Lehrstuhl Energiesysteme und Energiewirtschaft
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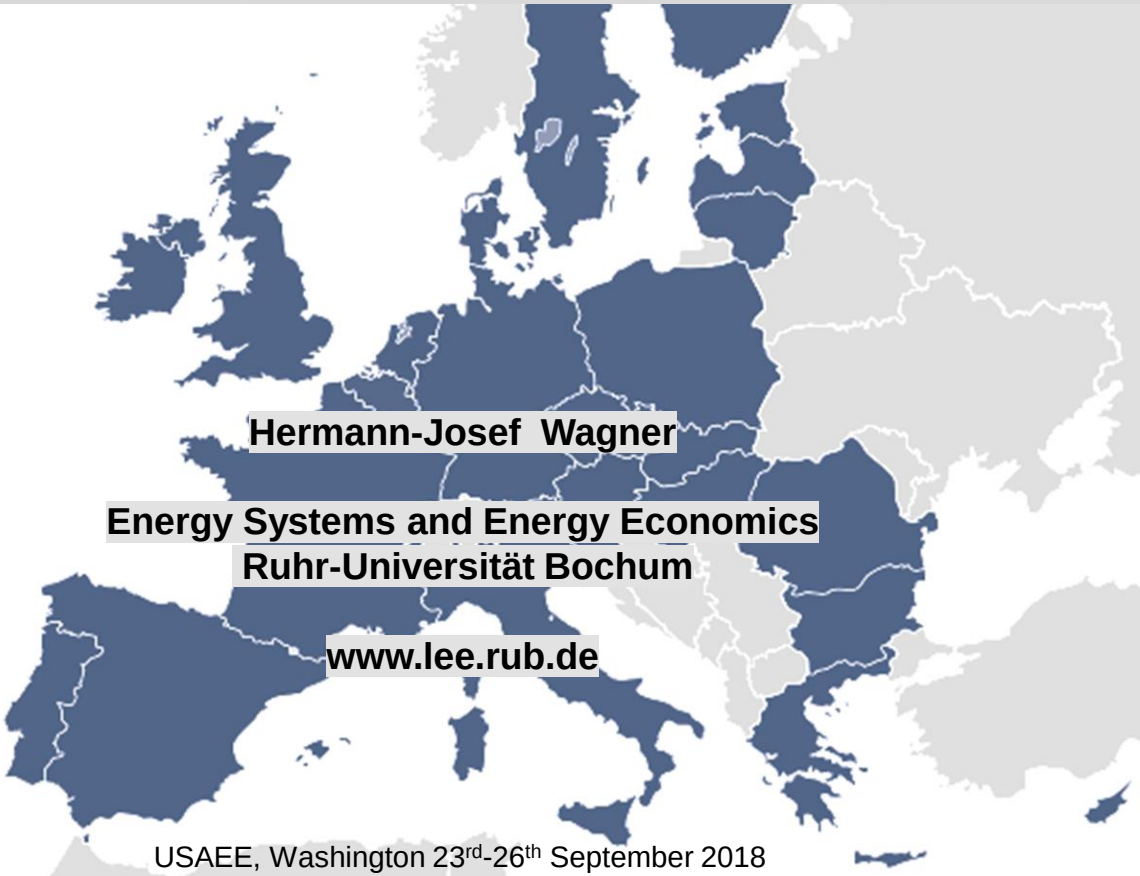
RUB

Renewables for electricity
Advantages, problems, status in Europe



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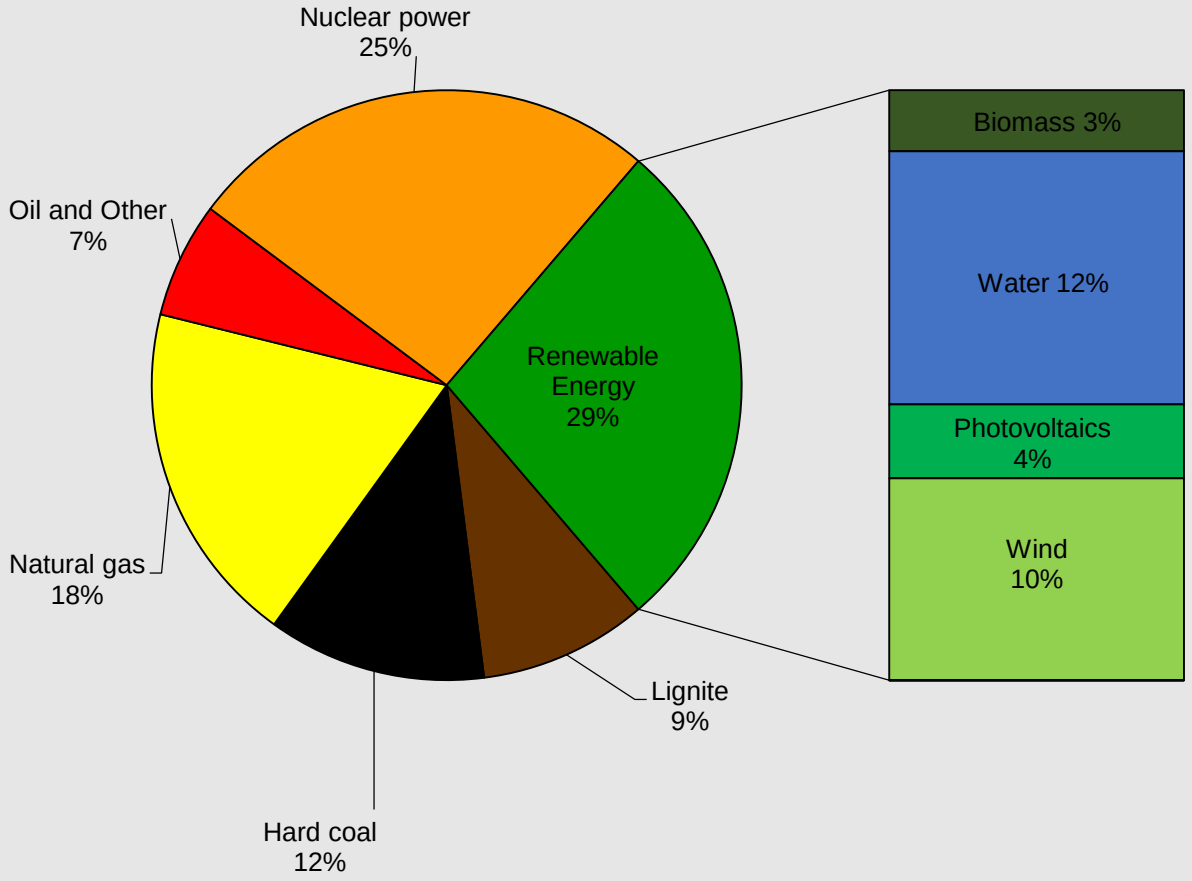
www.lee.rub.de

