Prof. Dr. Peter Hennicke

Germany´s Energiewende as a model for change? Problems, disruptions and policies

Speech at the 8th LCS-Meeting

Wuppertal, 6-7 September, 2016

Global driving forces for the Energiewende

Global pathway to zero emissions: Efficiency + Renewables

Comparison: IEA Current Policy (CP) vs. Energy (r)evolution (E(R))

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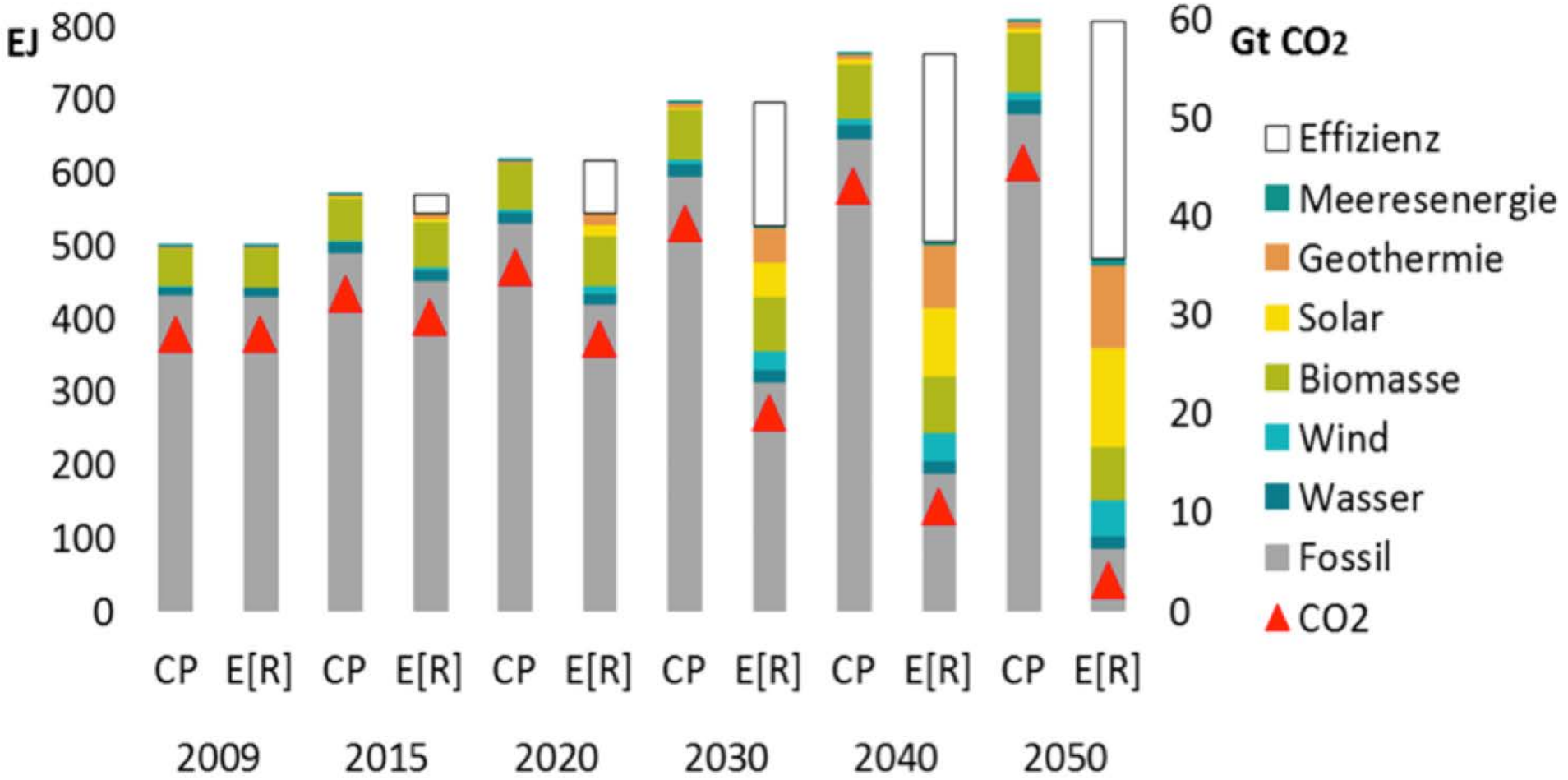
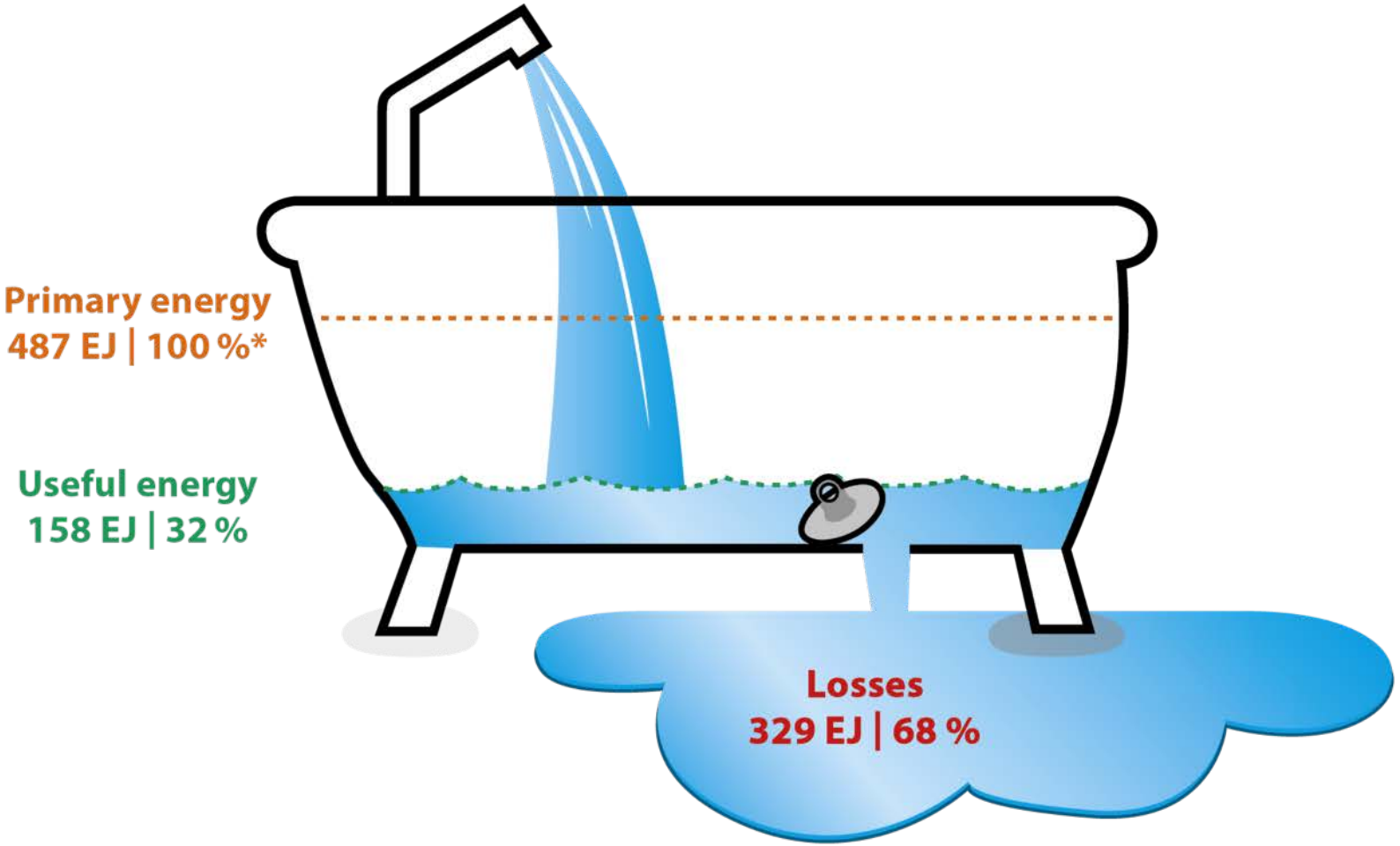


Source: DLR 2015

Efficiency first: Reduce losses of the global energy system!

