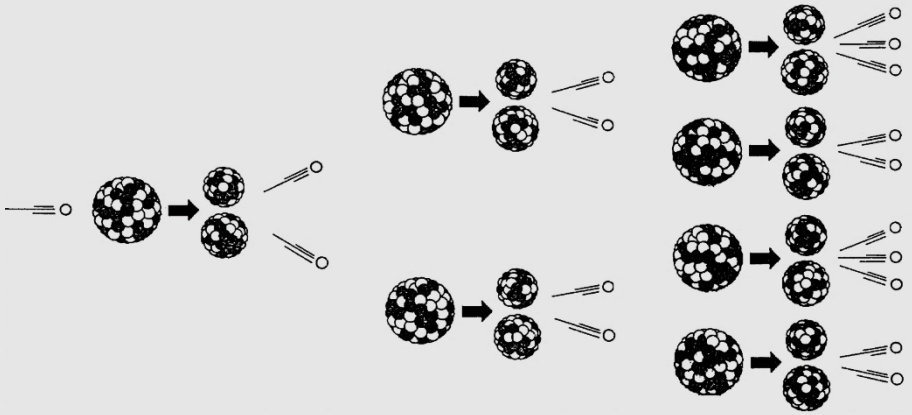
Phasing out nuclear - Motivation, Status, Policies in Germany and Europe



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Electricity generation in Germany and Europe

Motivation and status

Policies

Conclusions - personal contribution

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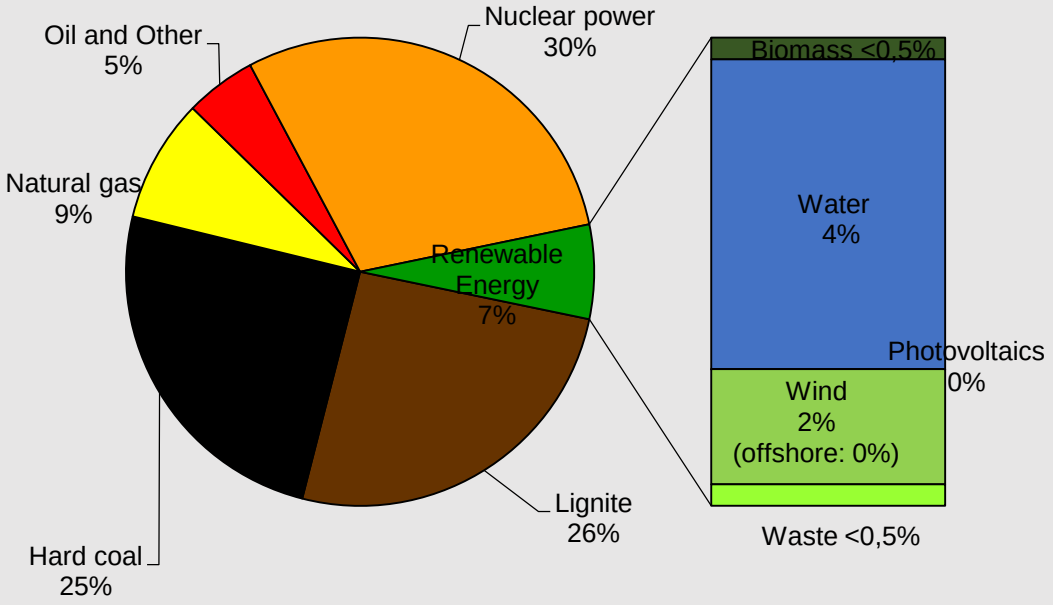
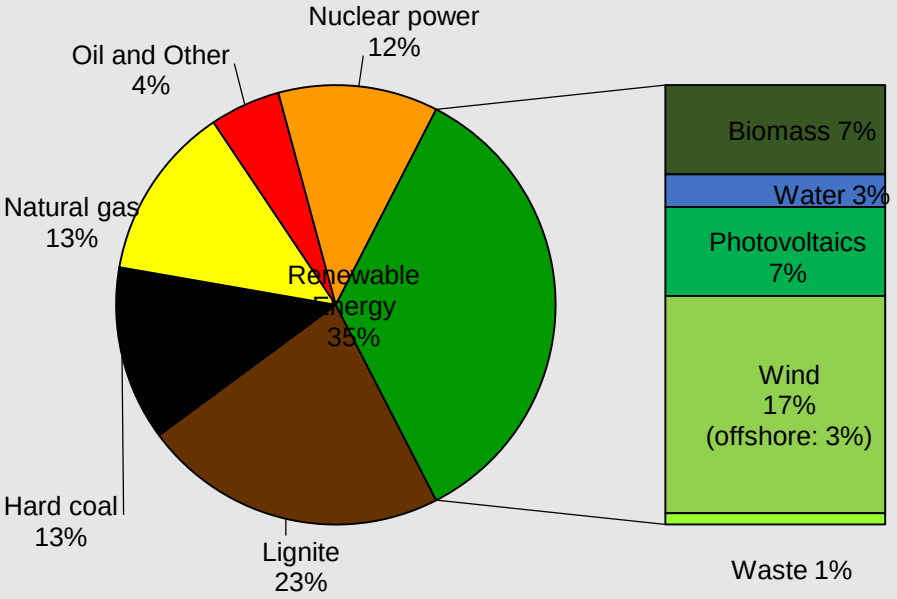
2000: 576,6 Mrd. kWh