USAEE, Washington 23rd-26th September 2018

Source: http://www.asapfrance.info/files/images/europe/carte-zone-europe-27.png

- Actual Situation
- Policies and Objectives
- Scientistic Effects - Eco-Balance Alpha Ventus

2017: 3.255 Mrd. kWh

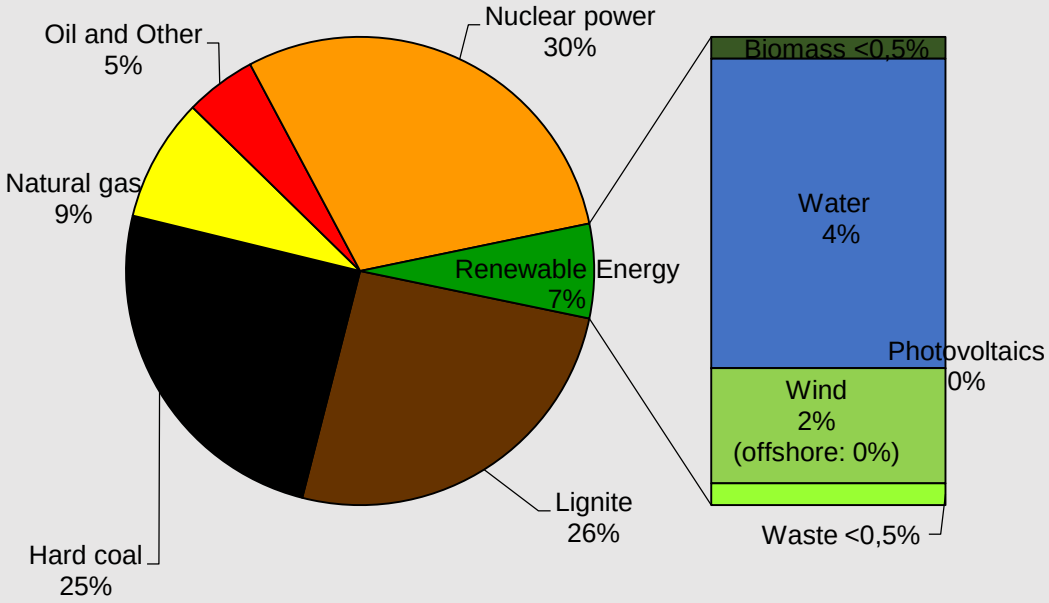


Rounded values
1 Mrd. kWh = 10^9 kWh

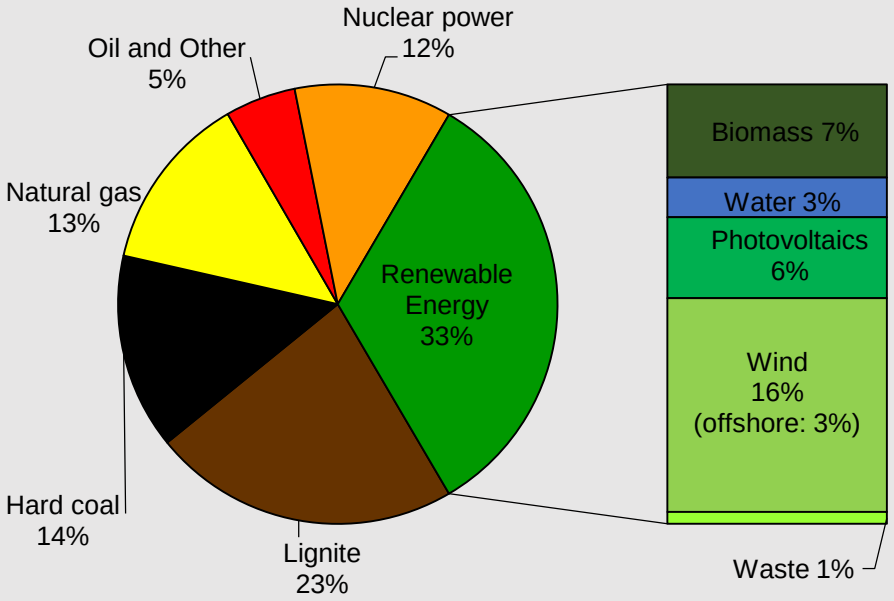
Source: Statistik der Energiewirtschaft, Ausgabe 2018, VIK Energie für die Industrie

