Renewable Energy Can Support Resilient and Equitable Recovery

A German Perspective

Berlin, 20.05.2020

Prof. Dr. Claudia Kemfert

Foto: Fotolia

COVID-19 and climate crisis have similar patterns

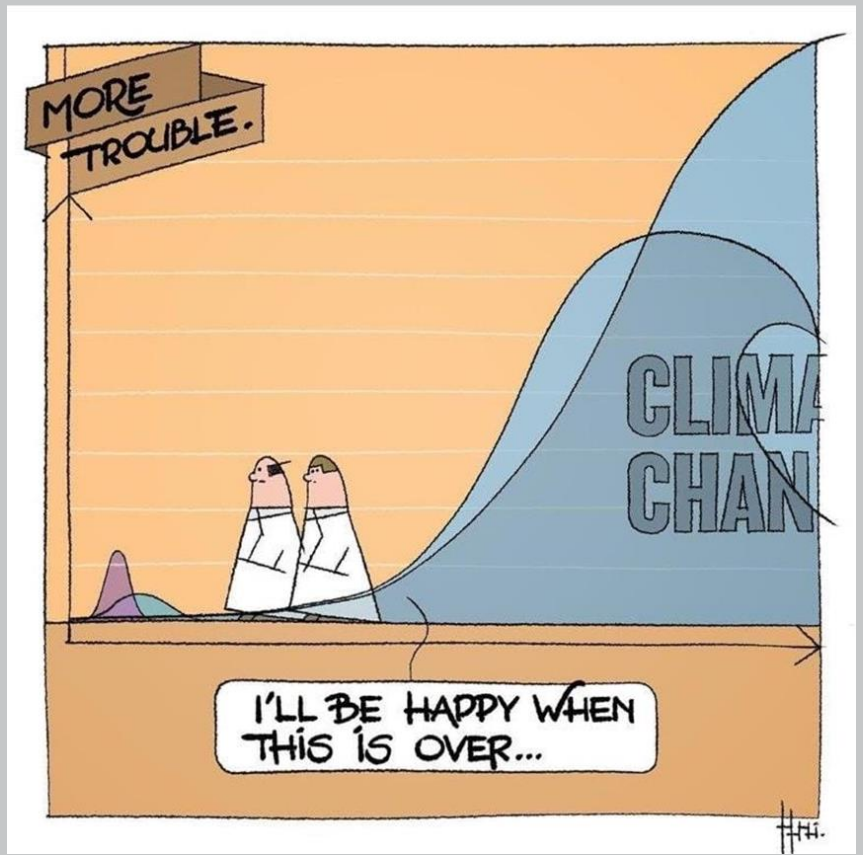
1. **Science has long warned** of pandemics and developed scenarios

2. **Foresight is worthwhile**: preparation (COVID: test capacities, communication etc), climate: adaptation through dyke construction etc.

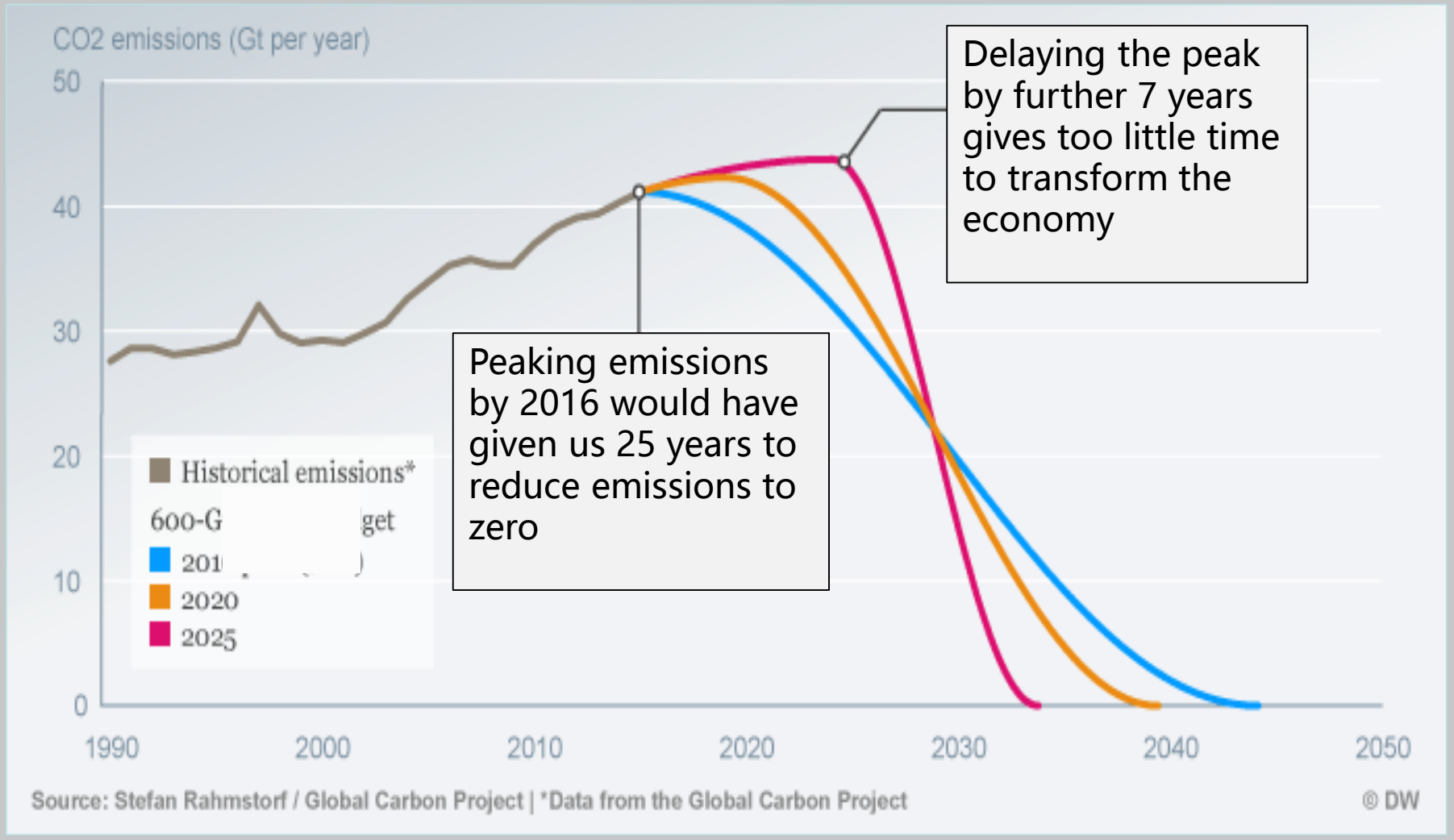
3. The crisis motto **"FlattenTheCurve**" for COVID and climate

4. **Strengthening democracy** through solidarity: generation justice: Today the young strengthen the old through their consistent social distancing behaviour. Tomorrow the old will strengthen the young through consistent climate protection.

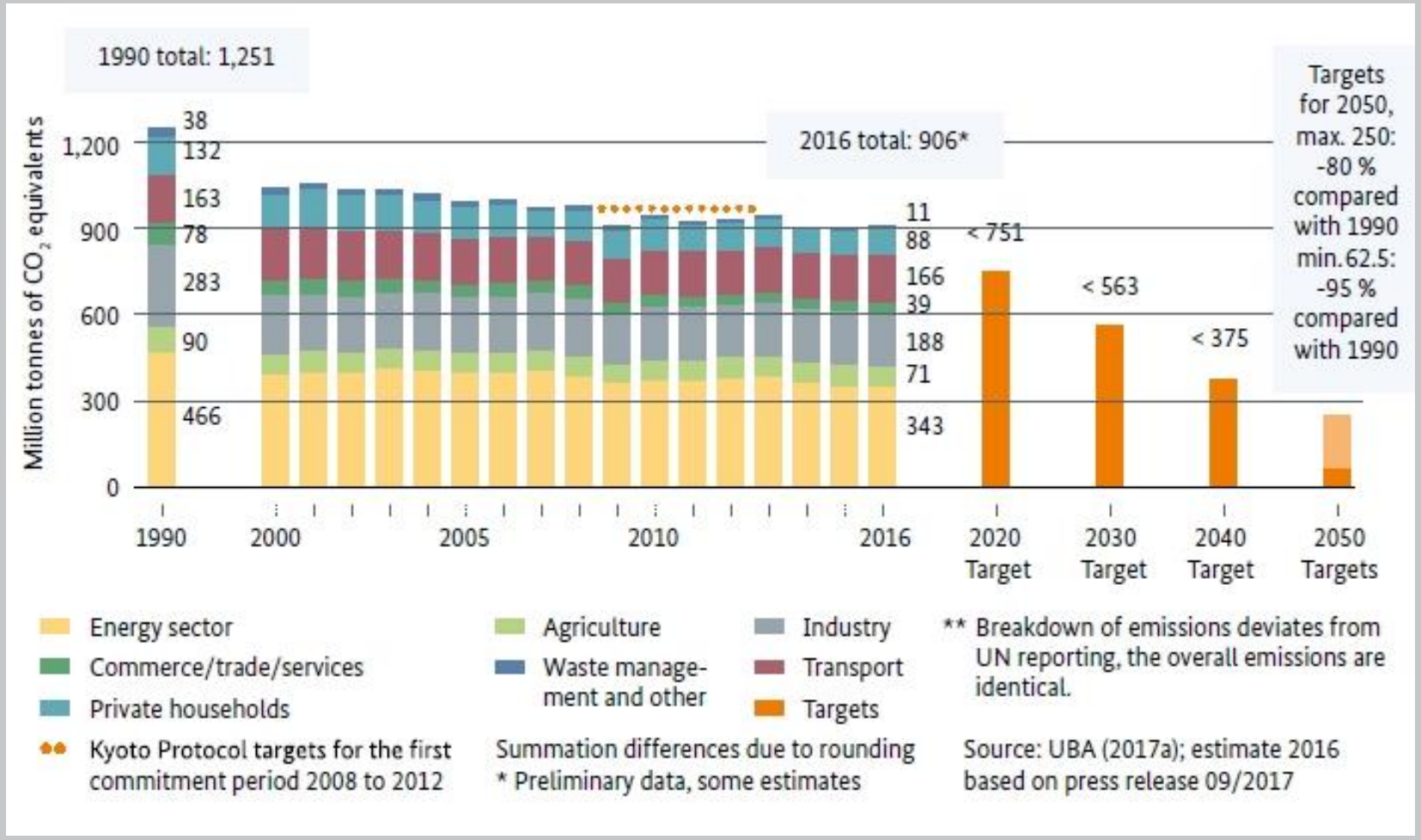
3. Motto #flattenthecurve



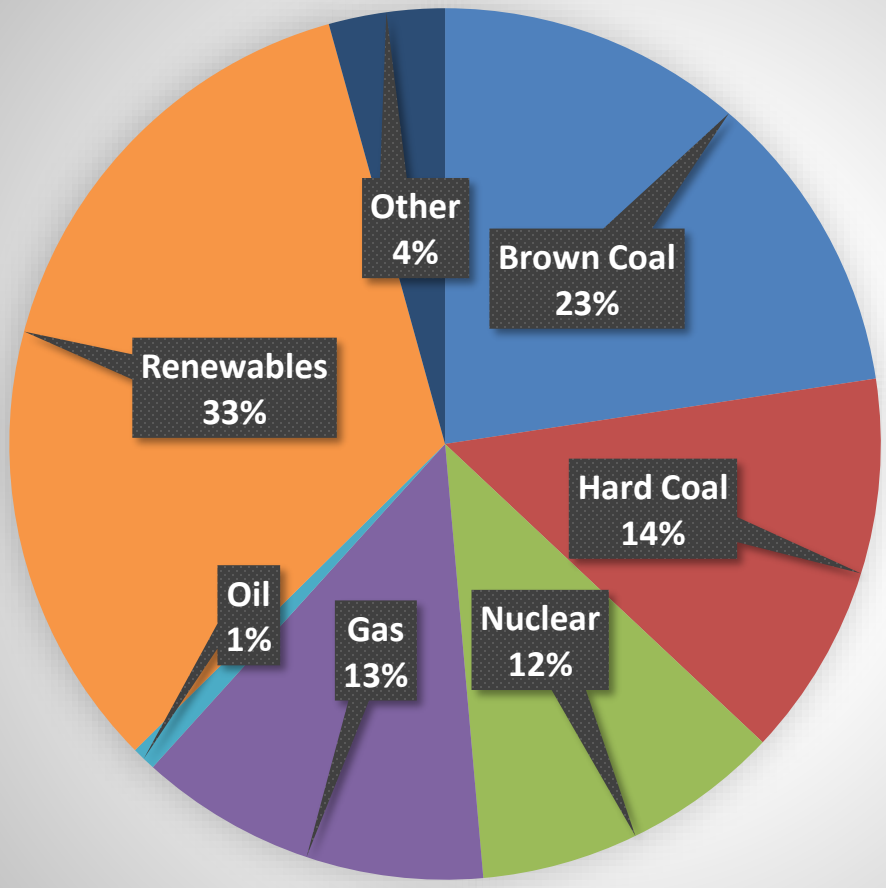
Global GHG Emissions Must Come to Zero around 2030 to Reach the 1.5°C Paris Target