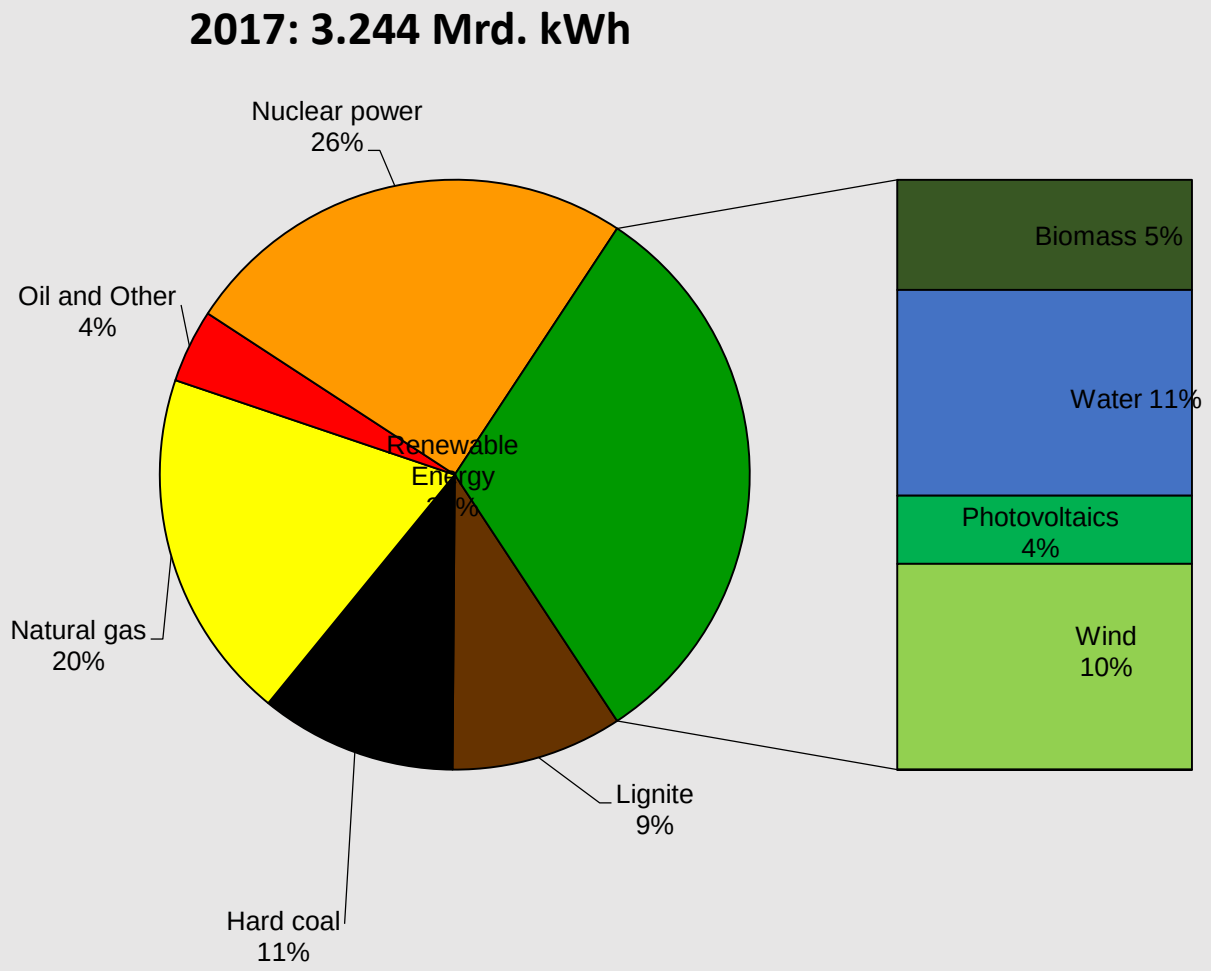
2018: 646,8 Mrd. kWh



Rounded values
1 Mrd. kWh = 10^9 kWh

Source: AG Energiedaten, 06.03.2019

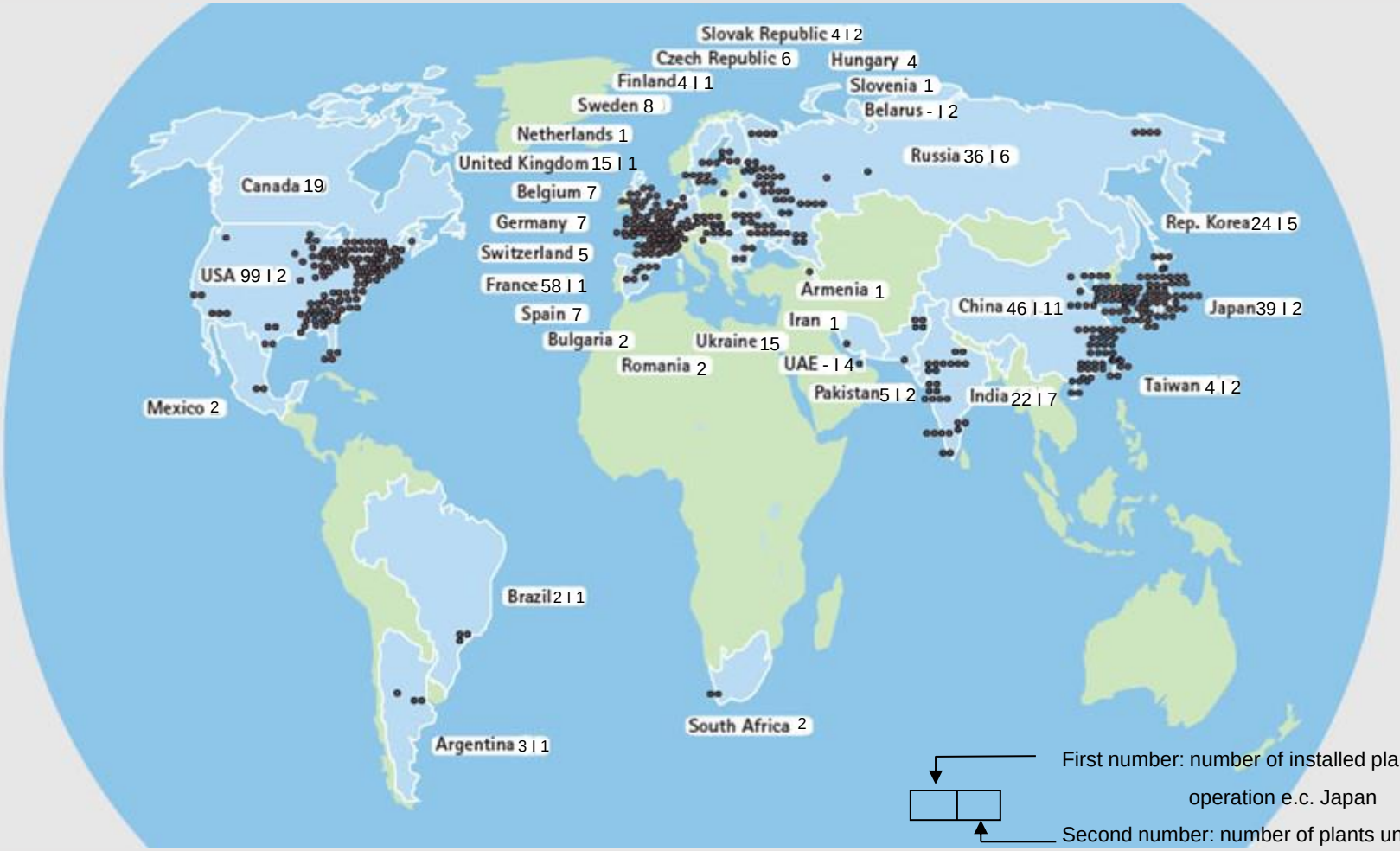
Electricity generation in Germany – comparison of the years 2000 and 2018



Rounded values
1 Mrd. kWh = 10^9 kWh

Source: https://sandbag.org.uk/wp-content/uploads/2018/01/EU-power-sector-report-2017.pdf