European electricity generation

2000: 576,6 Mrd. kWh



2017: 654,2 Mrd. kWh

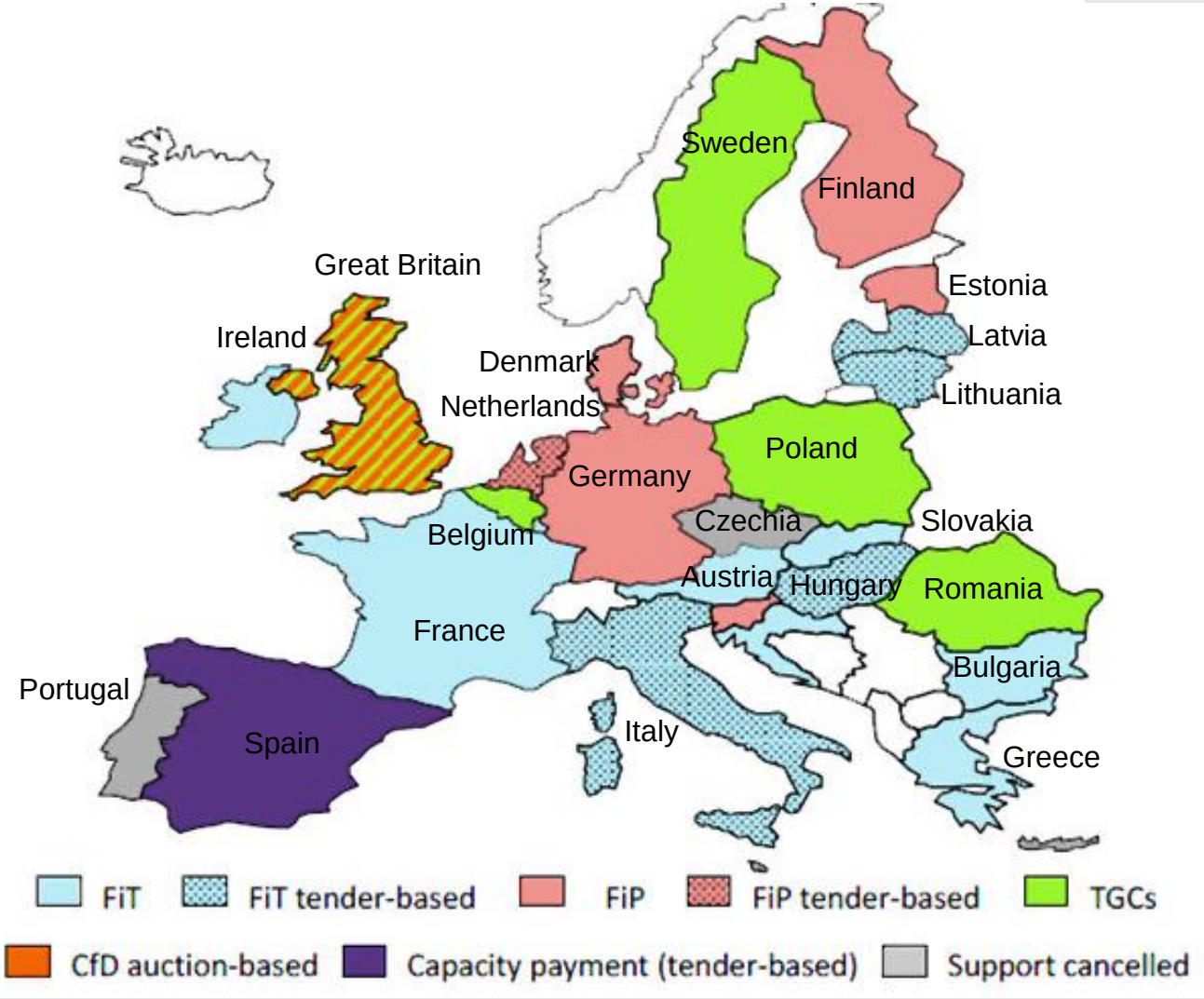


Rounded values
1 Mrd. kWh = 10^9 kWh

Source: AG Energiedaten, 21.12.2017

Electricity generation in Germany – comparison of the years 2000 and 2017

Policies are changing in direction of invitation of tenders



FiT = Feed-in tariffs
FiP = Feed-in premium
TGCs= Tradable green certificates
CfD= Contract for Difference