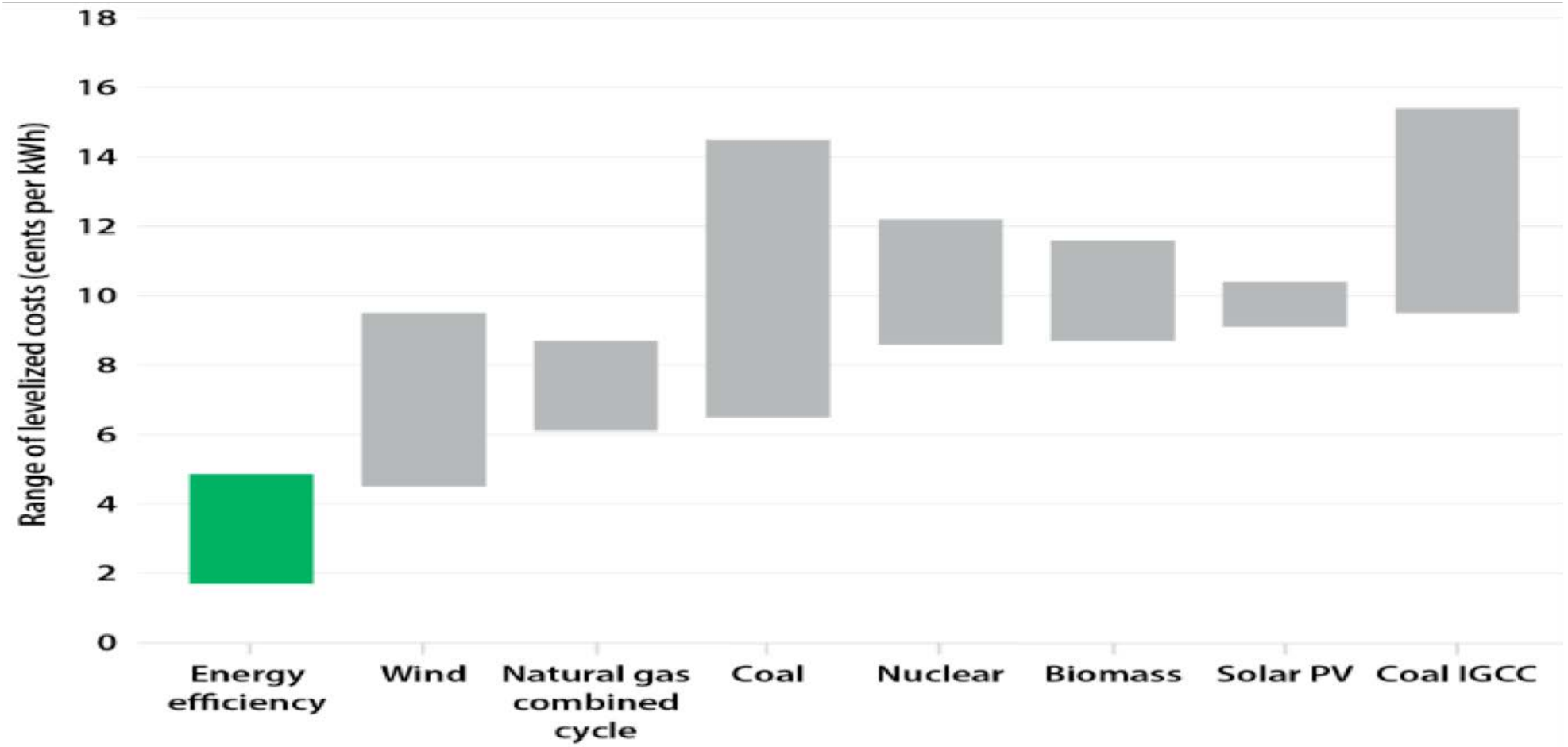
Energy efficiency revolution (= end use + decentralized power) needed



*Total primary Energy 519 EJ less 32 EJ non energetic consumption

Source: Hennicke/Grasekamp 2014; based on Jochem/Reize 2013; figures from IEA/OECD/IREES

US: Cost of utility efficiency programs (average: 2.8 cents per kWh) A factor of 50-75% less than levelized cost of new electricity resource options