European electricity generation

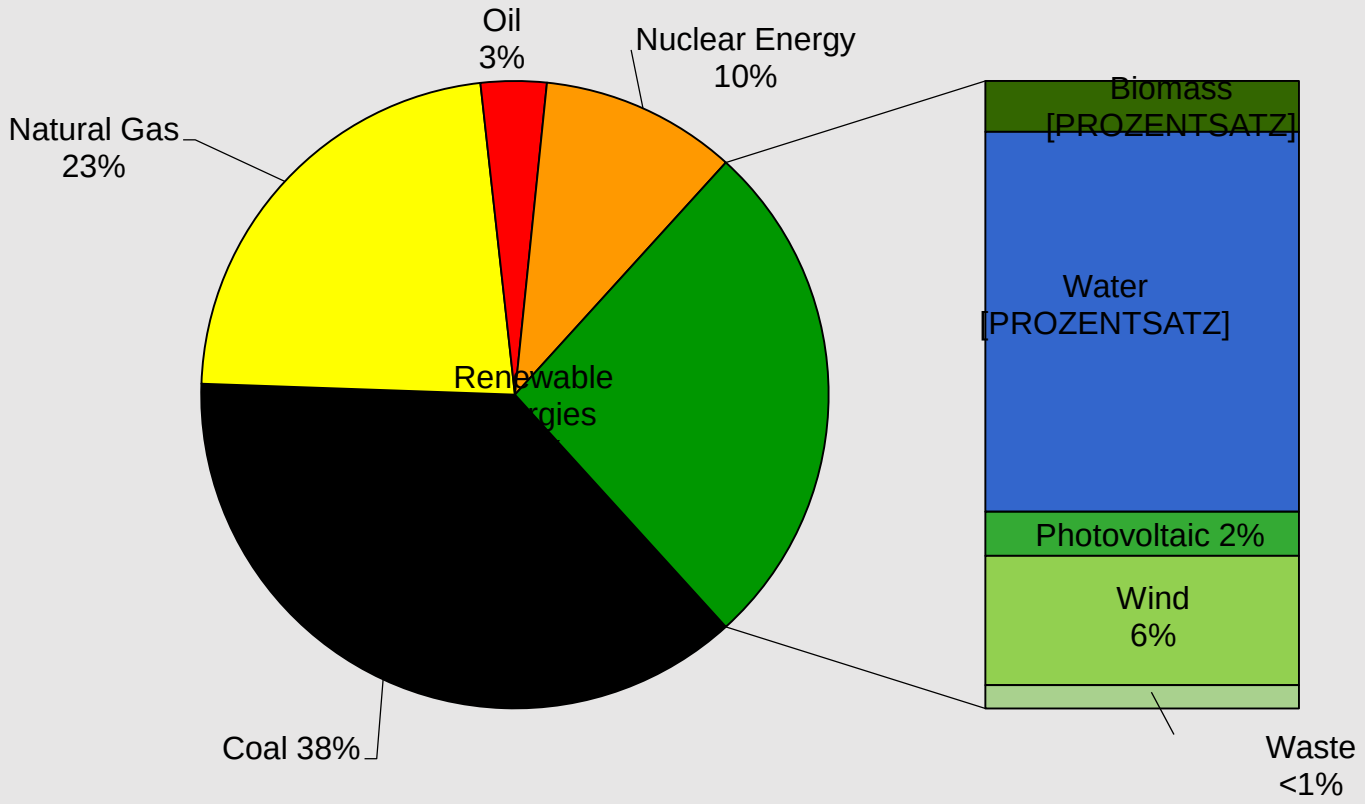


Source: Bild:http://www.kernenergie.de/kernenergie-wAssets/docs/fachzeitschrift-atw/2014/atw2014_07_kernenergie-weltreport-2013.pdf

Data: kernenergie.de 12.2018

Overview map of the nuclear power plant operating countries (December 2018)

Worldwide electricity generation 2017: 25.500 TWh



Gross = incl. Own consumption of the power plants → balanced on the generator

Source: BP Statistical Review 2018,
Renewable Energy : https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/erneuerbare-energien-in-zahlen-2017.pdf?__blob=publicationFile&v=27