Source: 2014 JRC wind status report

Different conveying systems for renewable electricity in the EU

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 %

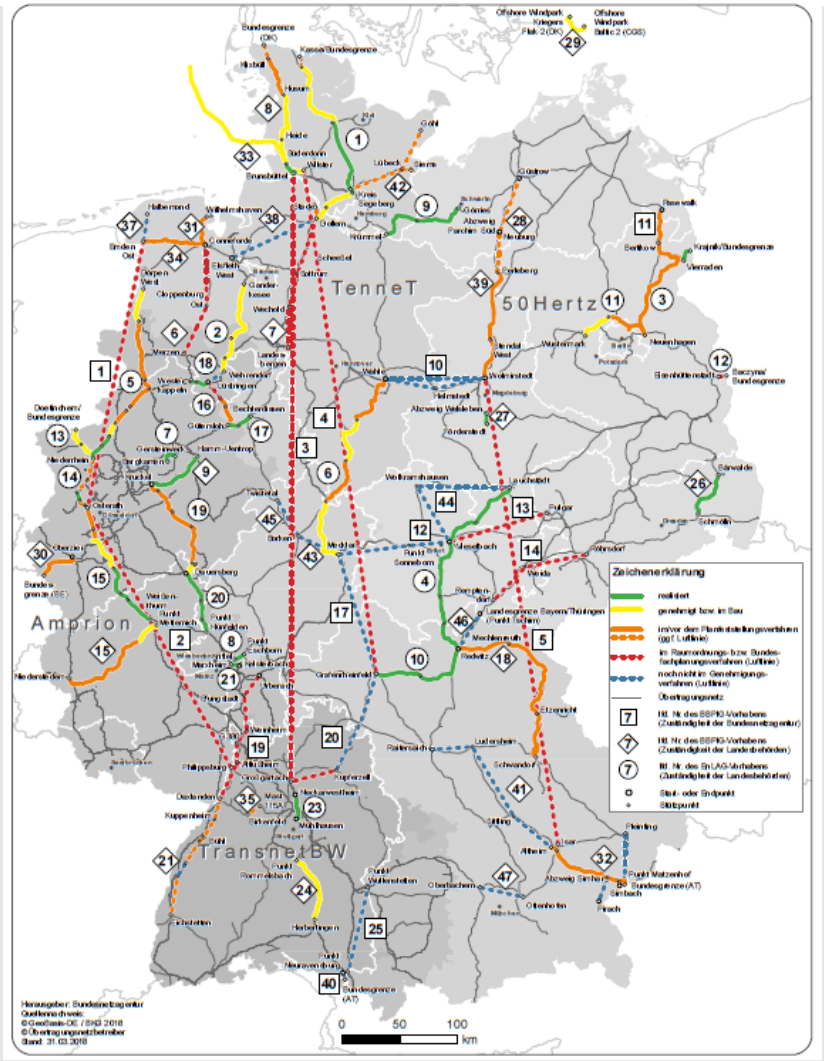
Own power consumption:
- Existing plants are exempted from the Renewable Energy Act
- Electricity, generated by eco-electricity plants, is charged with 40 %, all the rest has to pay the whole amount
- Small plants up to 10 kW (e.g. photovoltaic systems on house roofs) are exempted from the Renewable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

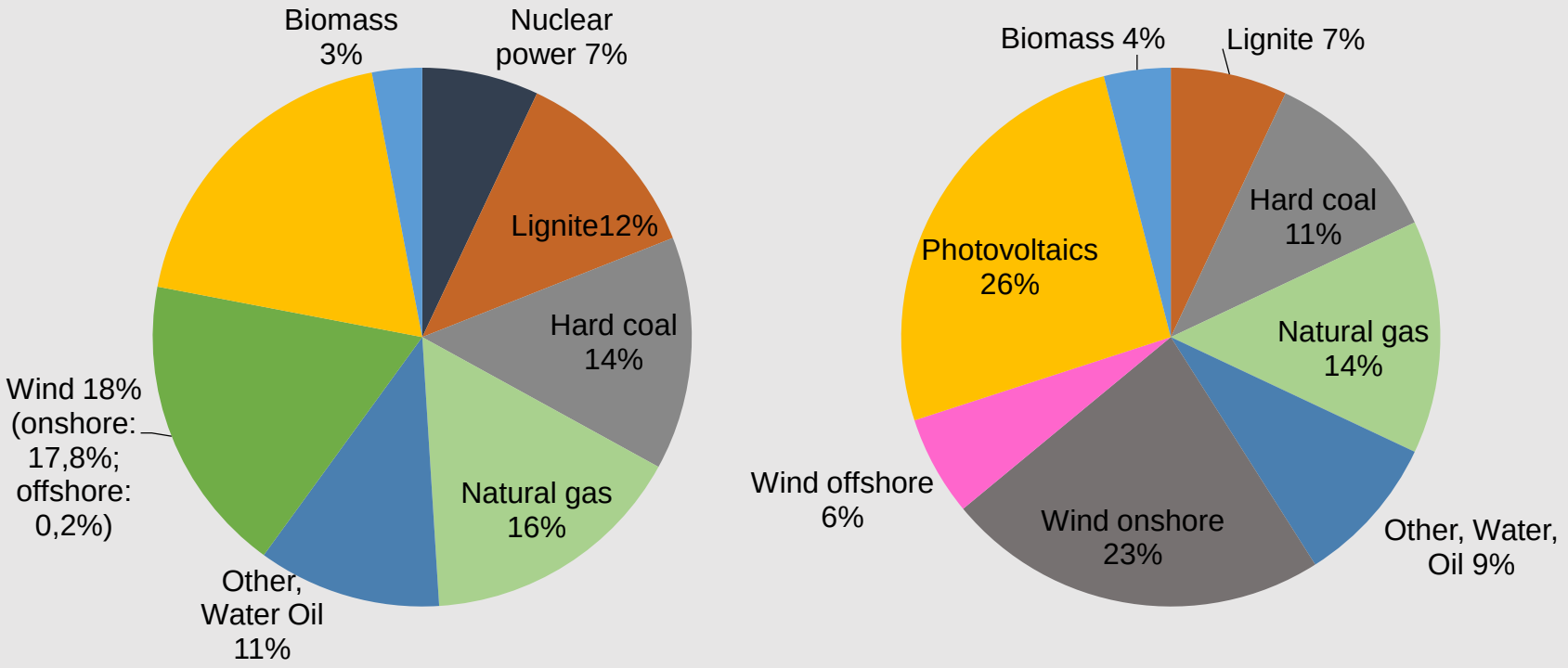
Source: - VDI Nachrichten, 4.Juli, 2014, Nr. 27/28
- http://www.bmwi.de/DE/Themen/Energie/Erneuerbare-Energien/eeg-reform.htm
-Different internet sources – Status: 5 August 2016l