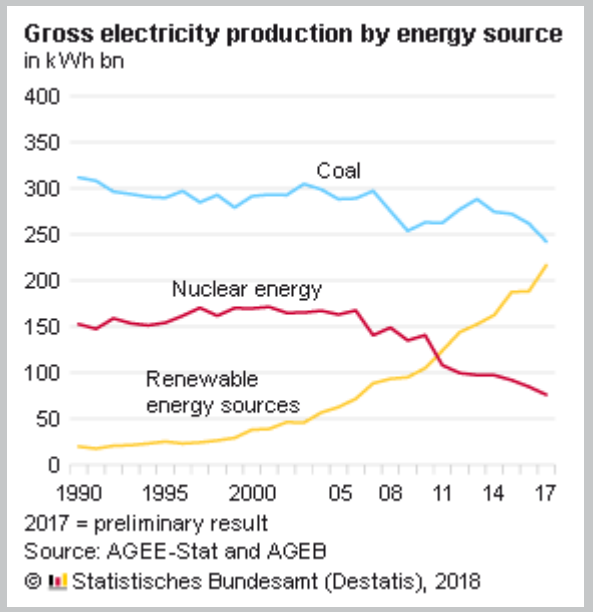


Emission Development by Sector and Targets



Electricity Production in Germany in 2017





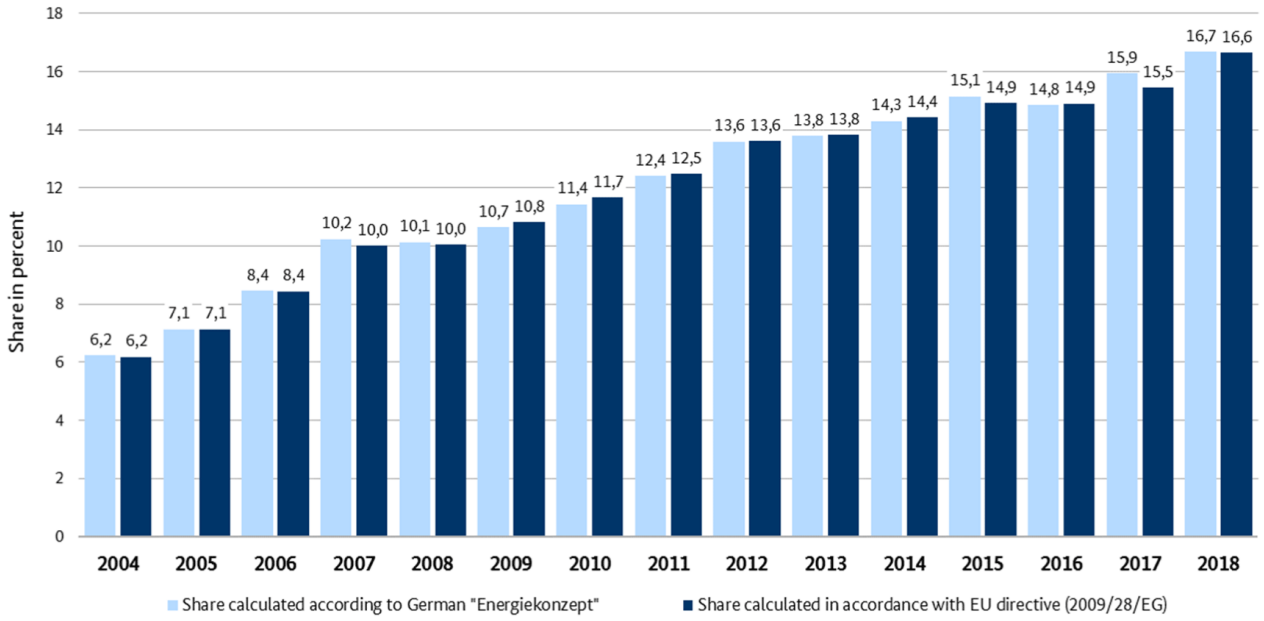
Source: BMWI 2017

Development of RES in Germany 1990-2018

Federal Ministry
for Economic Affairs
and Energy

AGEE stat
Arbeitsgruppe Erneuerbare Energien - Statistik

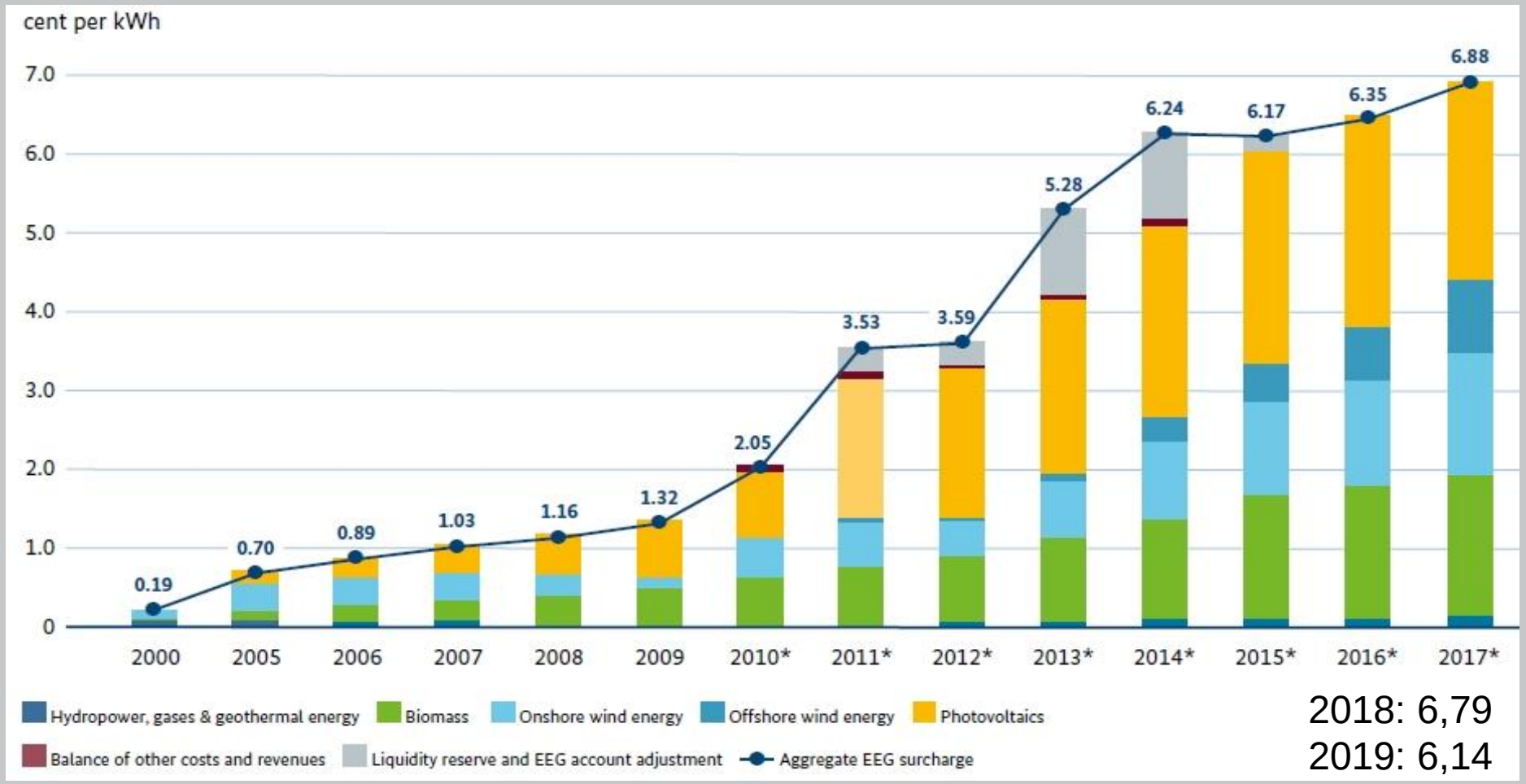
Development of renewable energy share of gross final energy consumption in Germany



BMWi based on Working Group on Renewable Energy-Statistics (AGEE-Stat); as of February 2019; all figures provisional

