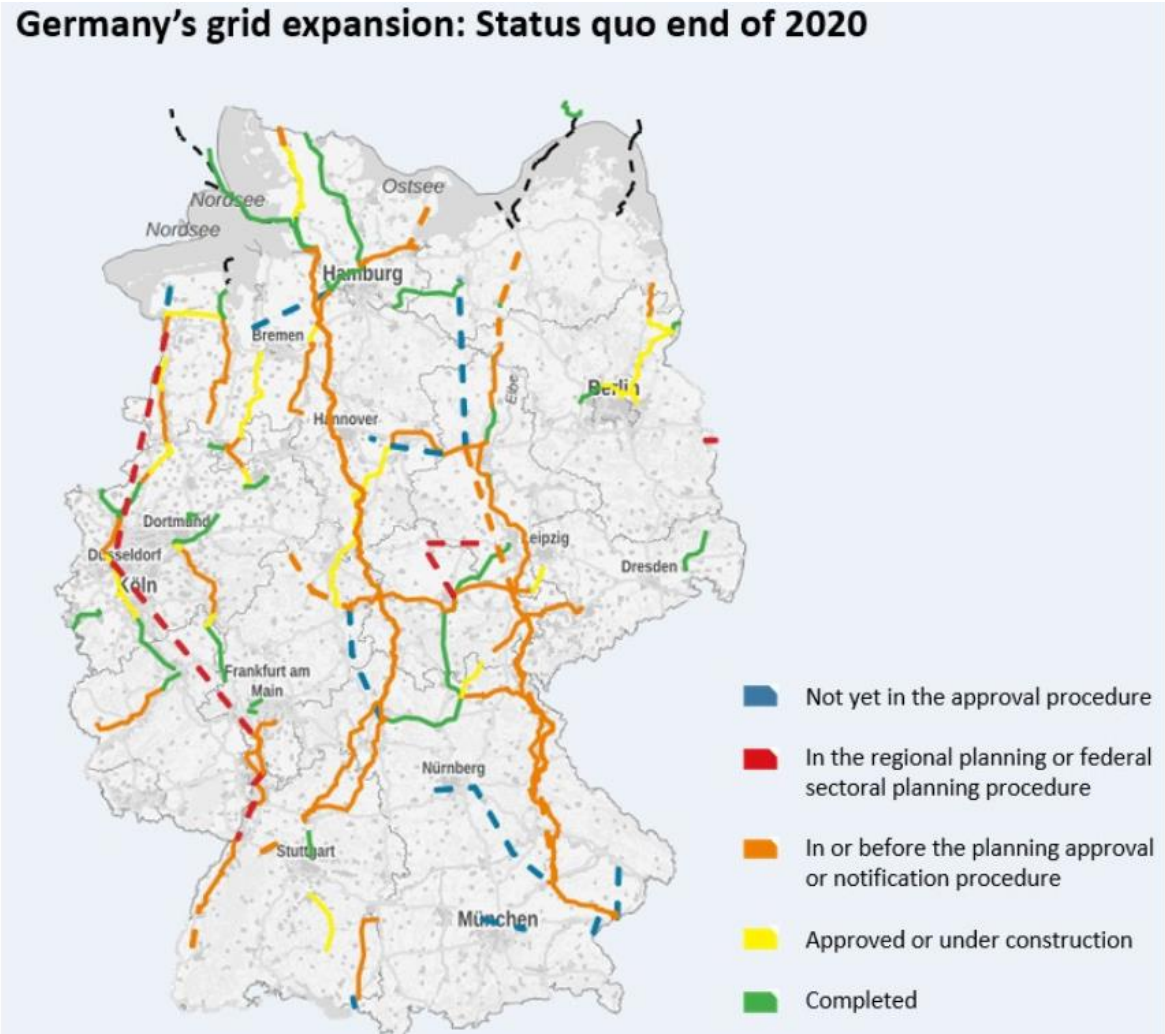
Grid capacity

- more solar and wind (far from areas with high electricity consumption) resources - **requires strengthening of electricity grid**
- electromobility
- protests of local residents and state governments

Grid capacity



Germany's grid expansion: Status quo end of 2020



Additional challenges

- battery storage
- hydrogen
- backup and flexible resources
- new market design

Discussion

You are an unconstrained ruler of a country very similar to Germany... Would you follow Energiewende? Would you do anything differently? Why?

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