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



Picture: http://www.netzausbau.de/SharedDocs/Bilder/DE/Karten/MonitoringGesamt.jpg?__blob=normal

Electricity network development plan for the Germany (BBPIG 2018)

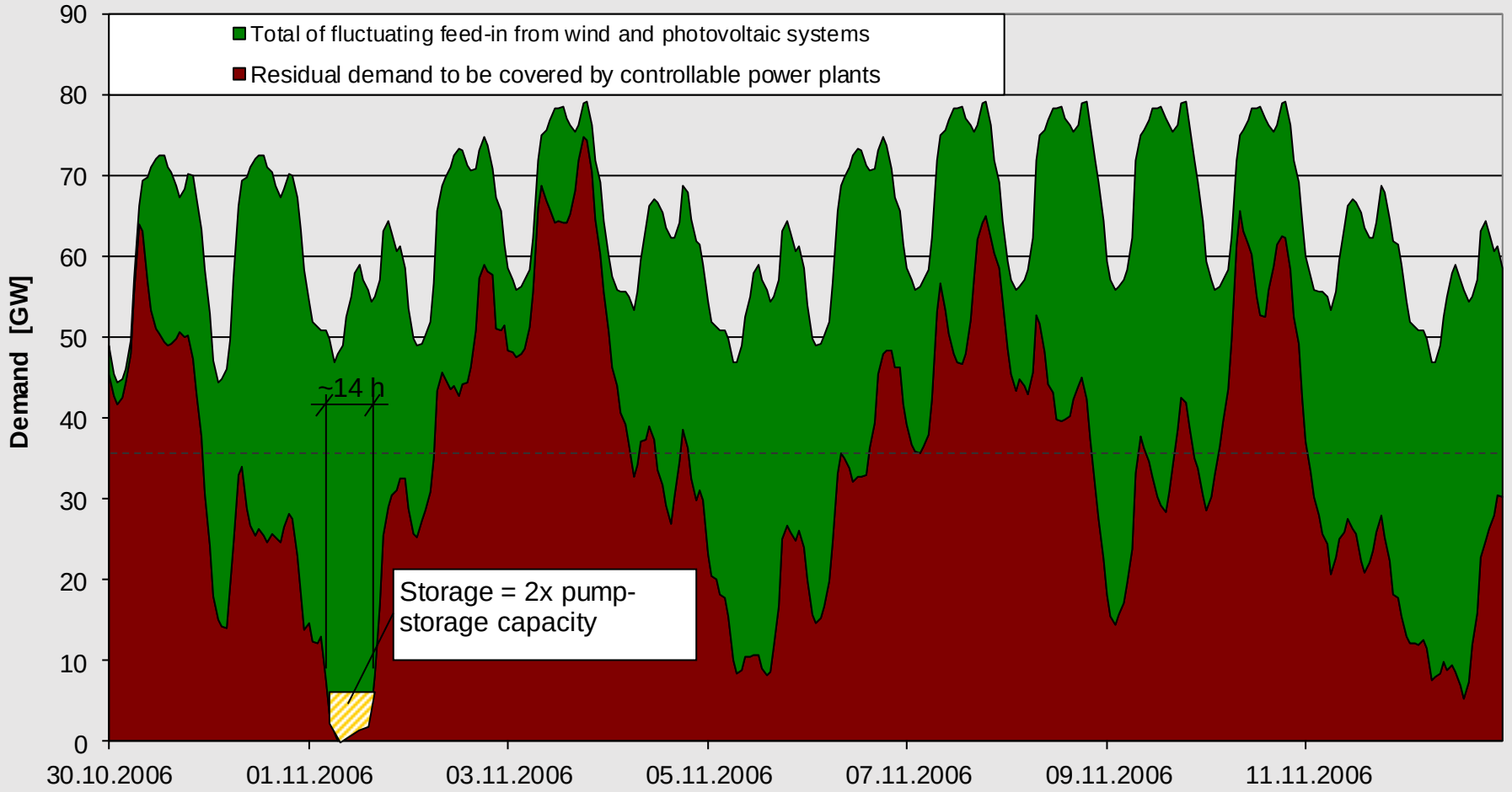


2012
Statistical value (175 GW)

2024
Objective of government (225 GW)

(Scenario B)

Objective for the power station capacities in Germany in the year 2024



Source: Doctoral thesis from T. Große Böckmann; Szenario BEE2020-2 Wochen

How much wind and photovoltaic without storage?