Gross electricity generation in the world in 2017

Electricity generation in Germany and Europe

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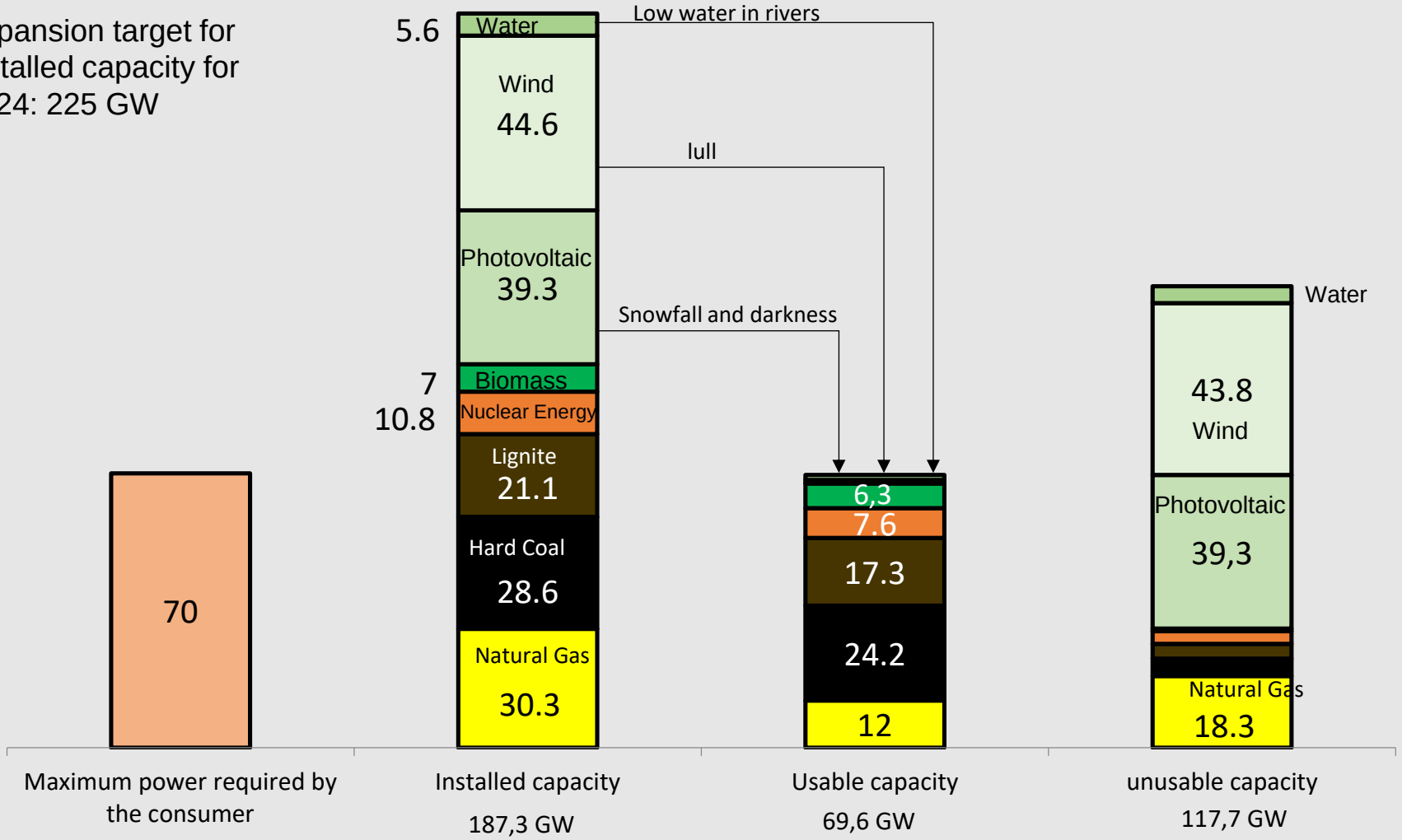
Year	Forecast	Political goal	Reality in the forecast year
1973	Big increase in primary energy consumption (GDP growth 70%)	**High expansion rate for nuclear energy to 50.000 MW by 1985**	• 1973 Jom-Kippur War • Oilembargo of OPEC, increase from 2 to 11 US$/b → production slump →recession • GPD growth only 32%
1974	1. updating	Adjustments to the figures for the year 1985	
1977	2. updating	Adjustments to the figures for the year 1990	
1981	3. updating Increase in the price of oil by around 70%	Adjustments to the figures of the year 1995 → **Further expansion of nuclear power to 38.000 MW** → Stabilization of the contribution of domestic hard coal	• Real oil price drops by 70% • **Nuclear energy loses competitiveness** → **Power generation capaciry in Germany around 25.000 MW**