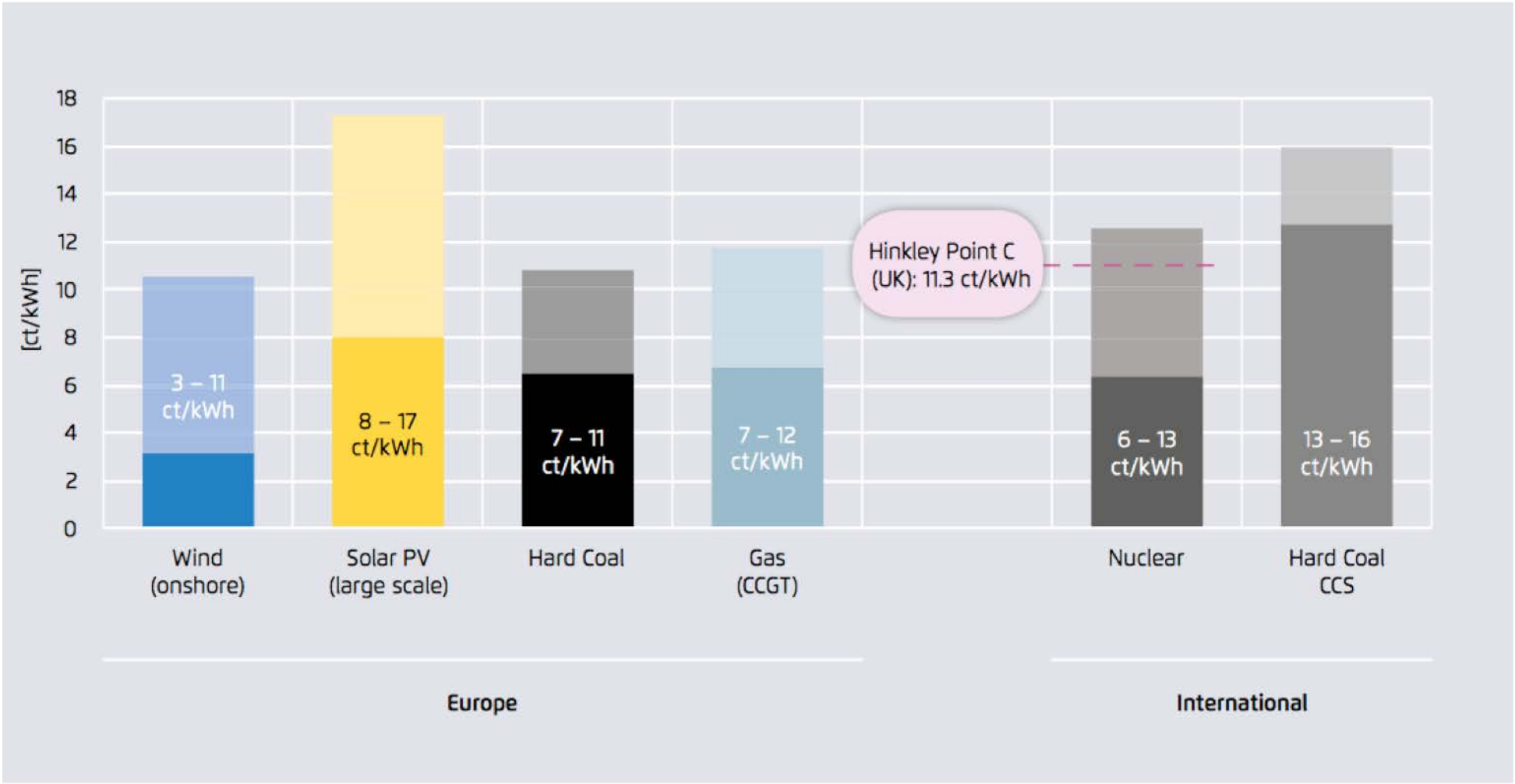
The high-end range of coal includes 90% carbon capture and compression. PV stands for photovoltaics. IGCC stand for integrated gesification combined cycle, a technology that converts coal into a synthesis gas and produces steam.

Source: ACEE 2014. Energy efficiency portfolio data from Molina 2014; all other data from Lazard 2013.

Forecasted cost degression of new PV power
- in North America, Australia, India and Mena region (in cts/kWh)

Source: Agora, Current and Future Cost of PV, 2015.

Current costs of PV and wind in Europe
Compared with levelized costs of nuclear (UK) and gas/coal (incl. CCS)



Sorce: Agora/Prognos 2016.