12 Wind energy converter, each 5 MW

(6 of Multibrid (AREVA) and 6 of REpower (Senvion) company)

Operation time 20 years

Lifetime foundation 20 years

Capacity Factor 45% (load duration 3900 h/a):

incl. maintenance- and failure times, power consumption of WEC and transmission platform inside wind park

Maintenance and services:

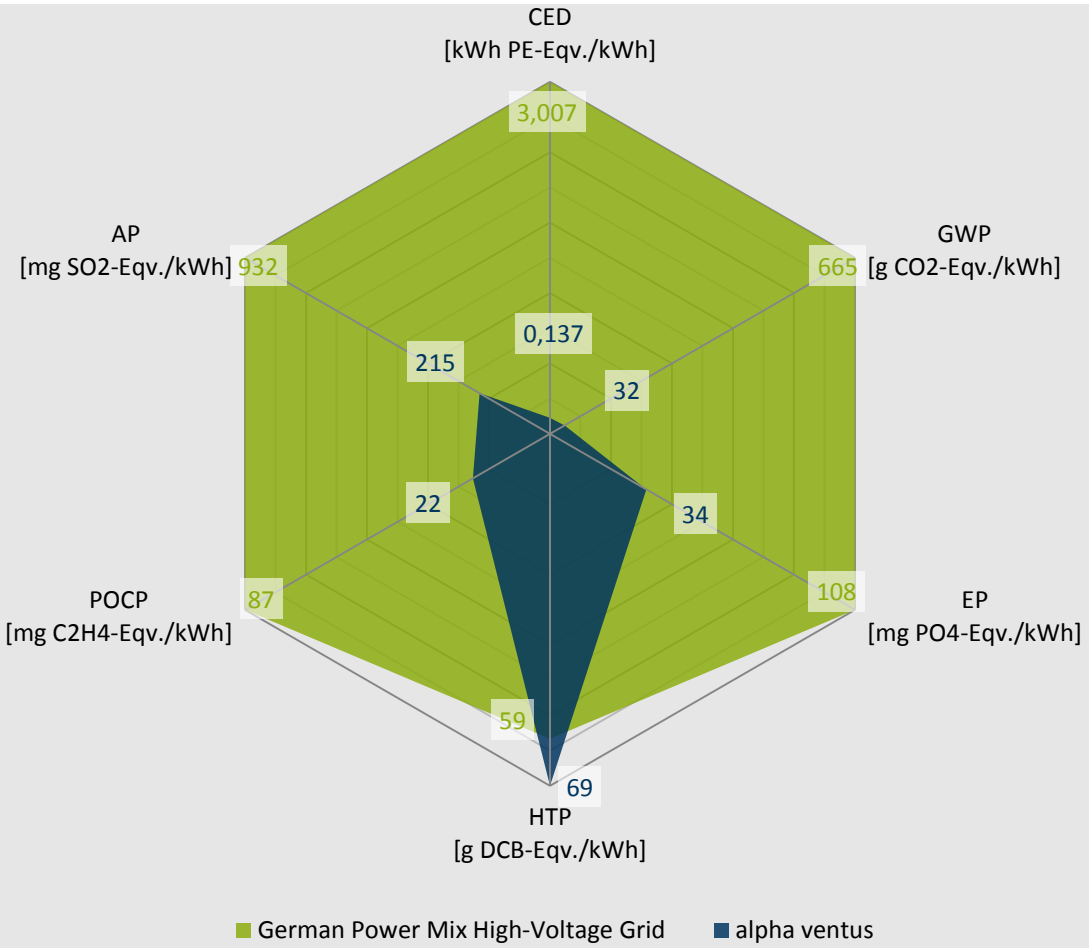
Change of 1/2 gearbox per station and operation time

Change of 1,25 rotor blades per station and operation time

120 helicopter transports per year for the wind park

180 ship transports per year for the wind park

Life Cycle Assessment wind park alpha ventus - Reference system



Classification of the results - Comparison with German Power Mix (uniform ranking)

- Scientific eco-balance of wind converter and photovoltaic shows good results
- Wind energy and photovoltaic use is increasing worldwide
- Technology is available
- Off shore wind park's are under construction, they deliver more electricity, but they are expensive
- In Europe are different support systems: Feed-in tariff, tax incentives, quota
- Germany: In the past fixed feet-in regulation for electricity of renewables over 20 years, private consumers are paying 7,4 €-Cent/kWh [1)] (wind) and 7-10 €-Cent/kWh [1)] (photovoltaic) for introduction and operating of renewables, companies less
- Today: The suppliers are selected through tendering
  - Last tendering on February 2015 = 4,5 €-Cent/kWh [1)]