1986	Anti-nuclear movement after accident in Tchernobyl	**Exit from nuclear energy through the inclusion of renewable energies** → Estimated electricity generation in 2015 for wind energy to 20,6 TWh and photovoltaic to 0,4 TWh	• **2002 Exit from nuclear energy by amendment of the Atomic Energy Act legally protected**
1991	Electricity Feed		
2001	Renewable energy law	**By 2020 replace the 20% nuclear energy with renewable energy**	• Success through Technology Improvement and Cost Reduction→ Economic downturn due to collapse of US Bank Lehman Brothers • By 2015 already 30% electricty from renewable energies
2010	Energie concept	• **Extension of nuclear energy use** • Expansion of renewable energies → by 2050 80 % power generation in Germany	• **2011 Fukushima accident → Nuclear phase-out until 2022**

Energy forecasts for Germany

Expansion target for installed capacity for 2024: 225 GW



Current account of German power generation 24.01.2017 in GW

Electricity generation in Germany and Europe

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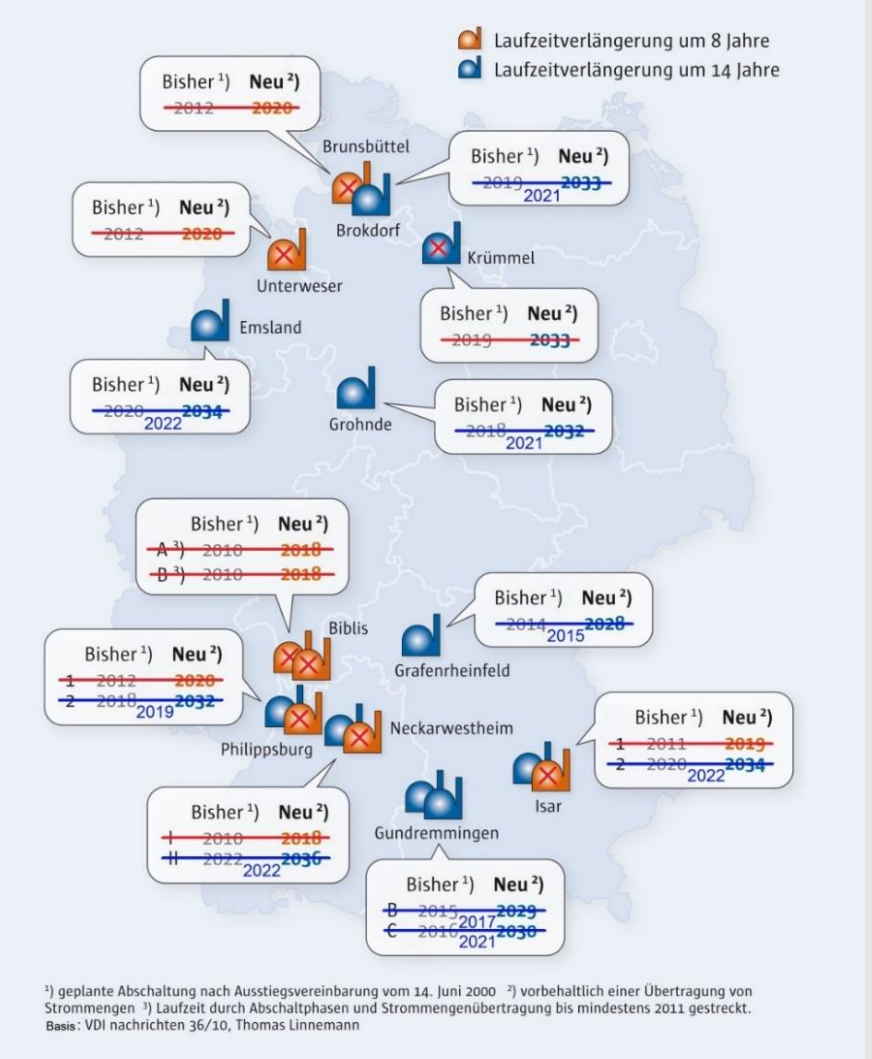
Energypolitics and research recomandations after the accident in Fukushima