The missing link:
“Act locally to change globally”

Opportunities and challenges of the German Energiewende

“Revolutionary Targets” (Chancellor Merkel)
Energy Concept, Federal German Government, 28. September 2010

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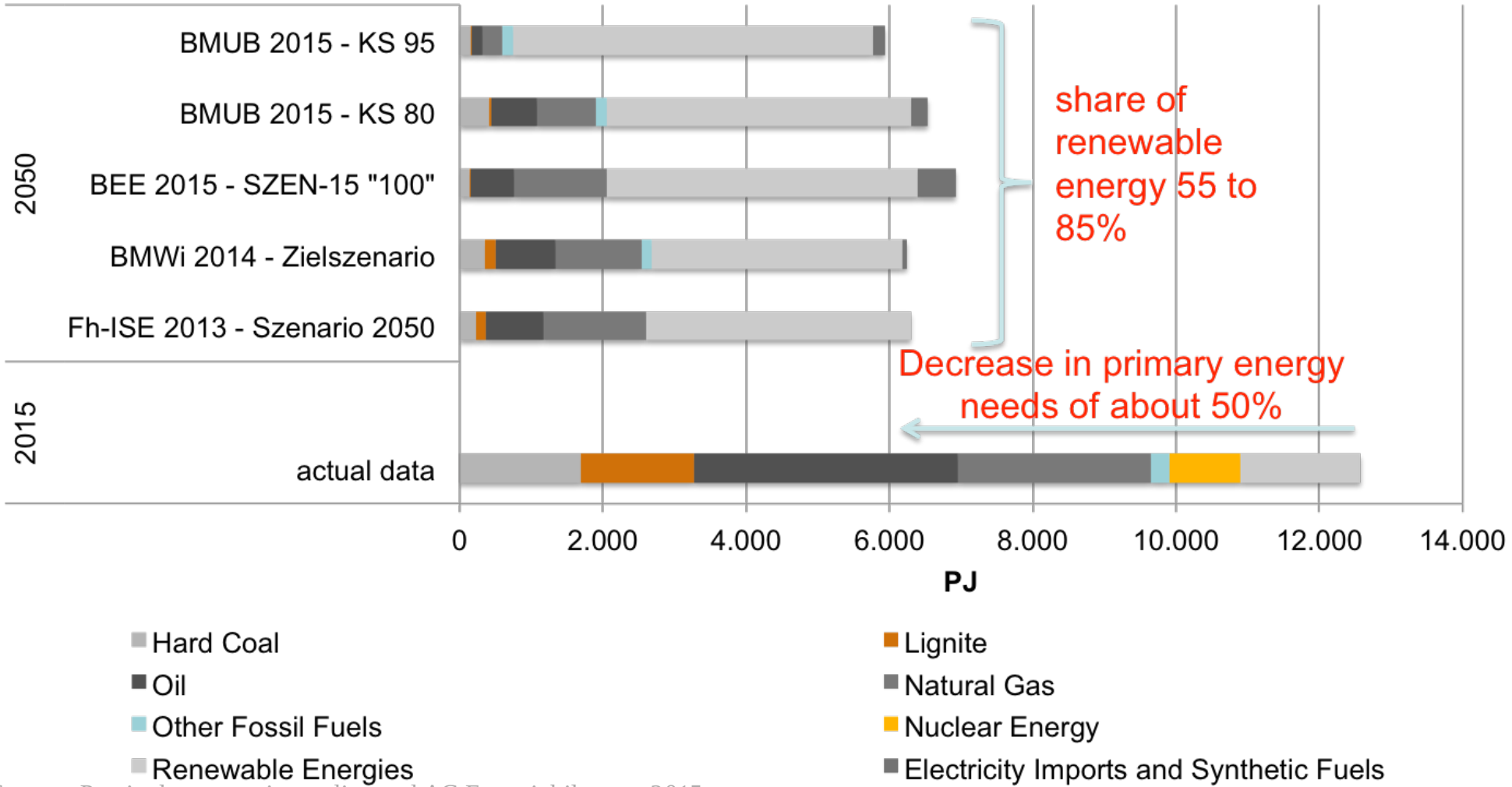
Development Path	2020	2030	2040	2050
Greenhouse Gas Emissions	- 40%	- 55%	-70%	- 80 bis 95%
Share of renewable energies in relation to the gross final energy consumption	18%	30%	45%	60%
Electricity generated from Renewable Energy Sources in relation to gross final energy consumption	35%	50%	65%	80%
Primary Energy Consumption [base year 2008] / annual average gain in energy productivity of 2.1 %, based on final energy consumption.	-20%			-50%
Electricity Consumption [base year 2008]	-10%			-25%
Doubling the Building Renovation Rate from the current figure of less than 1 % a year to 2% of the current building stock				
Reduction of the **Final Energy Consumption** in the **Transport Sector** [base year 2005]	-10%			-40%