Source: BMUB 2017

Promotion RES by FIT: 24 Billion Euro in 2017: Surcharge to electricity price



2018: 6,79
2019: 6,14

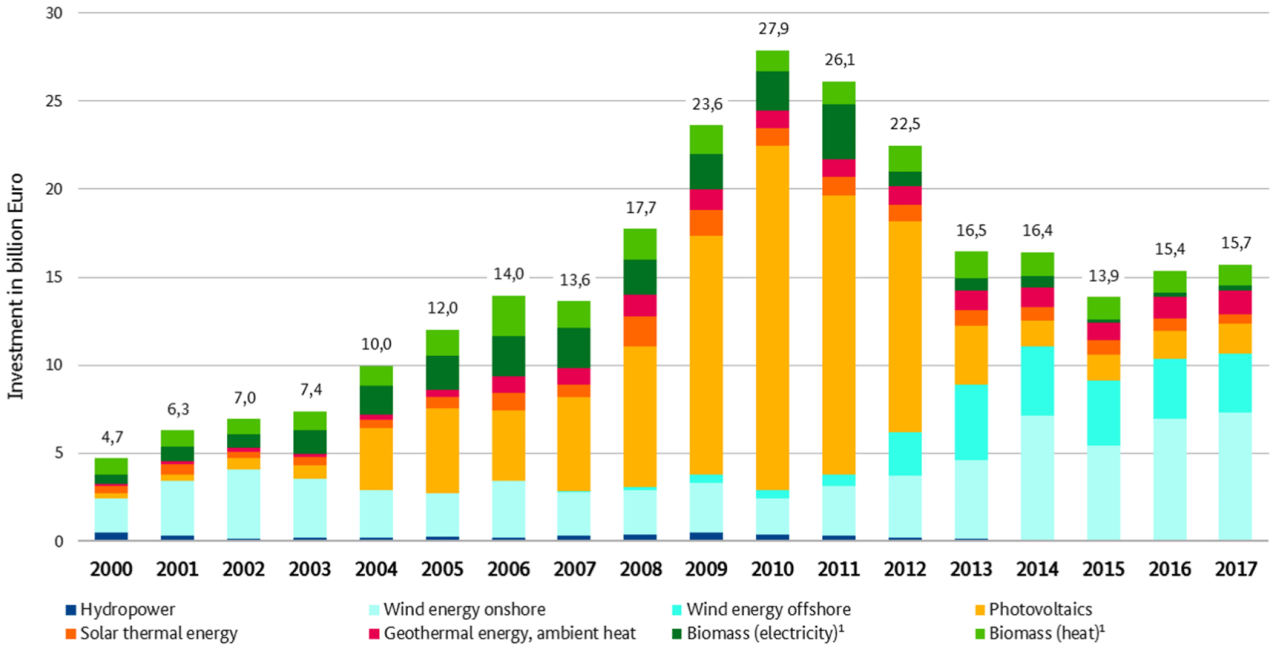
Source BMUB 2018

Development of Investment RES

Federal Ministry
for Economic Affairs
and Energy

AGEE Stat
Arbeitsgruppe Erneuerbare Energien - Statistik

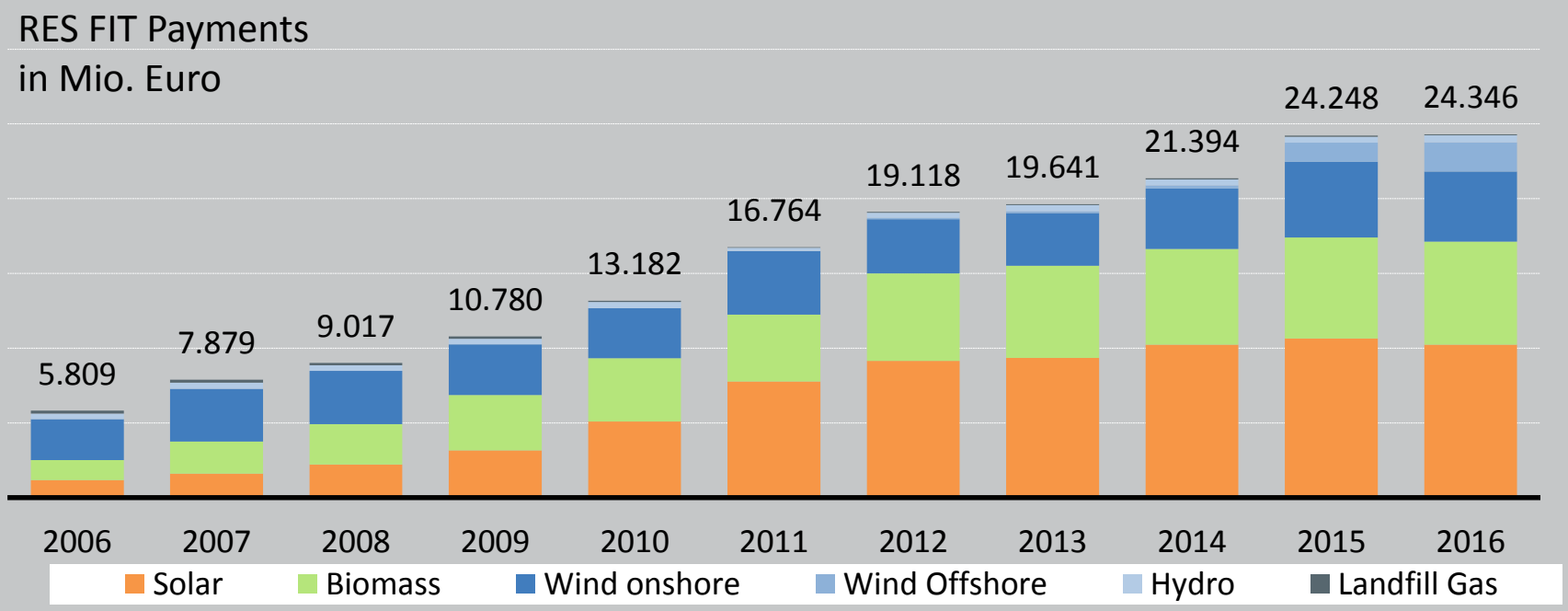
Development of investment in construction of renewable energy plants in Germany



¹ Solid, liquid and gaseous biomass

BMWi based on Centre for Solar and Hydrogen Research Baden-Württemberg (ZSW); as of December 2018

RES FIT Payments 2006-2016

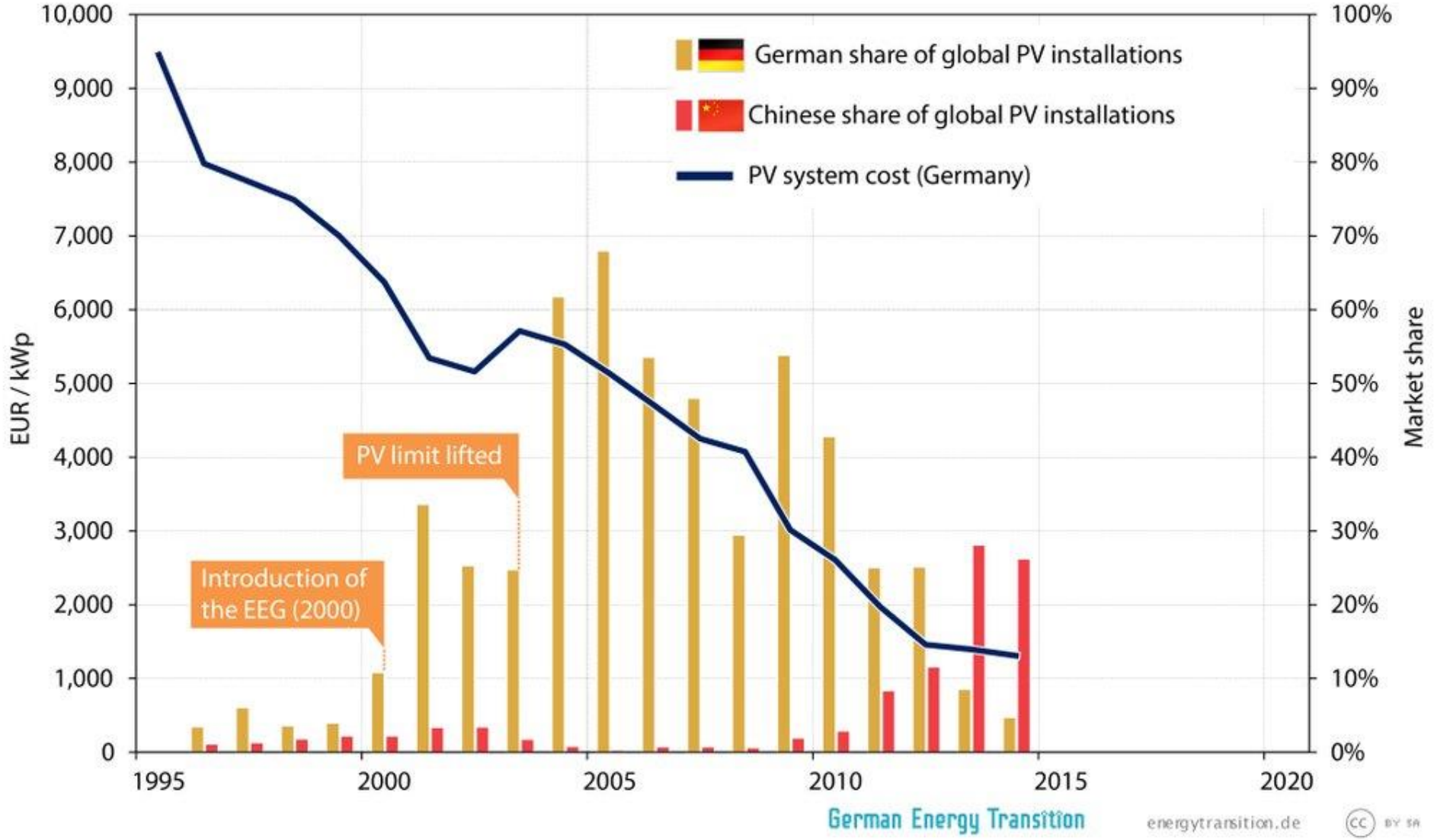


Quelle: Bundesnetzagentur

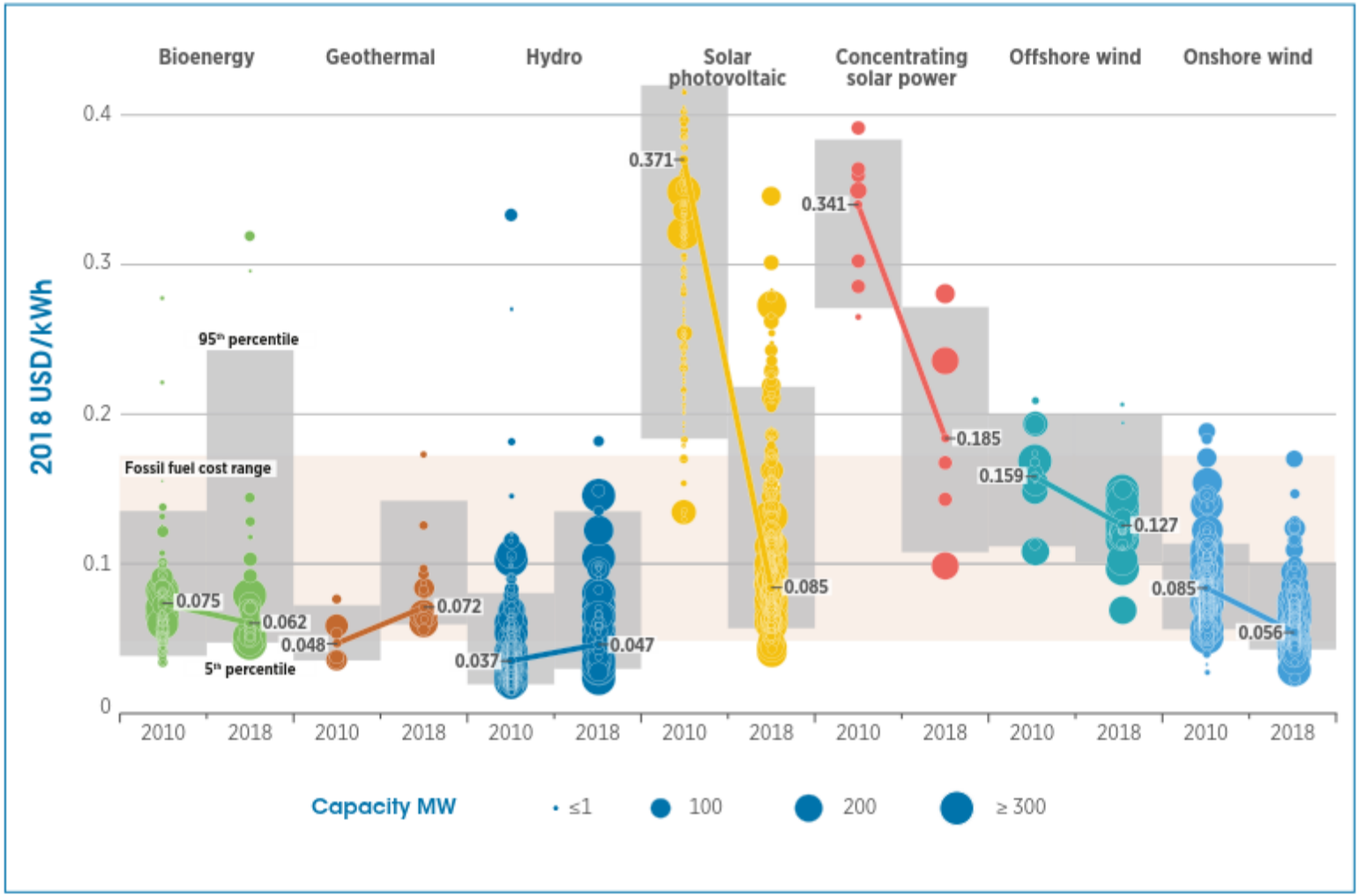
How Germany helped bring down the cost of PV for the world

When PV was still expensive, Germany built PV massively, accounting for up to two thirds of global installations

Source: BP, DGS, photovoltaikumfrage.de, BSW, Öko-Institut e.V.