Study of the German Leopoldina Nationale Akademie der Wissenschaften

The year stands for the predetermined switch-off time after the decisions after the Japan accident in the summer of 2011.



Nuclear energy in Germany and term after Japan accident

Electricity generation in Germany and Europe

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- Nuclear power worldwide 2520 TWh in 2018
- China, India and Russia are building new nuclear power plants
- Other countries like Germany, US and France will reduce the capacity
- High renewable share in grid makes nuclear power uneconomically

Conclusion

- Studying electro energy technology with main point on nuclear power stations
- Working as scientist in the two German parliament comissions „Future Nuclear policies“
- High engagement in German public energy discussion as scientist – nuclear energy was necessary at this time
- Working in systems analysis potentials of renewable energies – necessary research
- Working as scientist of German Academy of Science on the study for German ministry and parliament „Is phasing out of nuclear possible in Germany 2011?“

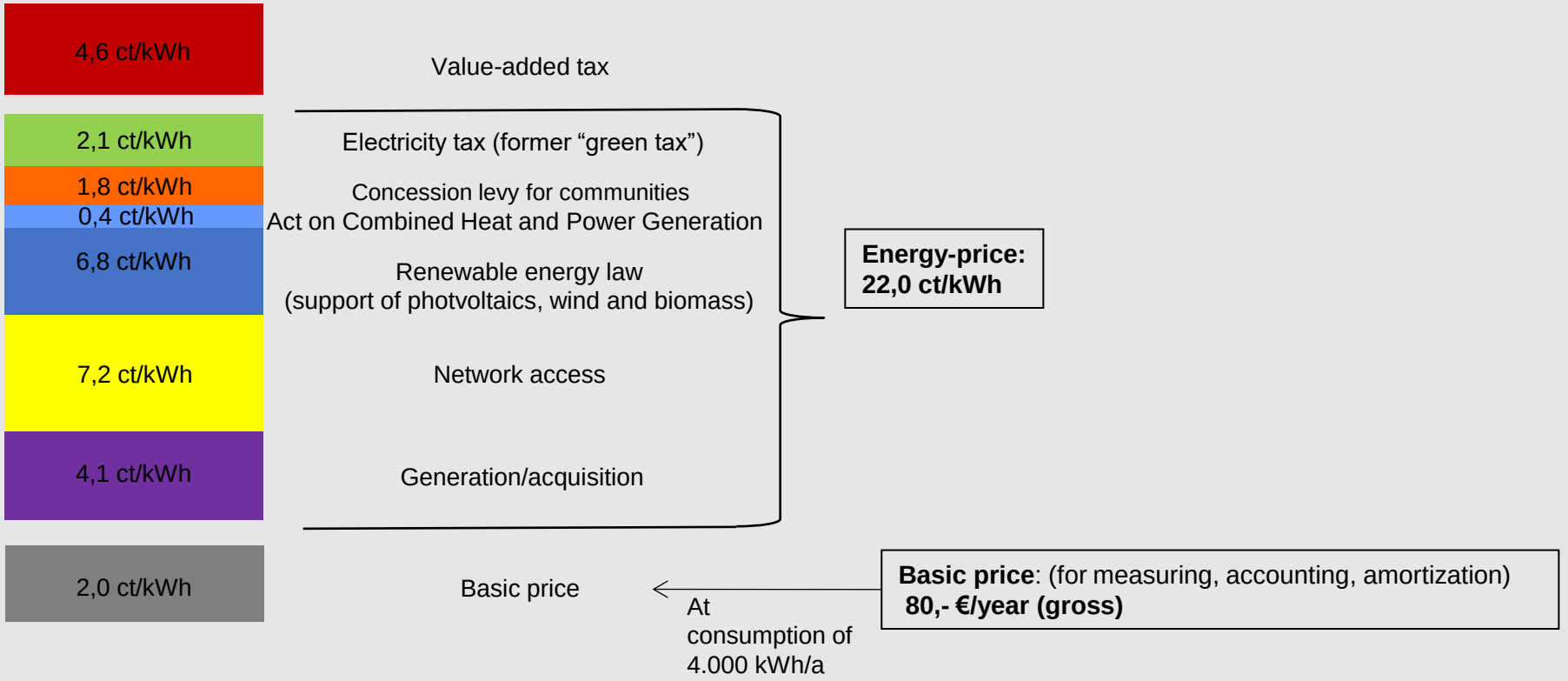
My „nuclear“ way

Thank you for your attention

Discussion

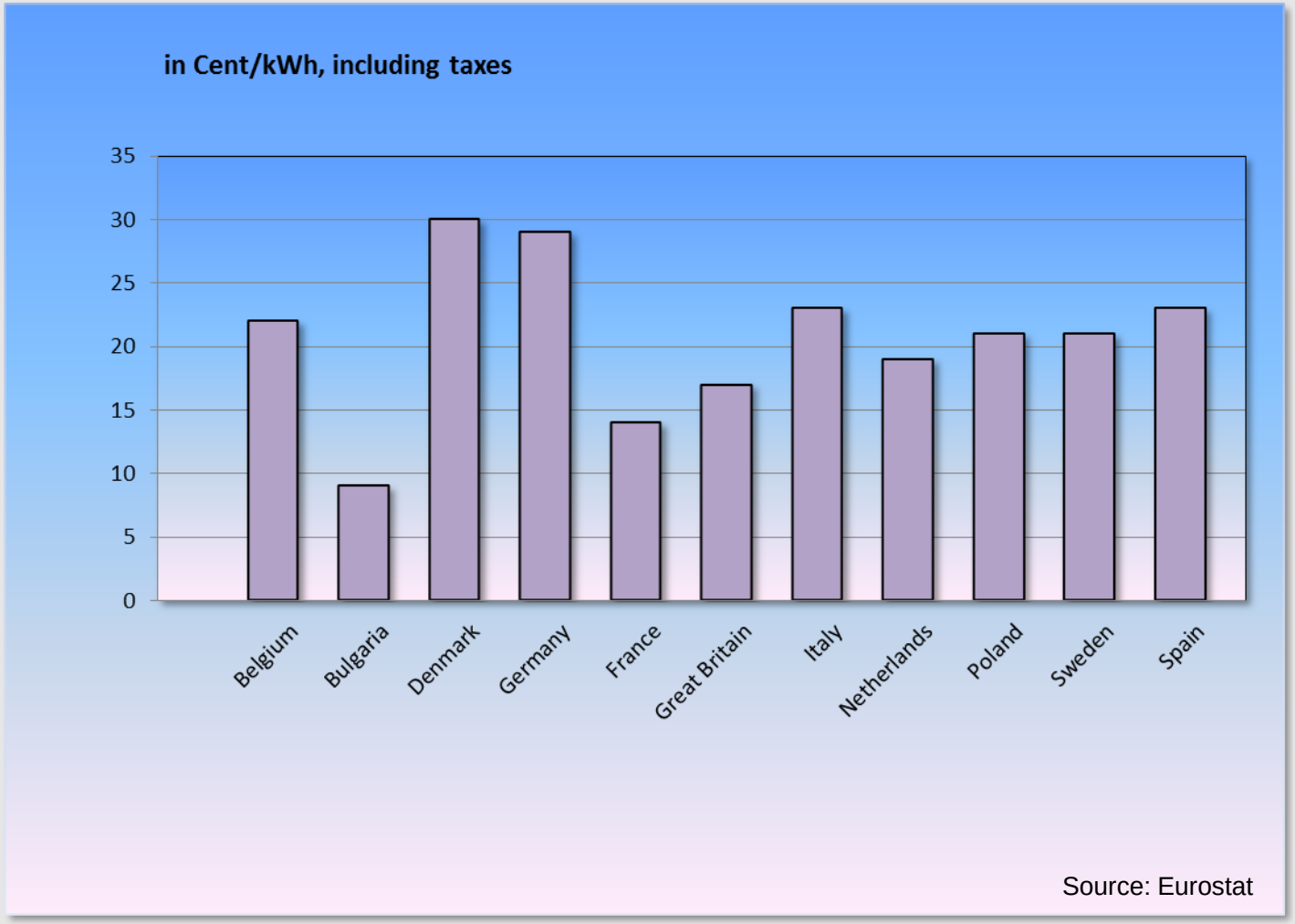
Total: 29,0 ct/kWh, of which 56% are federal demand

For comparison: The electricity price was at the beginning of the year 2010 about 21,3 ct/kWh