Research consensus: “Energiewende” is technically feasible

Decoupling GDP from quality of life plus ecological modernization in Germany

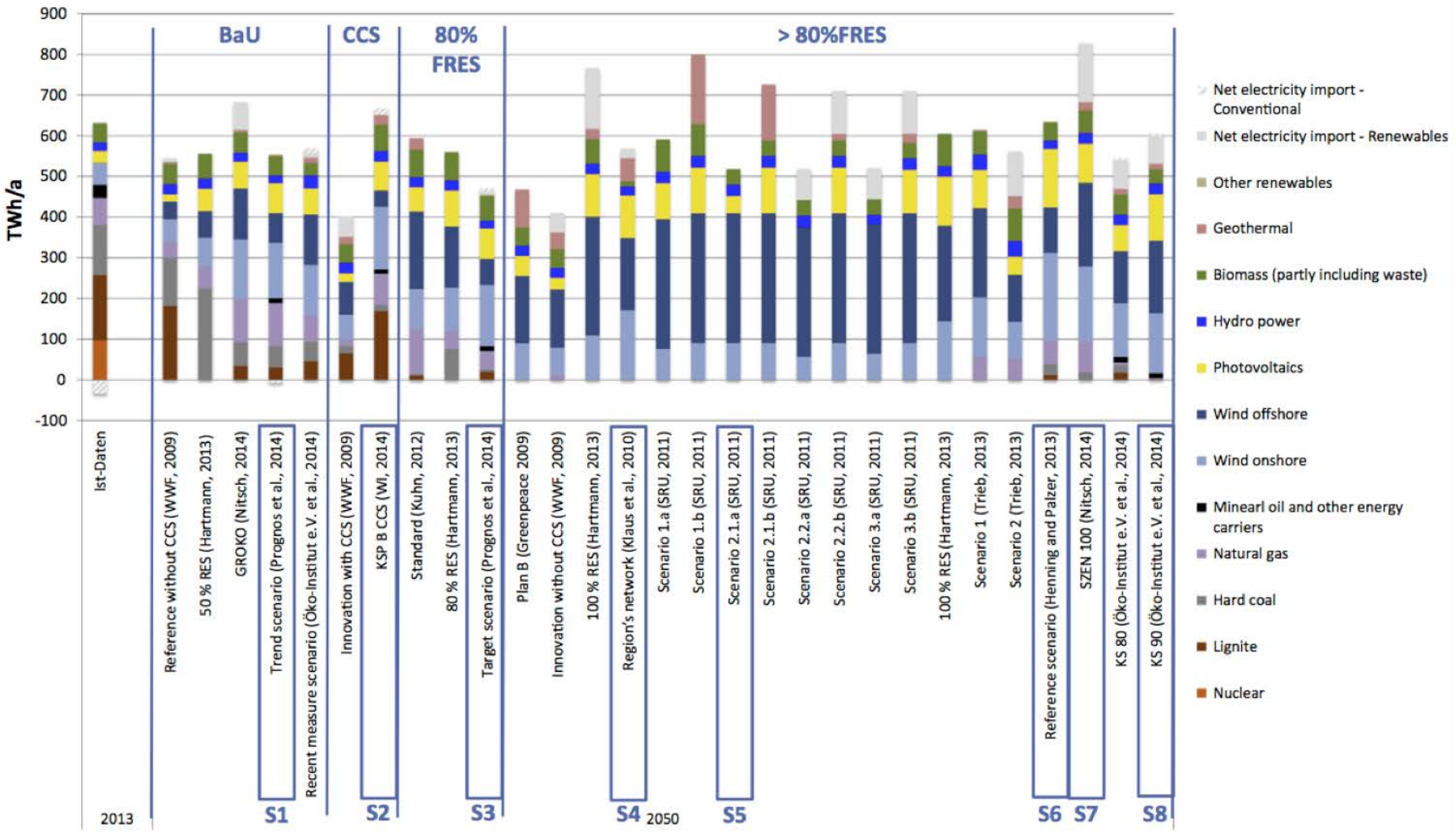


Source: Particular scenario studies and AG Energiebilanzen 2015.