LCOE Renewable Energy 2010-2018



Source: IRENA 2019

DIW BERLIN

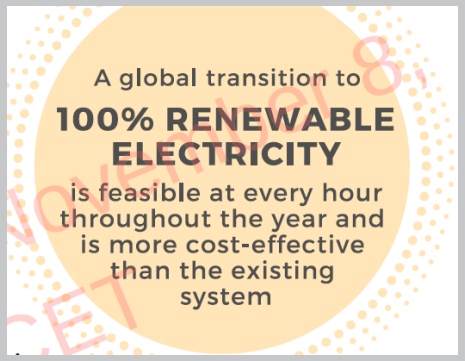
100% Renewable Energy Transition

Pathways and Implementation

Edited by

Claudia Kemfert, Christian Breyer and Pao-Yu Oei

Printed Edition of the Special Issue Published in *Energies*



Lessons from Modeling 100% Renewable Scenarios Using GENeSYS-MOD

PAO-YU OEI,[a,b*] THORSTEN BURANDT,[a,b,c,d] KARLO HAINSCH,[a,b] KONSTANTIN LÖFFLER,[a,b,c] and CLAUDIA KEMFERT[c]

ABSTRACT

The main aim of models has never been to provide numbers, but insights. Still, challenges prevail for modelers to use the best configuration of their models to provide helpful insights. In the case of energy system modelling, this becomes even

Renewable Energy 139 (2019) 80–101

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journal homepage: www.elsevier.com/locate/renene

Flexible electricity generation, grid exchange and storage for the transition to a 100% renewable energy system in Europe

Michael Child [a, *], Claudia Kemfert [b], Dmitrii Bogdanov [a], Christian Breyer [a]

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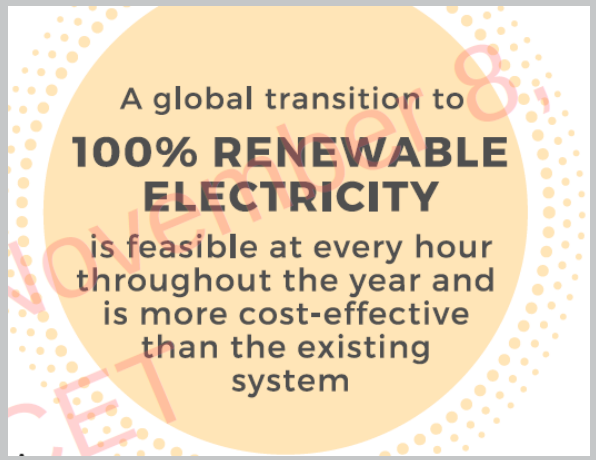
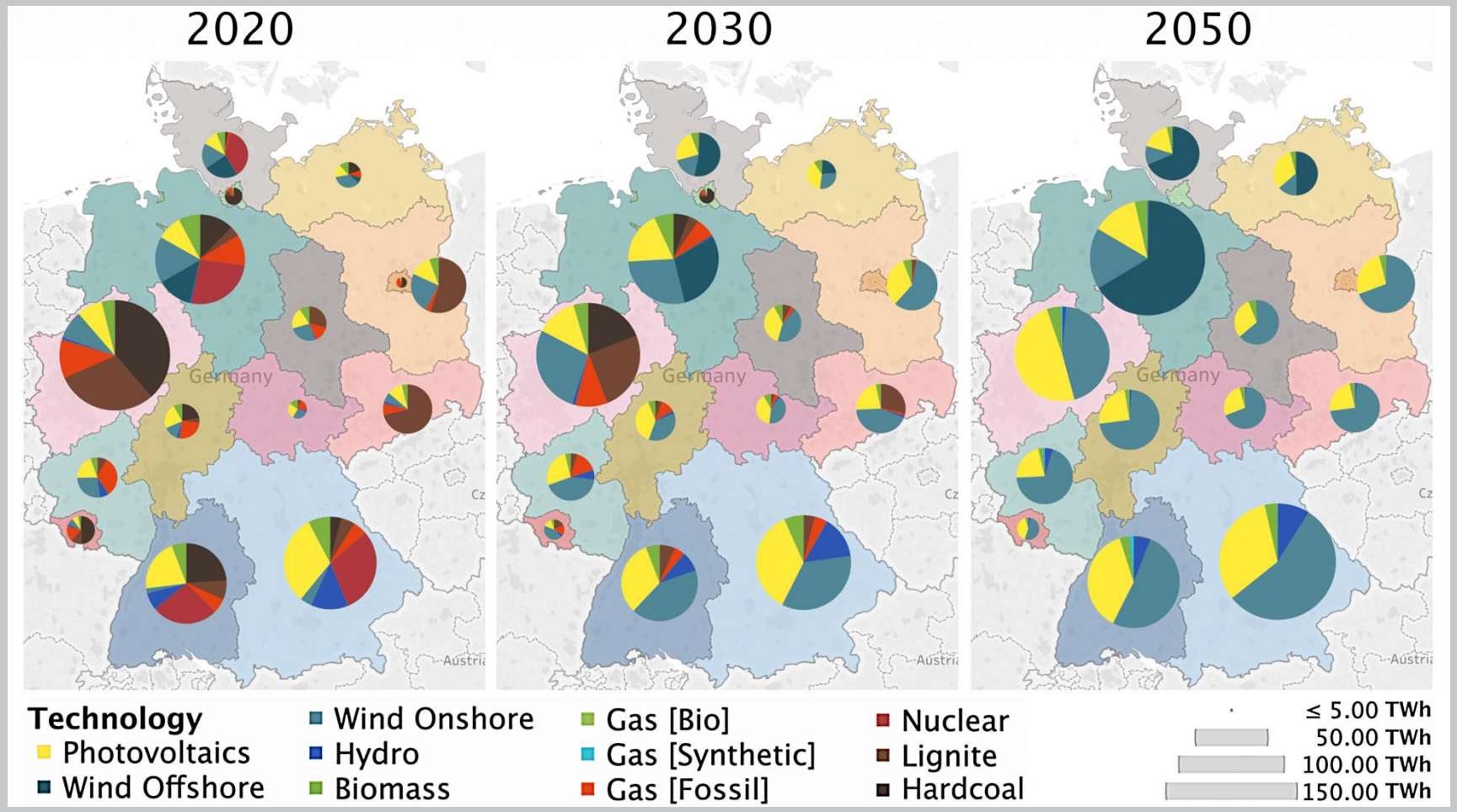
[b] German Institute for Economic Research (DIW) and Hertie School of Governance, Mohrenstrasse 58, 10117 Berlin, Germany

100 % Renewable energy system for all sectors feasible , economically and technically efficient



Energy Transitions changes all sectors

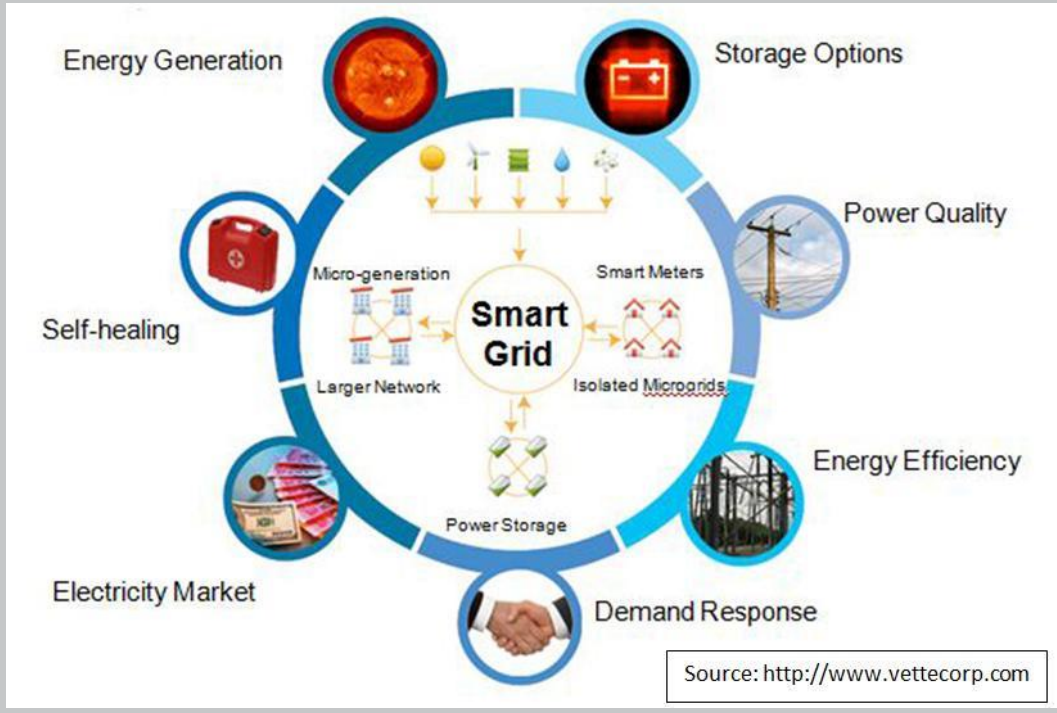
Model simulation für 100 % RES Germany



Source: Oei et al 2019

The Energiewende in Germany : different solutions needed

- Load management
- CHPs: Electricity and Heat
- Expanding renewable energy
- Smart Grids
- Storage
- Grid Extension to Scandinavia
- „Virtual Power Plant“



Quelle: Stadtwerke München

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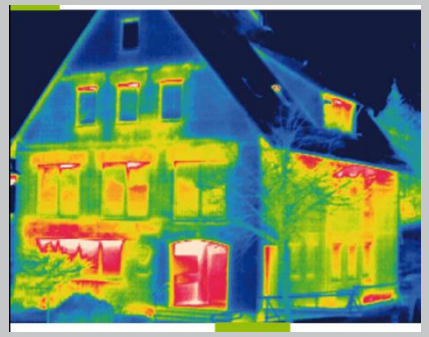
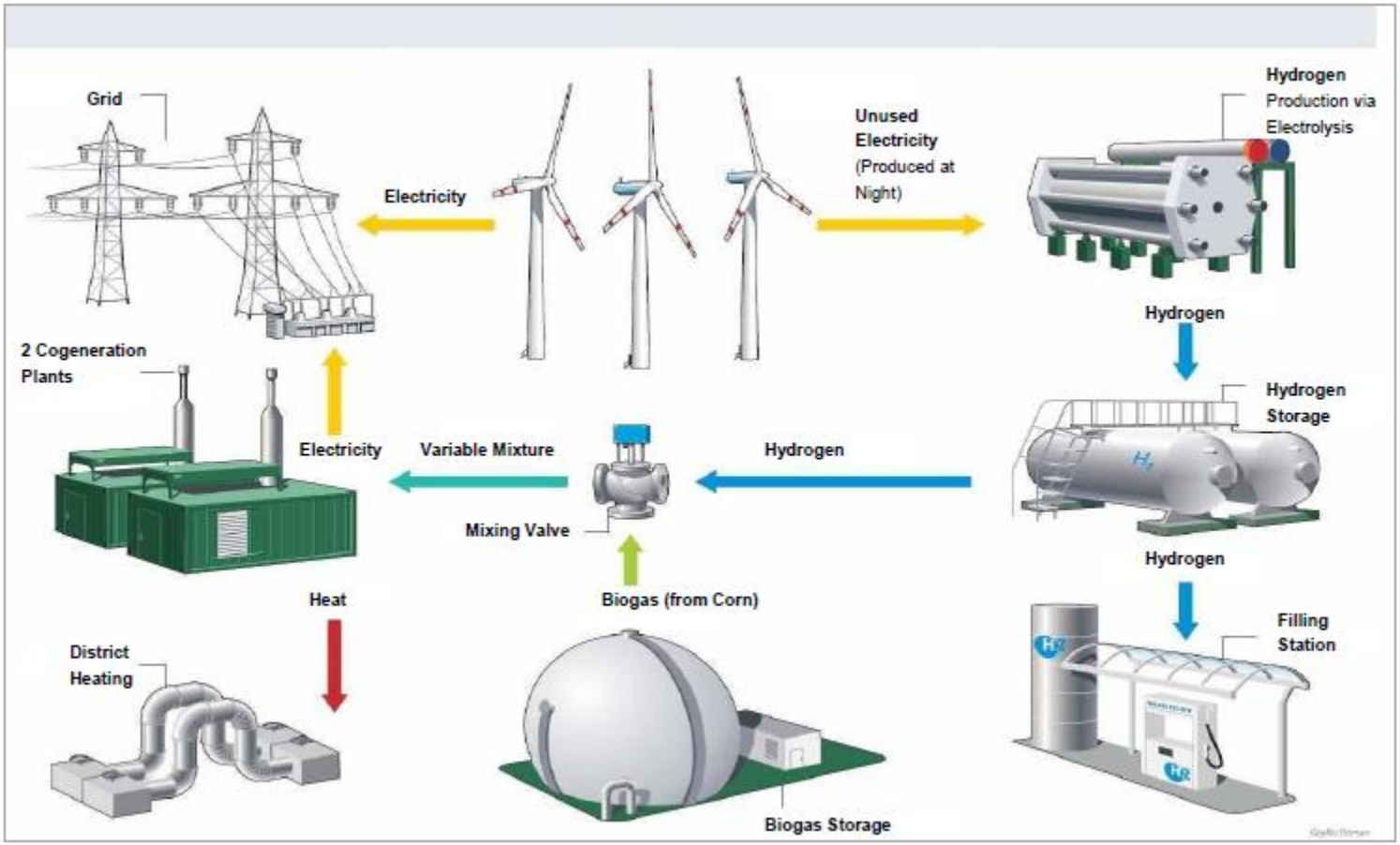
SUSTAINABLE TRANSPORTATION AND BUILDINGS