[1)] 1,00 € = 1,1682 USD – 25th July 2018

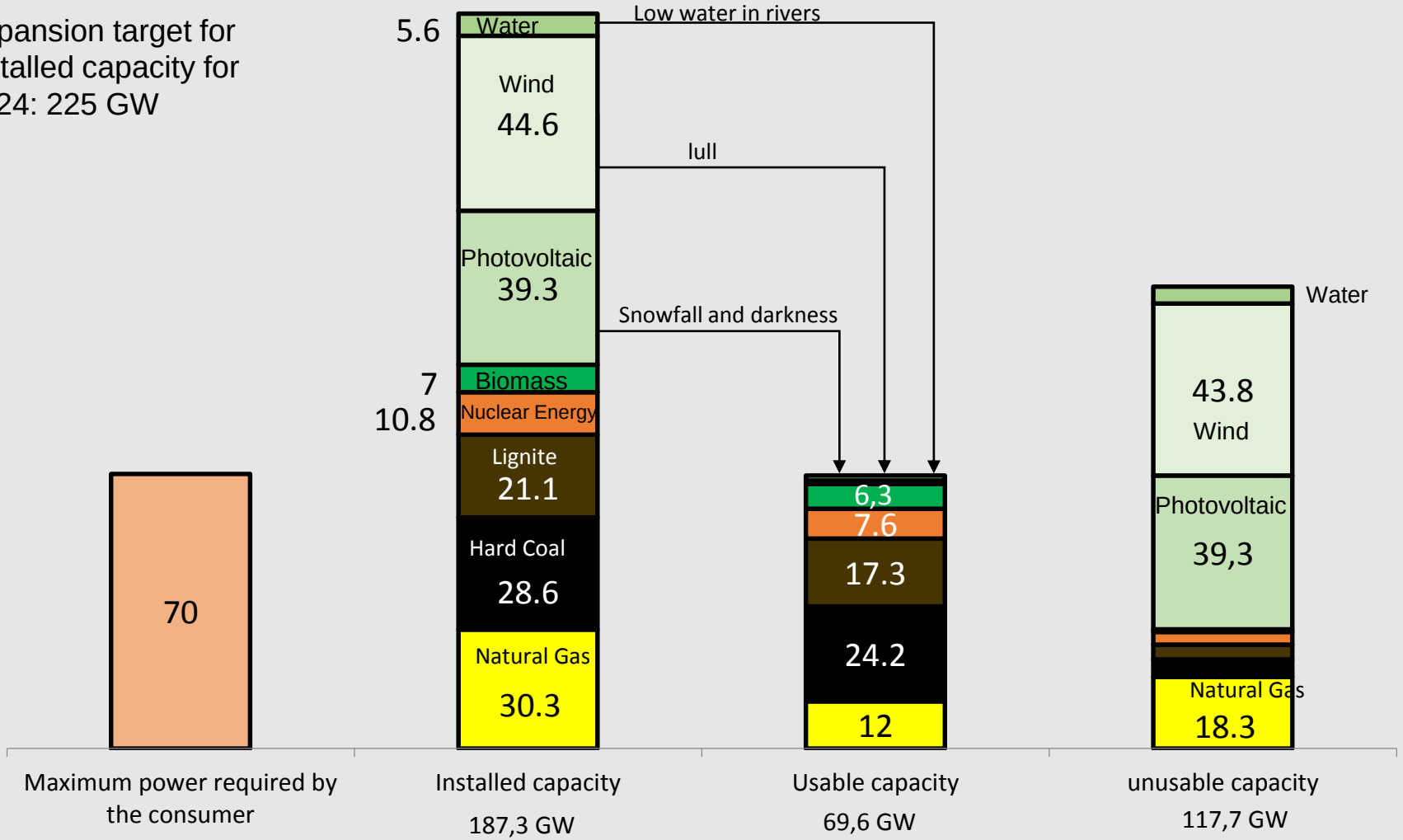
Conclusions

Thank you

Bild: http://www.cpmax.com/tl_files/content/leistungen/inspektionen/galerie/100629%20097_klein.jpg

Discussion

Expansion target for installed capacity for 2024: 225 GW



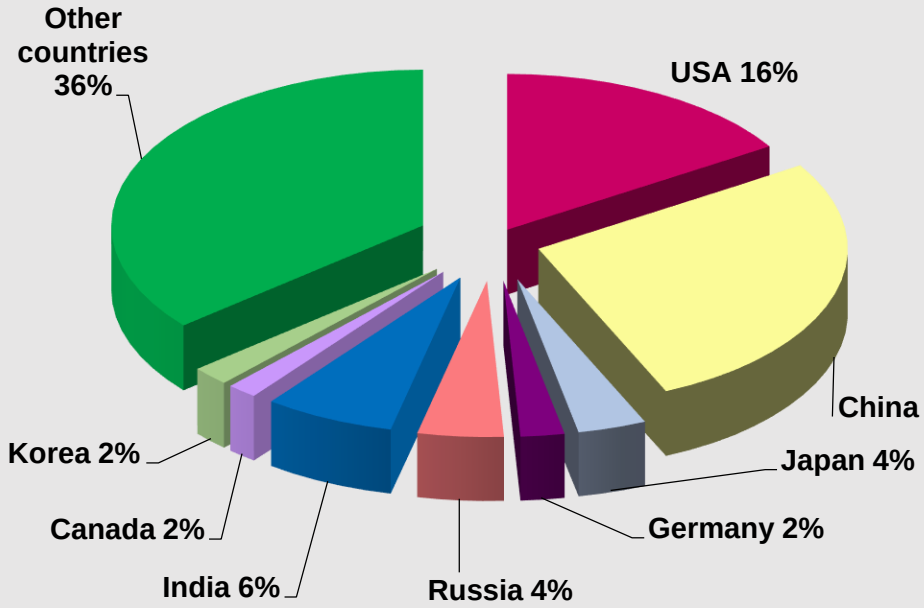
Current account of German power generation 24.01.2017 in GW