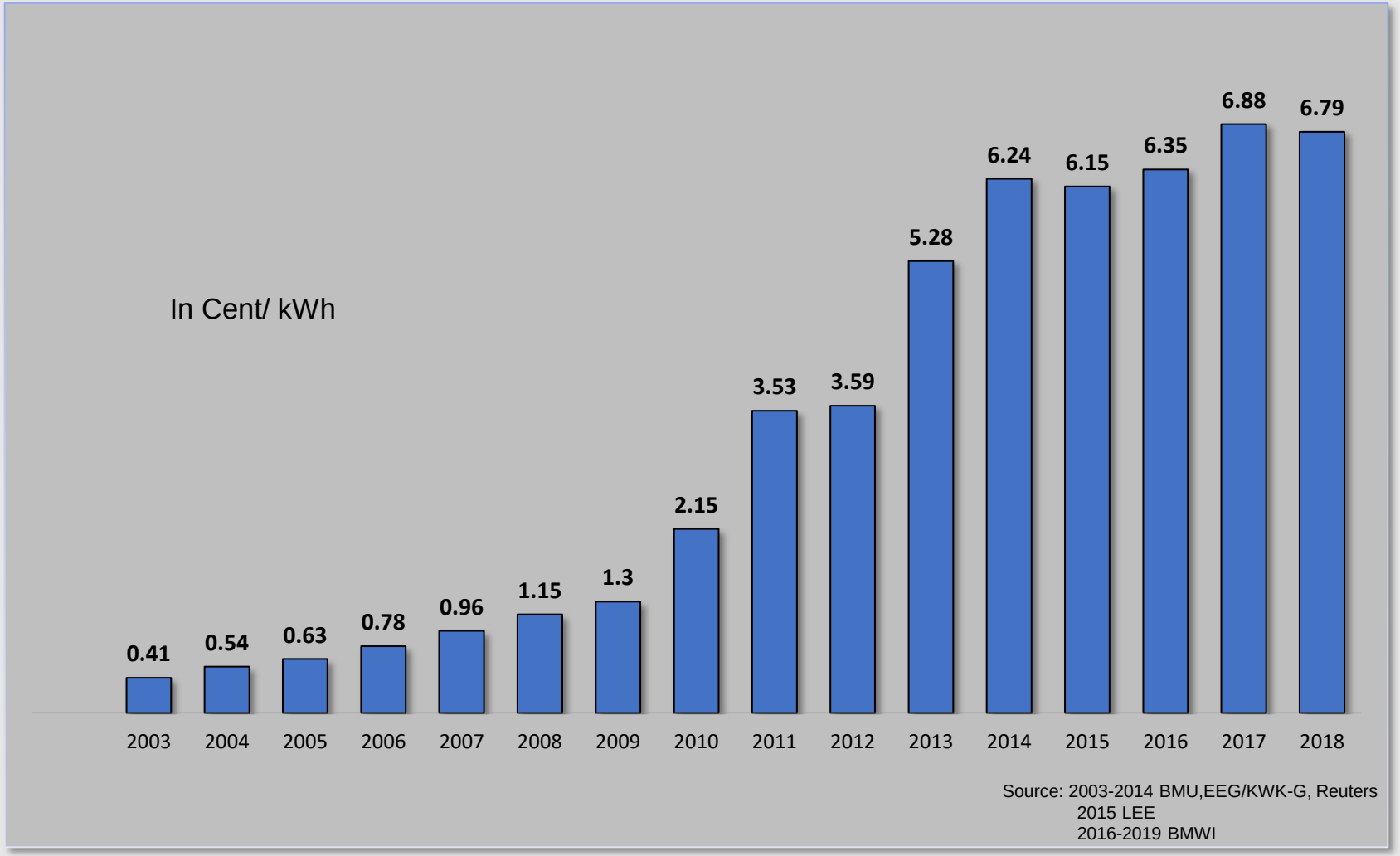


Source: *Basic price, generation, network access* by using of tarifs of the Stadtwerke Velbert, November 2018
Concession levy is an average: It is depending from the population in the city, Status 2018

Average structure of the electricity rate in Germany: Household with a consumption of 4.000 kWh/a



Average electricity prices for households in Europe in 2013



Renewable energy levy for households in Germany

Objective of green electricity:
- 2025 (2035): 40-45 % (55-60 %) of the electricity consumption should be covered by green energy
- Expansion target wind offshore till 2020: 6,5 GW and till 2025: 11 GW
- Limiting the expansion of new wind onshore: 2,9 GW/year including replacement of old stations
- Limiting the expansion of new biogas plants: 150 MW/year (next 3 years) than 200 MW/year
- Limiting the annual expansion of new photovoltaic: 2,5 GW/year

Green electricity marketing:
- Direct marketing of all new plants with a power output of 750 kW or more, except biomass 150kW or more

Reducing of financial support:
- Degradation of immoderate promotion and bonus, progressively reducing of support

Industrial companies:
- Energy-intensive companies have to pay about 15 % of the Renewable Energy Act levy, up to a maximum limit of 4 % of the companies´ gross value added
- For large scale consumers, such as aluminum or steel plants, the maximum limit decreases to 0,5 %

Own power consumption:
- Existing plants are exempted from the Renewable Energy Act
- Electricity, generated by eco-electricity plants, is charged with 40 %, all the rest has to pay the whole amount
- Small plants up to 10 kW (e.g. photovoltaic systems on house roofs) are exempted from the Renewable Energy Act levy

Railway:
- Payment of 20 % of the Renewable Energy Act levy

Private Consumer:
- Payment of 100 % of the Renewable Energy Act levy (about 7,3 €-Ct/kWh)

Source: - VDI Nachrichten, 4.Juli, 2014, Nr. 27/28
- http://www.bmwi.de/DE/Themen/Energie/Erneuerbare-Energien/eeg-reform.htm
-Different internet sources – Status: 5 August 2016l

German Renewable Energy Act (EEG) 2016 (valid from 2017)