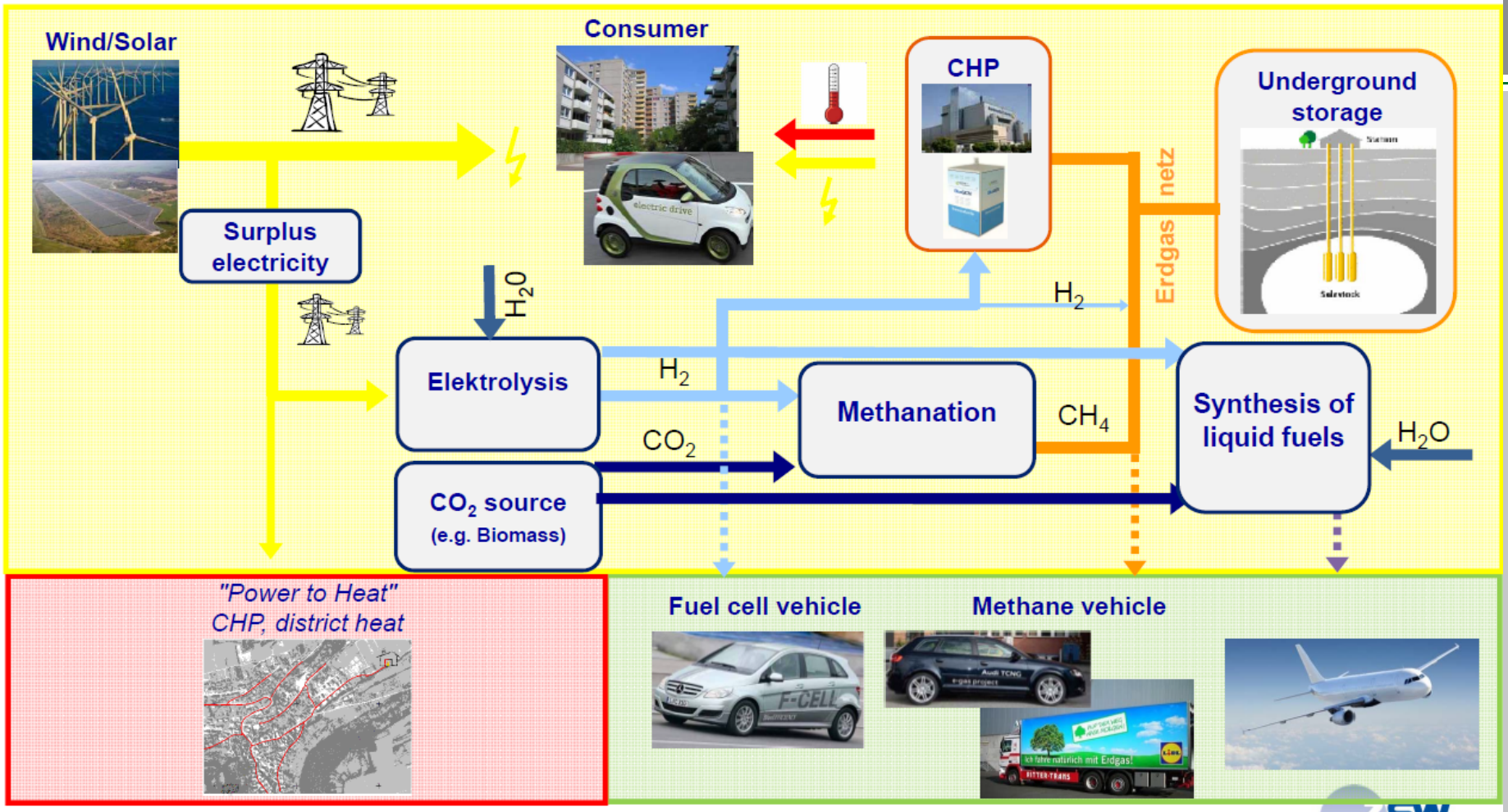
Energy Transition: Sector Coupling



Source: http://www.bi-bigben.de/elements/hybridkraftwerk1.jpg

„We need a more integrated approach.“
Connecting the Energy Sectors

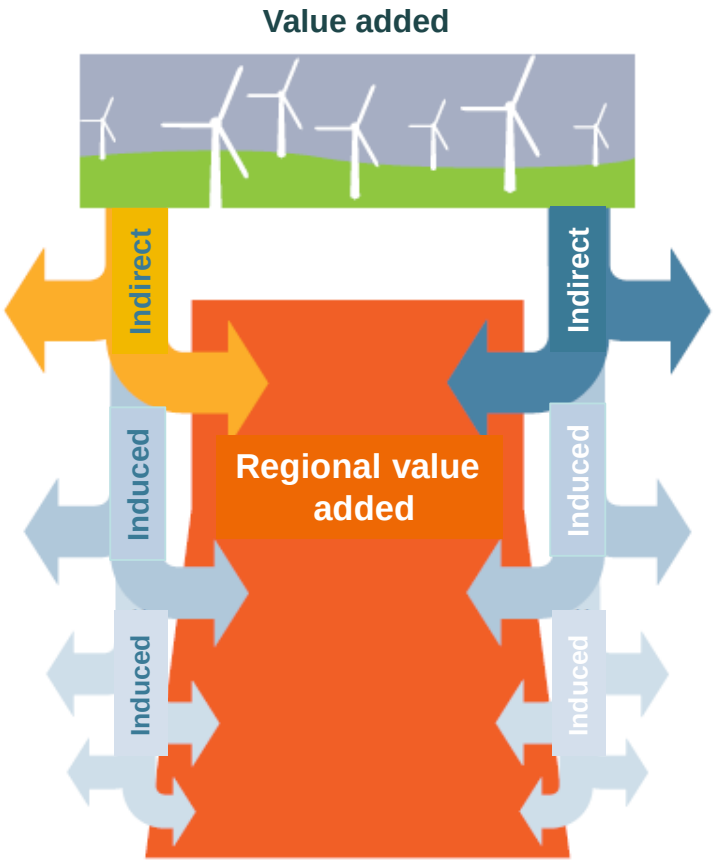
Example: Power to Heat, Power to Gas, Power to Liquids (Power to Chemicals)



RENEWABLE ENERGY IN THE CITIZENS‘ HANDS

Value added in the region

Value added scheme



Source: Based on Studie Uni Kassel

Direct regional value added

- Income of employed in RE facilities
- Taxes
- Portion of income taxes
- Portion of foreign investors

Indirect regional value added

- Demand for commodities (replacement parts)
- Demand for services (eg. Maintainance)

Induced value added

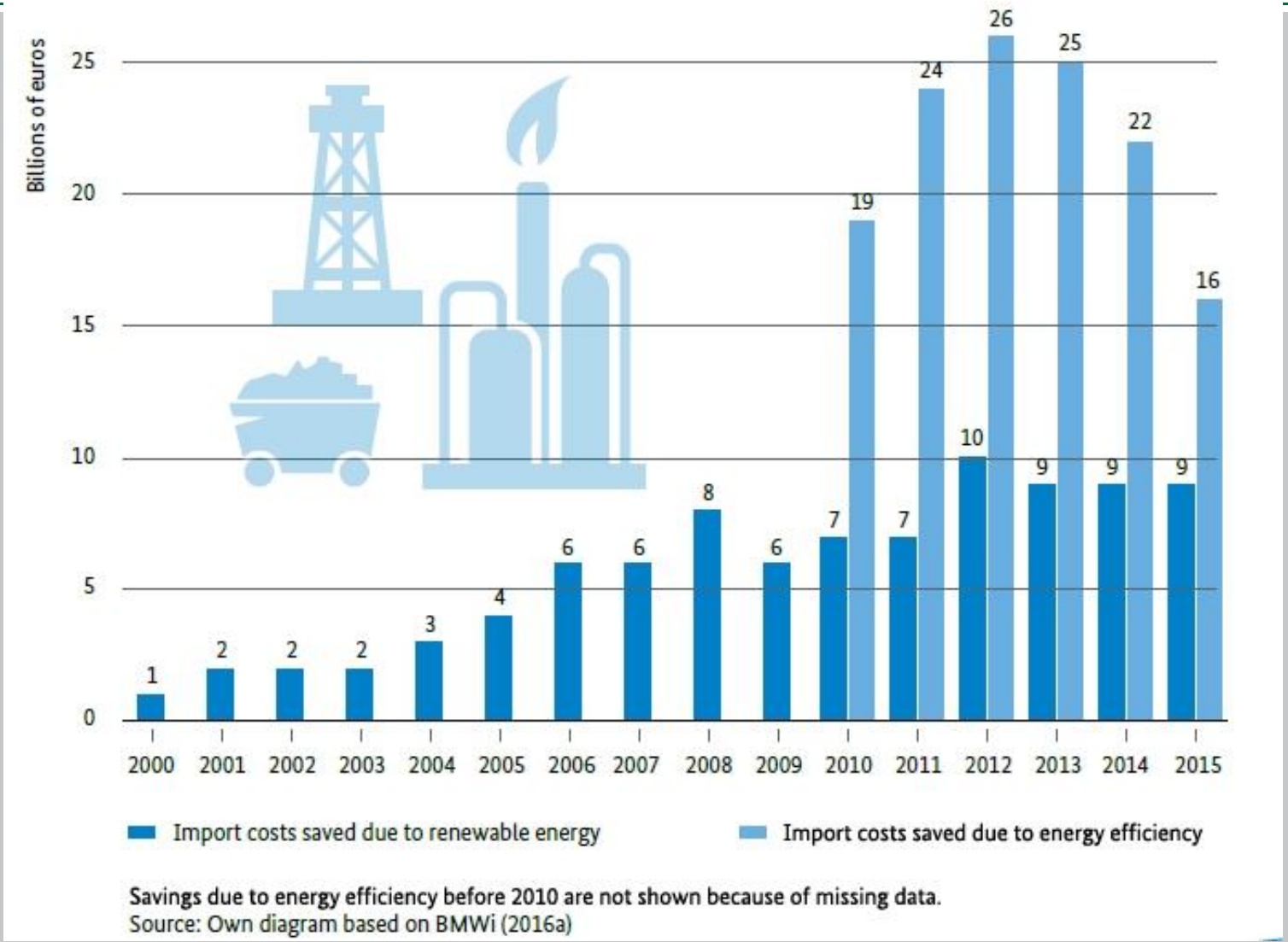
- Spending of created income, profits and revenues of the companies in the communities of the region

Quelle: BMVBS, 2011

Co –Benefits of the energy transition

Source: DiW Econ 2015

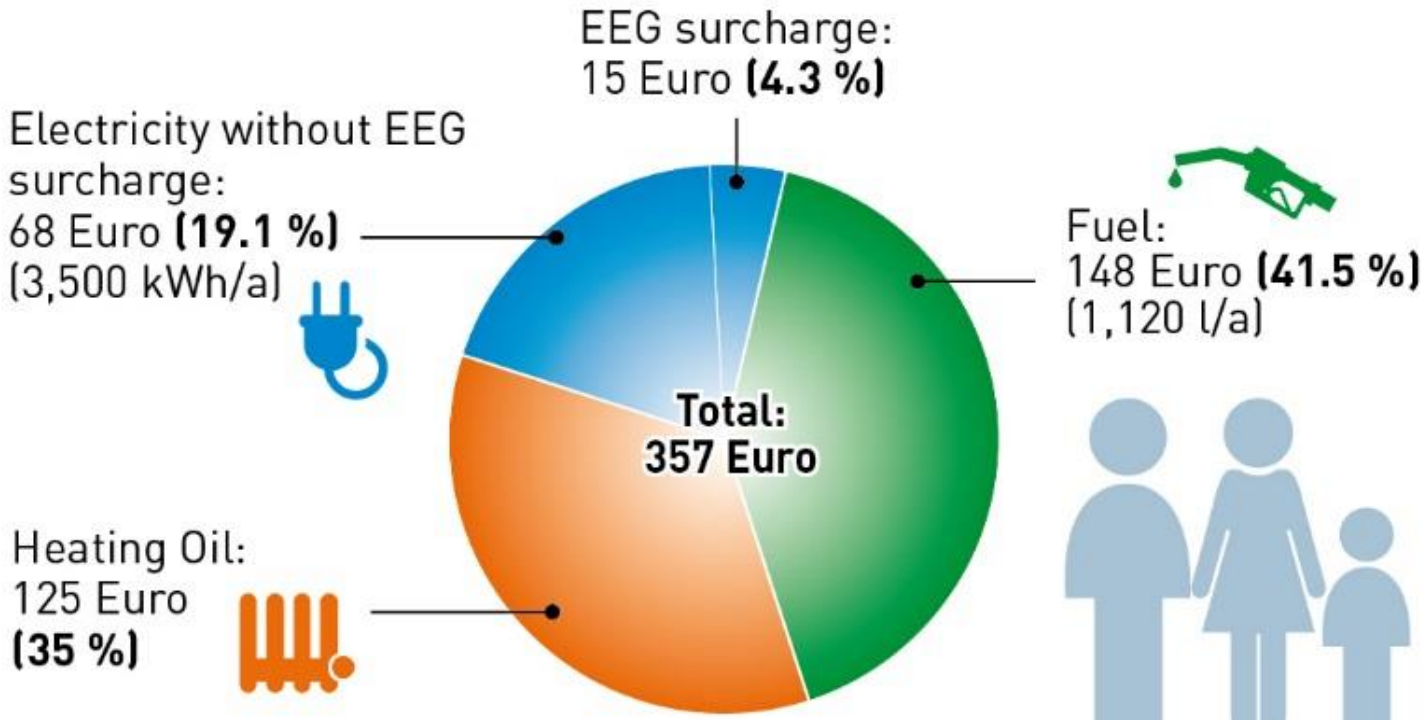
Co-Benefit: Reduced Fossil Import Costs



Savings due to energy efficiency before 2010 are not shown because of missing data.
Source: Own diagram based on BMWi (2016a)