Global

CO_2 emission worldwide

2016: ~ 33,4 billion t

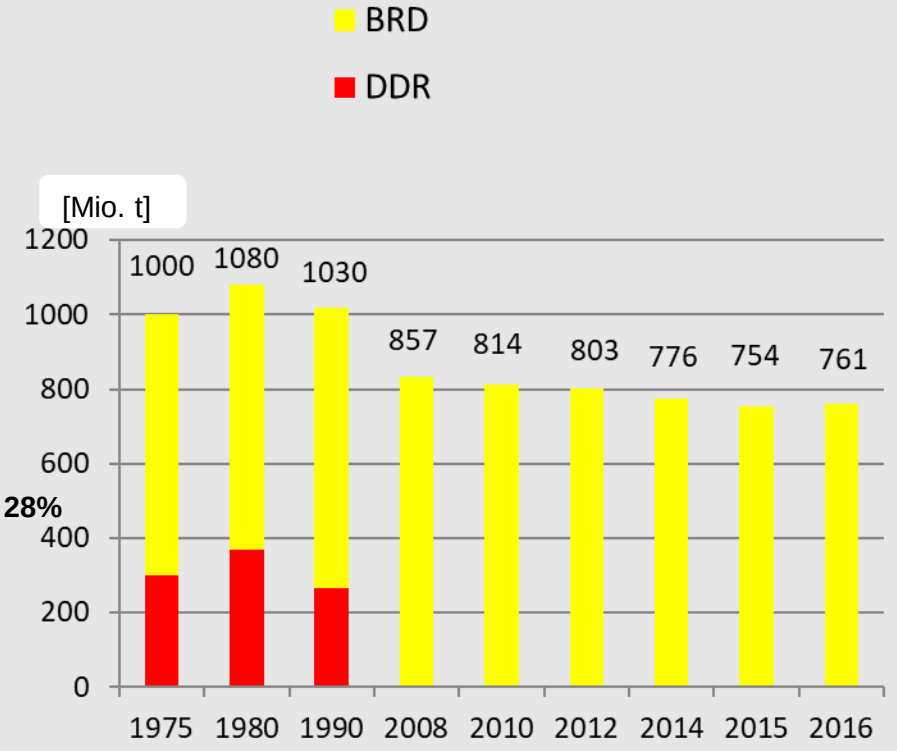
(In 2000: 24 billion t) In 1991: 21,6 billion t



FRG

CO_2 emission Germany

2016: ~ 760 million t



Rounded values

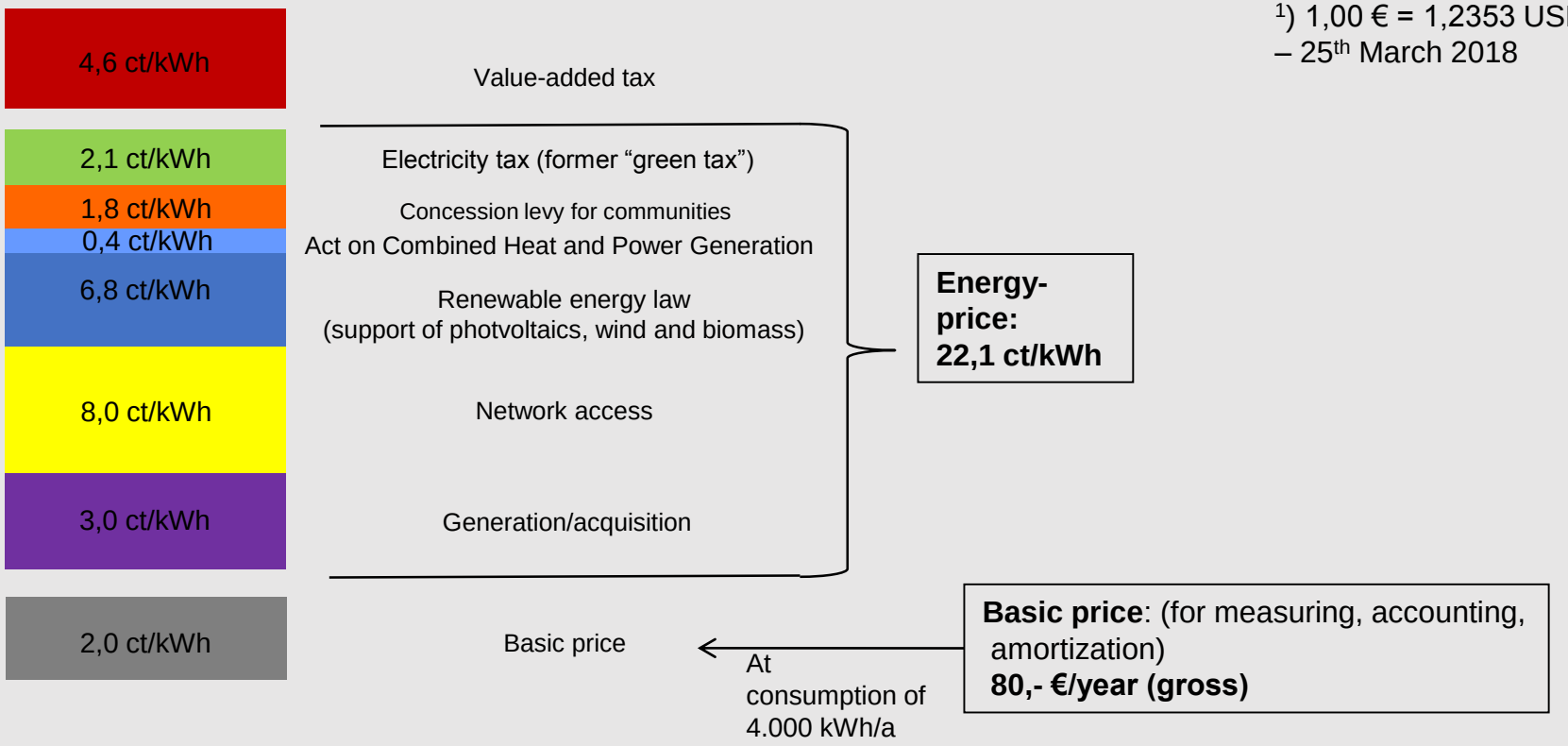
Sources: BMWI Energiedaten Status 04.10.2017
BP Statistical Review 2017

Global and energy consumption CO_2 emission

Total: 28,7 €-ct/kWh [1]), of which 56% are federal demand

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

[1]) 1,00 € = 1,2353 USD – 25th March 2018



Source: *Basic price, generation, network access* by using of tarifs of the Stadtwerke Velbert, November 2017
Concession levy is an average: It is depending from the population in the city, Status 2017

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