Monthly Energy bill of a Three-Person Household in Germany in 2013

(Oil heating / Petrol-driven car included)



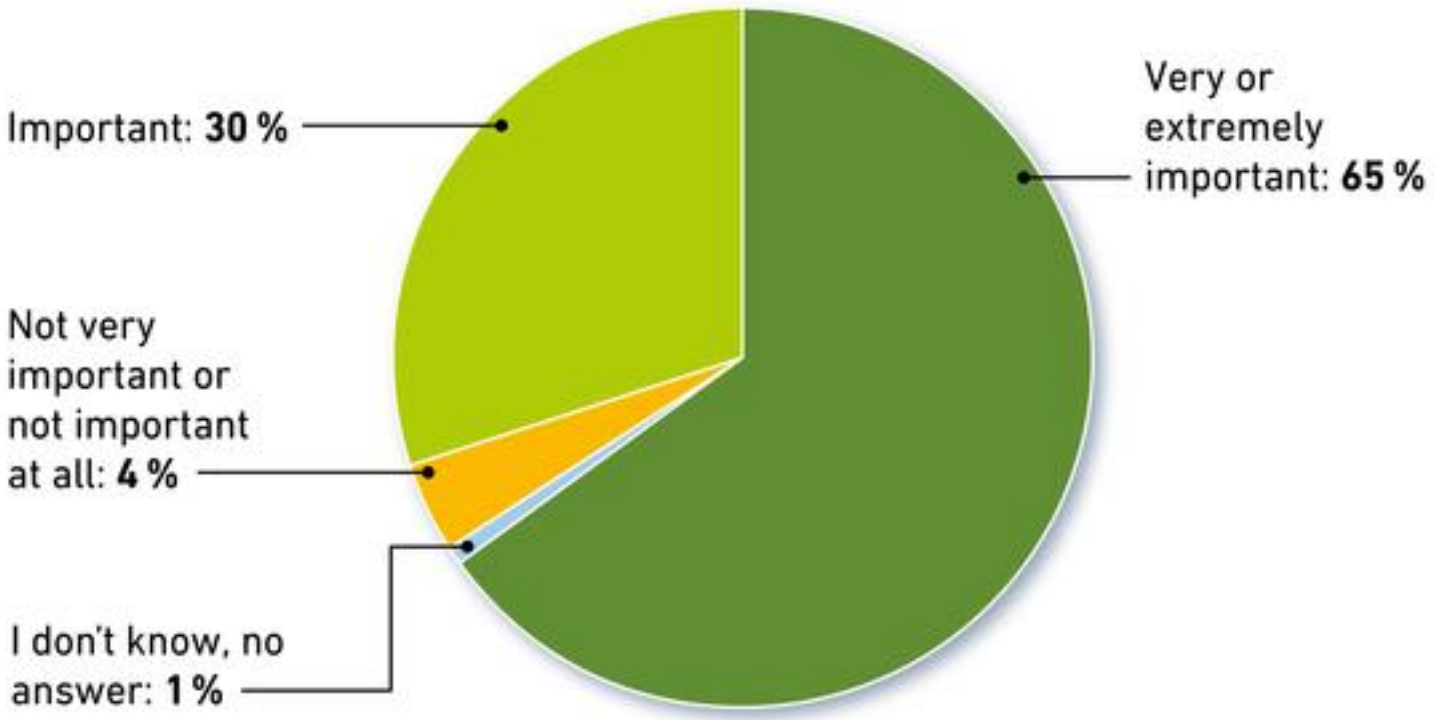
Source: AEE, own calculation; as of 10/2013

www.renewables-in-germany.com

Renewable Energies Agency

95% of the German population support further expanding renewable energy

Increased use and expansion of renewable energy is...



Source: Poll from Kantar Emnid commissioned by the Renewable Energies Agency, 1,016 polled
As of: 7/2017

RENEWABLE ENERGIES AGENCY
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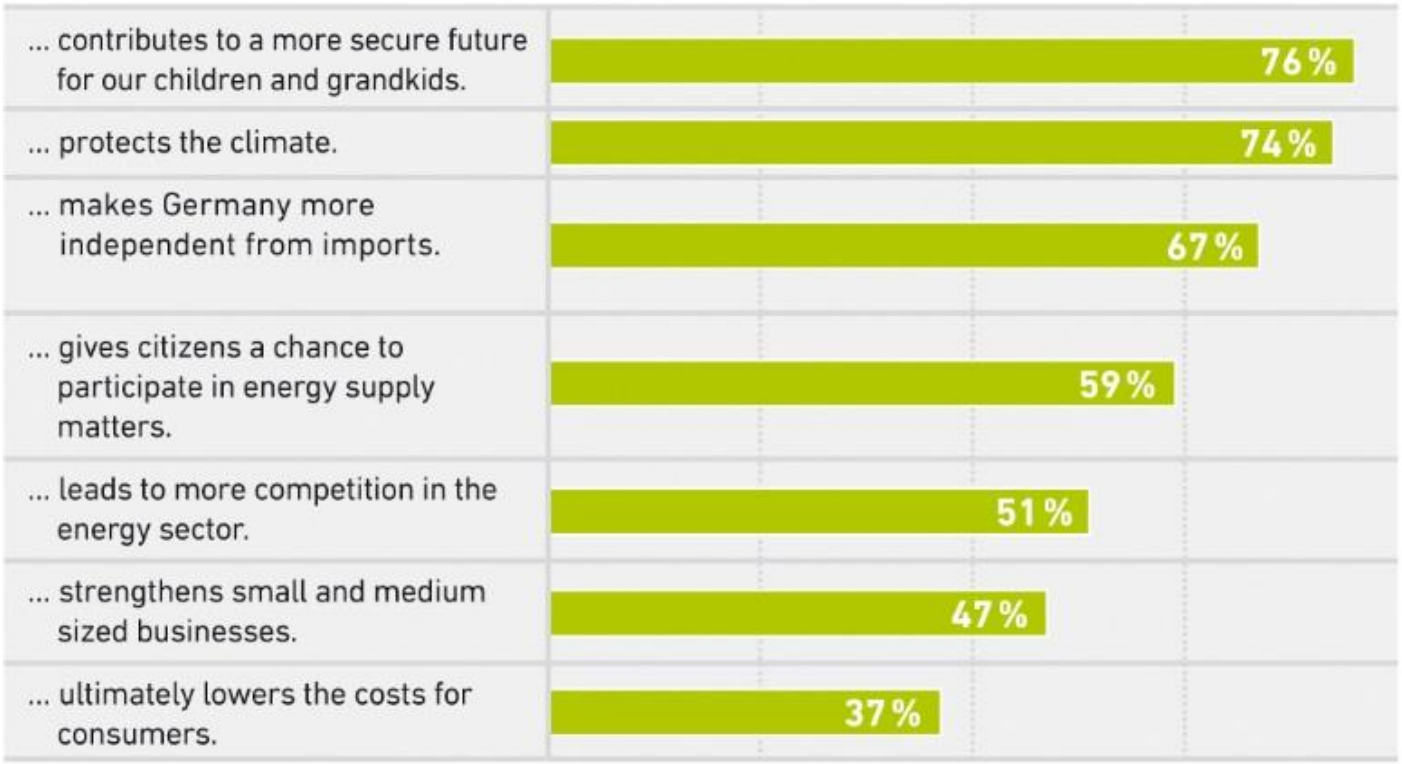
Sustainability and climate protection are the most important advantages of renewable energy

Which statements do you agree with? (Multiple answers possible)
Renewable energy...



Source: Poll from TNS Emnid commissioned by the Renewable Energies Agency, 1,000 polled
As of: 9/2016

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Sudies confirm:

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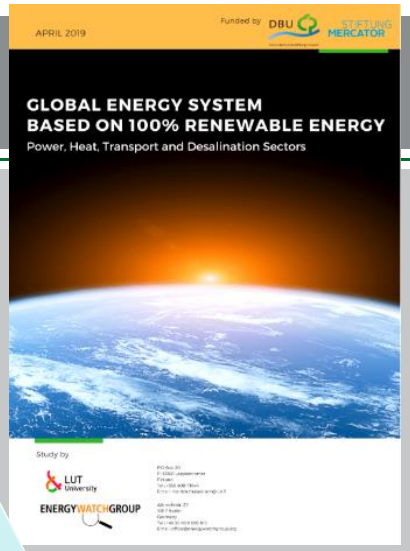
The energy transition is not a question of technical feasibility or economic viability, but one of political will.



100% renewable energy worldwide is more cost effective than the current energy system and leads to zero emissions before 2050.

Largely domestic energy systems based on 100% renewables will create energy independence and support millions of local jobs in the energy sector.

Hot Topics of the Energy policy agenda

- Main aim: **2030 emissions reductions** goals in all sectors need to be met
- Climate Action plan, **Climate law**
- **Coal phase out** plan (not yet specified)
- Feed in Tariff-> Auctions, revisions will follow to increase share of renewables
- **CO2 Prices** /Emissions trading (MSR)
- Effort sharing: C02 price (transportation, buildings)+**electricity tax reduction**
- **Promotion of rail transport, electric mobility** (investment into loading infrastructure, buyer's premium)
- Promotion of investments into **energy saving potentials of buildings**

Green Deal: Investment needs:

Europe: Stimulus package 500 Billion Euro

Investment: **100 billion euros annually** (until 2027, Europe-wide)

- **Investment needs to go into diversification of coal regi**ons and new industries – not to coal companies
- For comparison: amount spent **annually on fossil subsidies: 57 billion** (2012, in Germany)

- **Fossil subsidies must be stopped, renewable energies must be expanded**
- Further **areas of investment needs**:
  - **Investments in railways**
  - **refurbishing buildings**
  - **electric mobility**
  - **climate-friendly marine and aviation fuels**

Investments bring huge economic chances

- Investments create **technological and competitive advantage**
- No other market will attract more investment in the coming decades than **sustainable energy and mobility markets**
- Investments create **added value and jobs**
- Investments in **energy efficiency create competitive advantages: falling energy costs**
- **Chemistry and mechanical engineering can benefit from investments in innovative recycling systems, new plastics and fuels and modern drive technologies**
- Clear signals and regulation necessary: **Climate protection goals, reduction of distorting subsidies**

Green Deal for Renewables

- 1.5° C scenario with zero GHG emissions in 2050
- Specific energy cost shrink slightly
- Broad electrification of the entire energy system
- Energy services expand, while primary energy grow slowly
- More renewable energy leads to more jobs
- Solar photovoltaic, wind energy, batteries, heat pumps and synthetic fuel conversion technologies are central
- Methods used: full hourly and high geo-spatial resolution and cost optimisation for applied constraints
- No risk technologies required
- Political will and ambitious execution drive transition

Crisis as a Chance: 4 D with Renewables

Decarbonization

Digitization

Decentralisation

Democratization

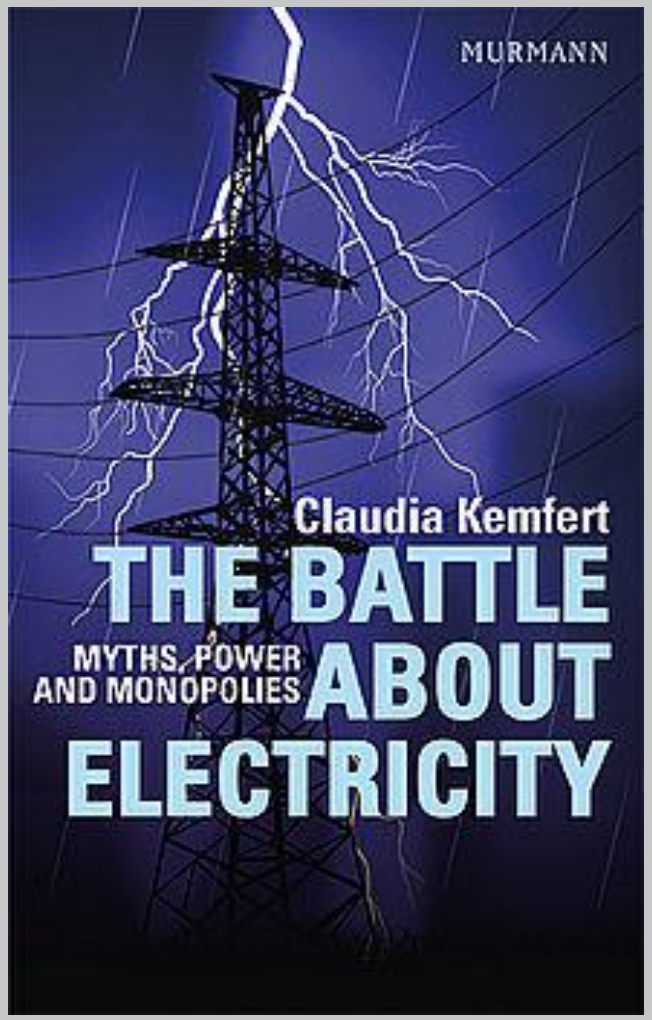
Readings

https://www.econstor.eu/handle/10419/180395

- Oei at al EEEP (2020) Lessons from Modeling 100% Renewable Scenarios Using GENeSYS-MOD Economics of Energy & Environmental Policy, Vol. 9, No. 1. lesen

- M. Child, C. Kemfert, D.Bogdanov, Breyer, C.: Flexible electricity generation, grid exchange and storage for the transition to a 100% renewable energy system in Europe, in : Renewable Energy 139 (2019), 80-101

- Löffler, K., Hainsch, K., Burandt, T., Oei, P.-Y., Kemfert, C., von Hirschhausen, C. (2017). Designing a Model for the Global Energy System – GENeSYS-MOD: An Application of the Open-Source Energy Modeling System (OSeMOSYS) In: Energies 10 (2017), 10, S. 1-28. lesen



Thank you!

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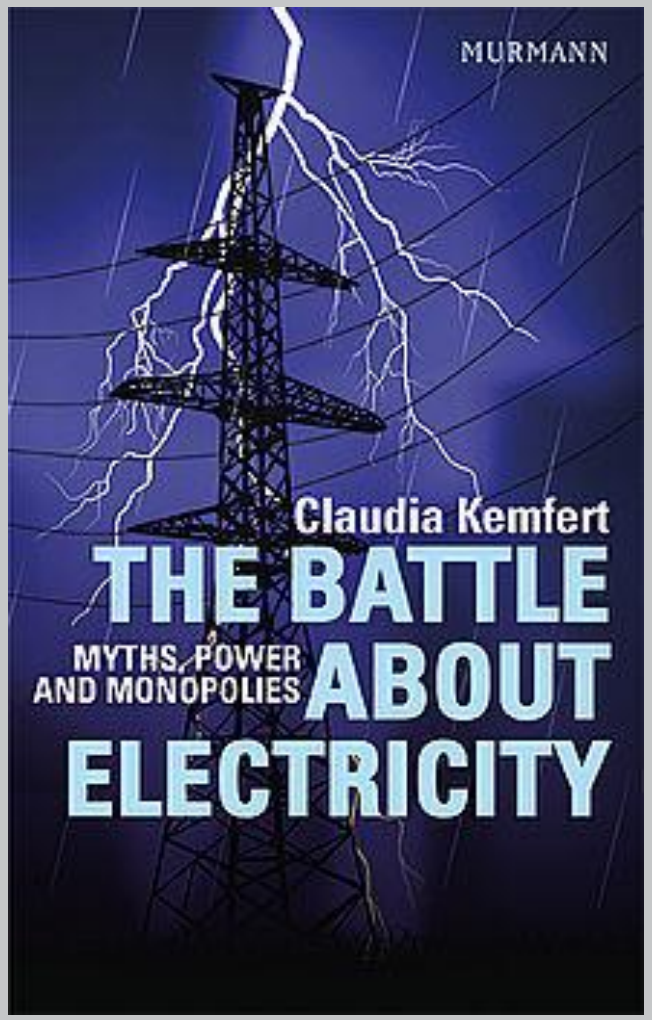

Backup Slides

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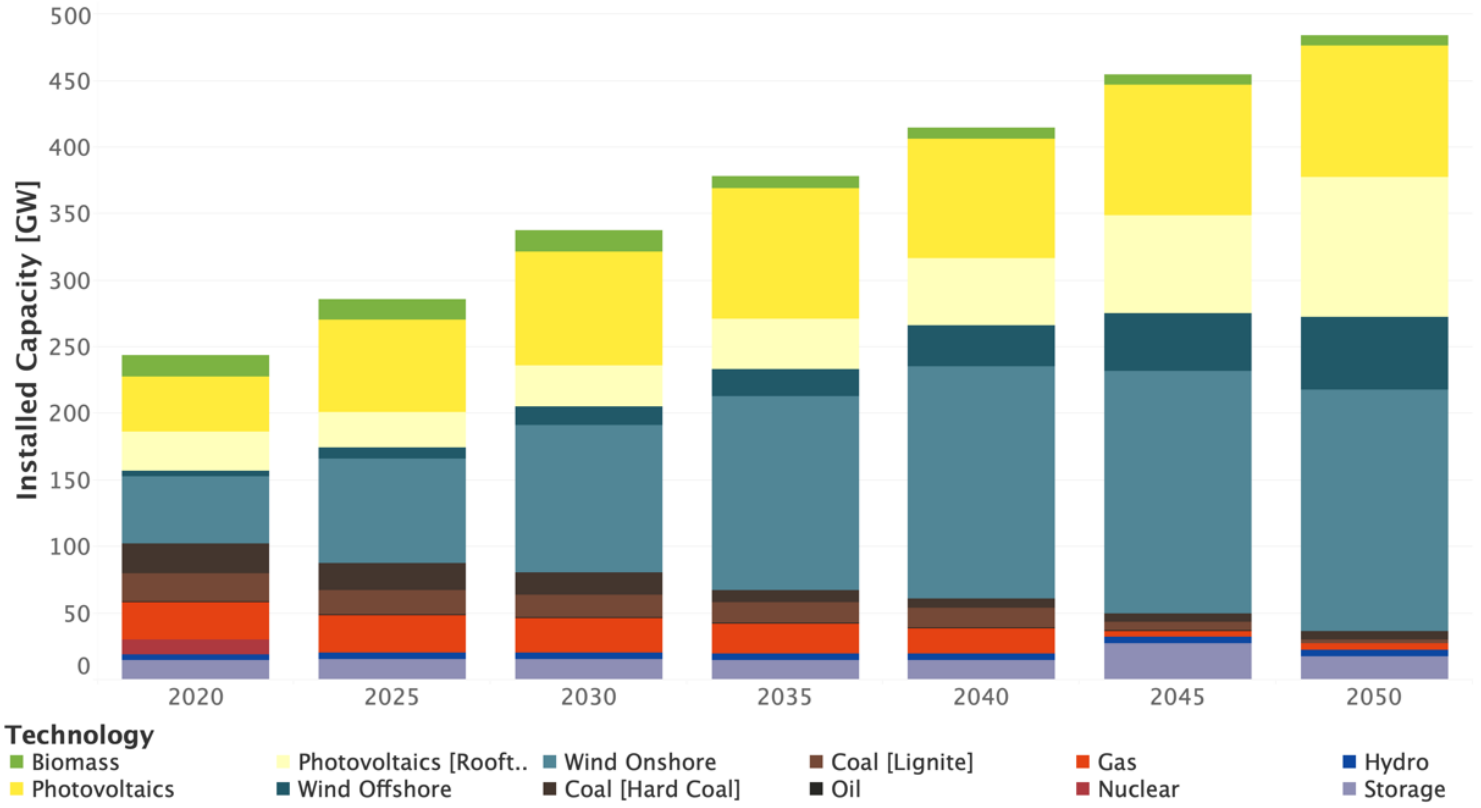
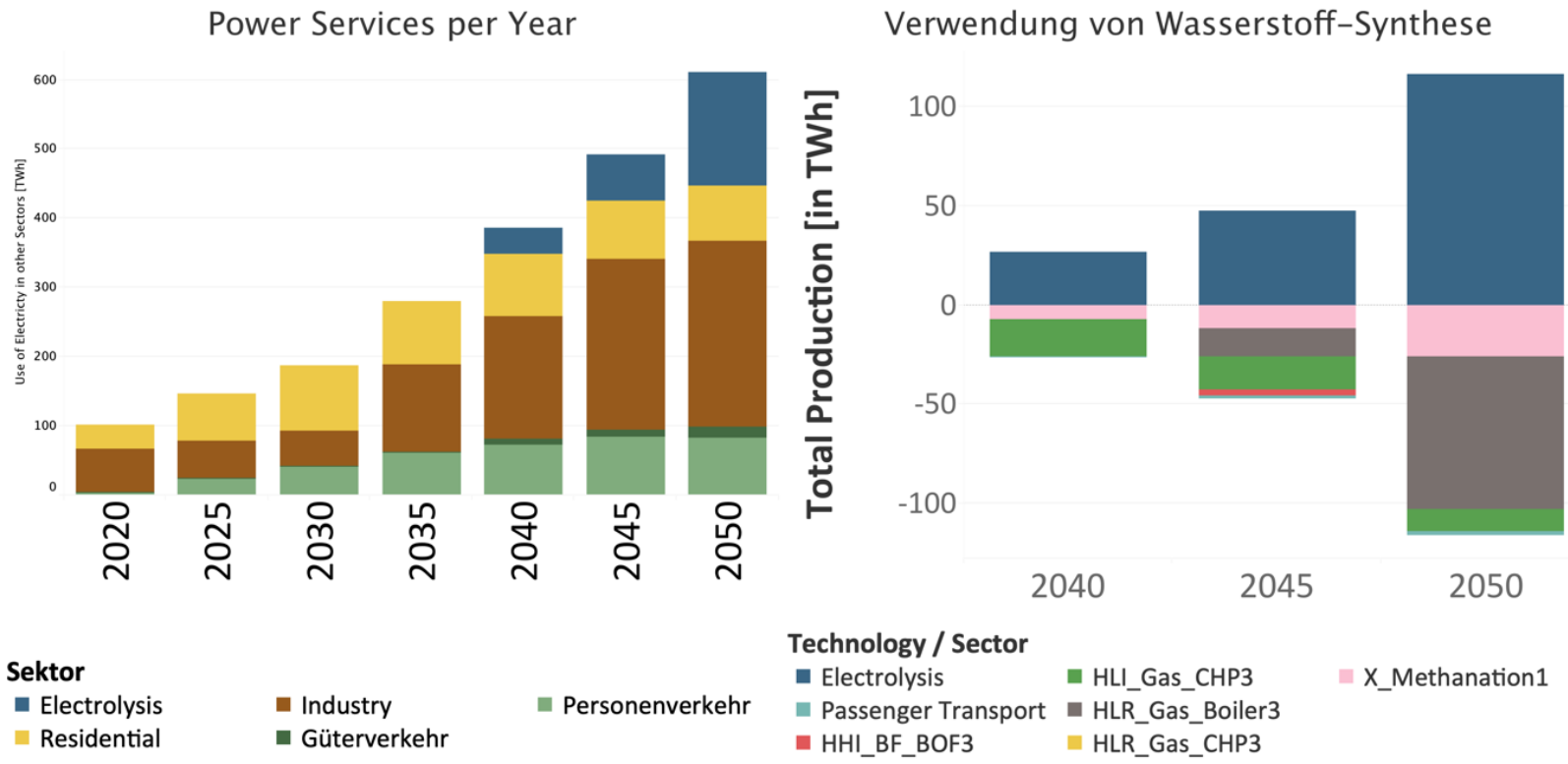
Electricity Production



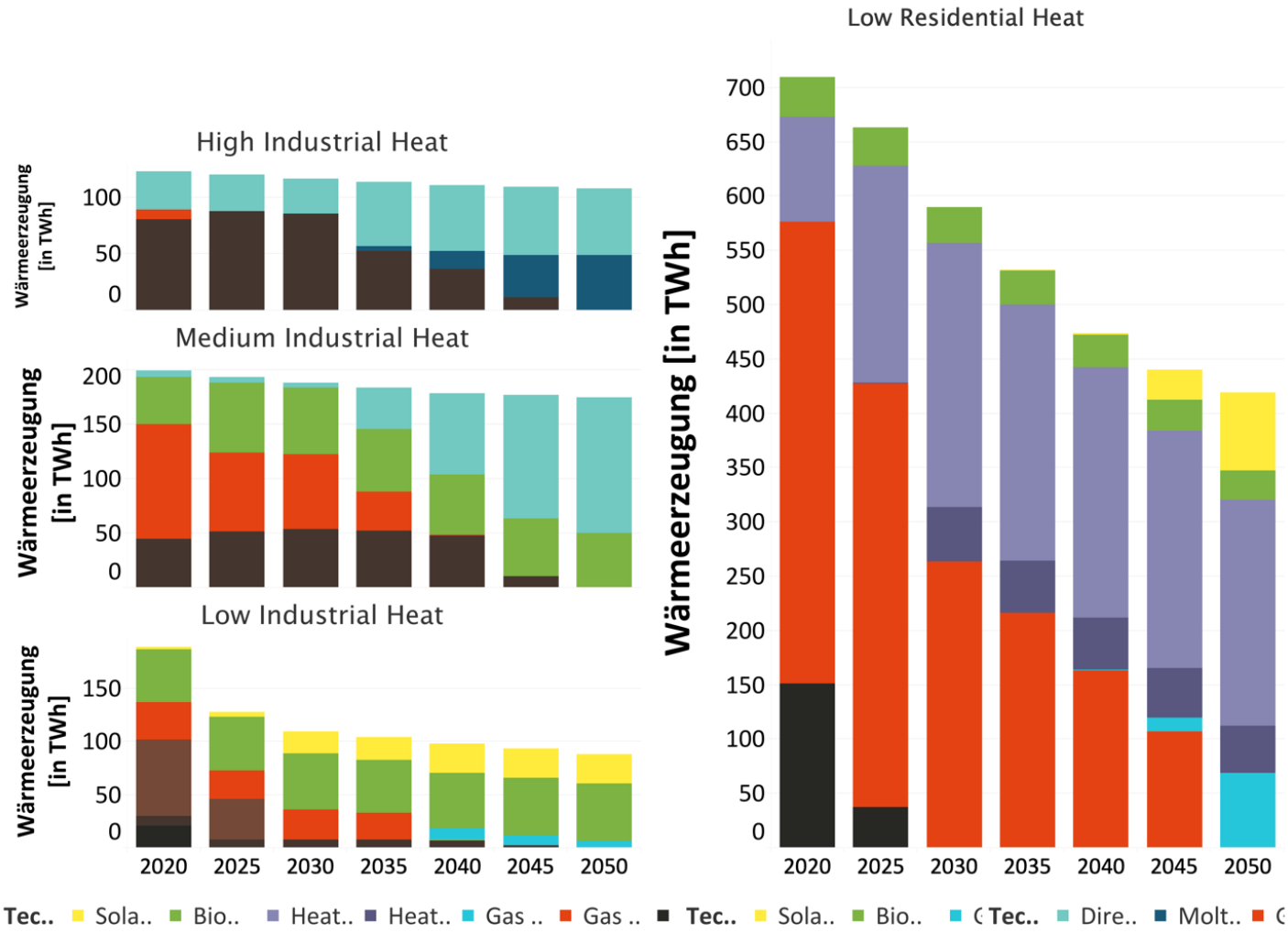
- Installed capacity almost doubles, with PV and WTGs being about equally powerful
- First freestanding PV systems, then rooftop systems
- Onshore wind potential 92 % exhausted in 2045, 63 % of offshore wind potential
- Installed electricity storage reaches its peak in 2045 with 54 GW

Sector Coupling

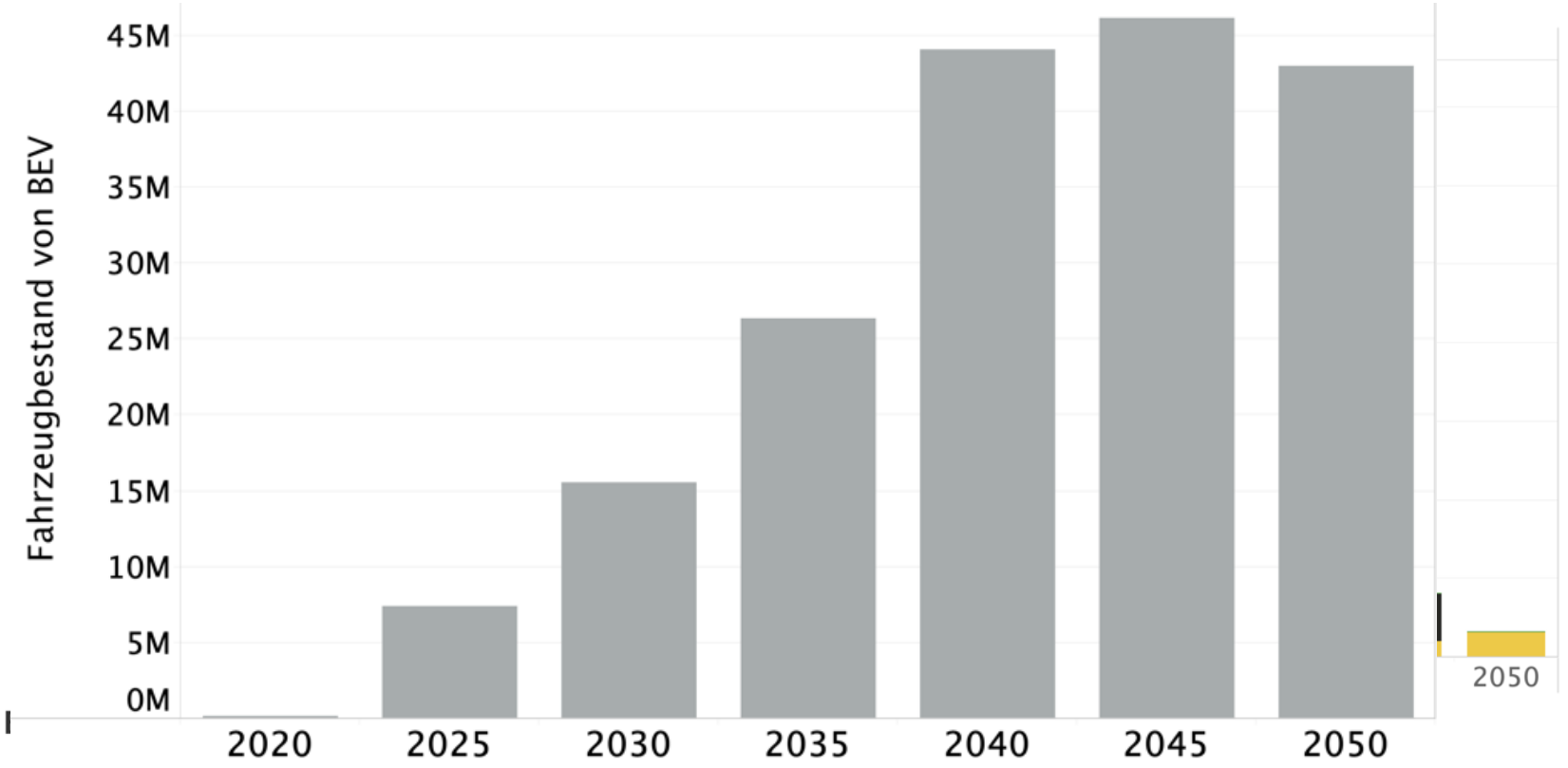


- Electricity utilization outside the direct demand for electricity increases sixfold
- Moderate increase in the household sector, strong in industrial sectors.
- From 2040 strong increase in H2 electrolysis up to approx. 170 TWh in 2050
- Substitution of gas burners for space heating & WW, major part in methane production

Heating

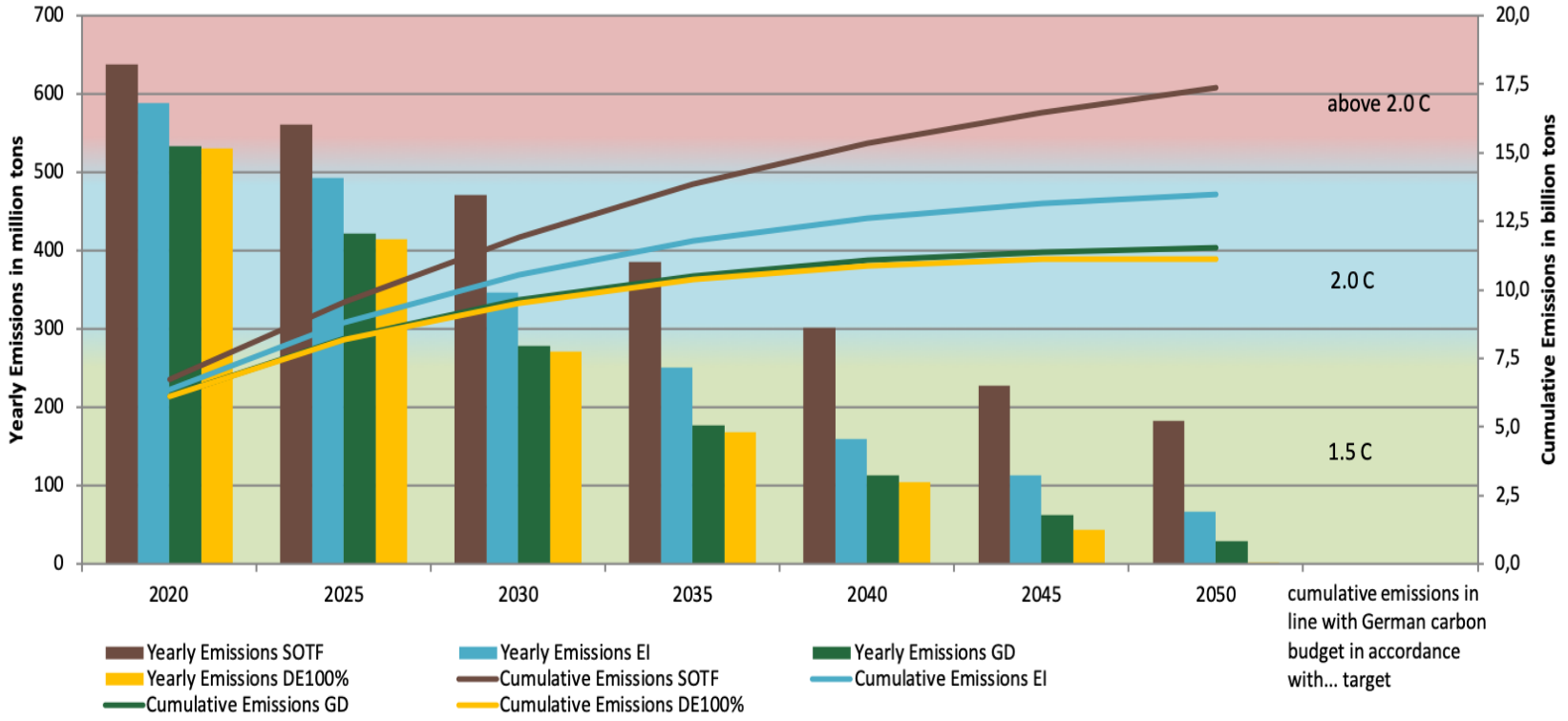

High Industrial Heat
Medium Industrial Heat
Low Industrial Heat
Low Residential Heat
Wärmeerzeugung [in TWh]
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
2020
2025
2030
2035
2040
2045
2050
Tec..
Sola..
Bio..
Heat..
Heat..
Gas ..
Gas ..
Tec..
Sola..
Bio..
Tec..
Dire..
Molt..

Transportation



- BEVs are becoming increasingly popular in motorised individual transport, overhead trucks in freight transport
- Decreasing energy consumption can be explained by higher efficiency of electric motors
- BEVs in MIVs from 2025, peak reaches 2045, then demographics reduce the need for cars

In Summary…



- Cumulative and annual emissions compared to the SOTF, GD and EI scenarios
- Budgets for Germany calculated as a proportion of the world population
- Agricultural emissions, process emissions and LULUCF excluded