Green electricity:
How much, how quick, how competitive?

Typical scenarios of future German electricity production

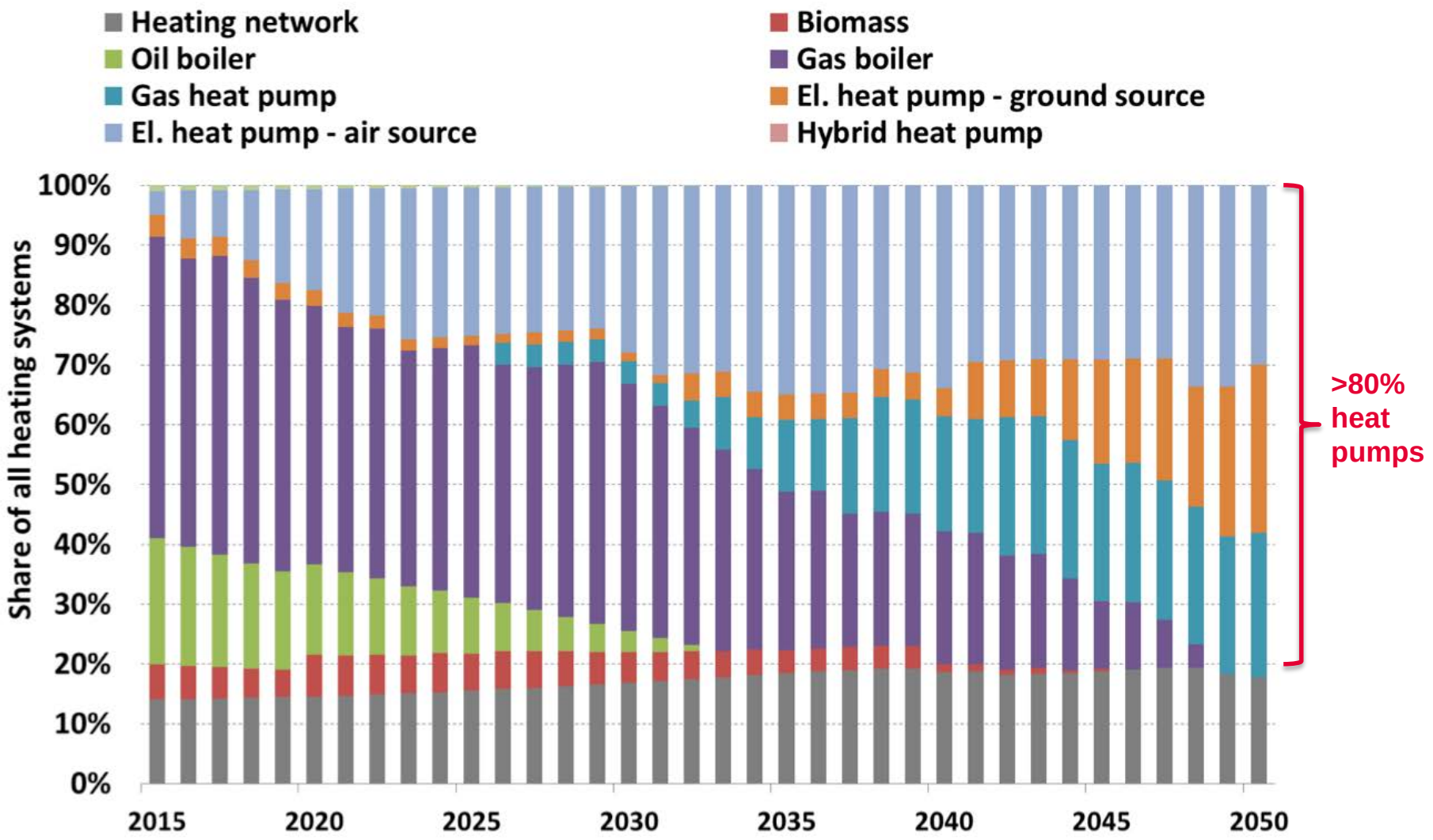
Many options, but uncertainty on final electricity demand and energy mix in 2050



Source: B. Lunz et al. 2016.

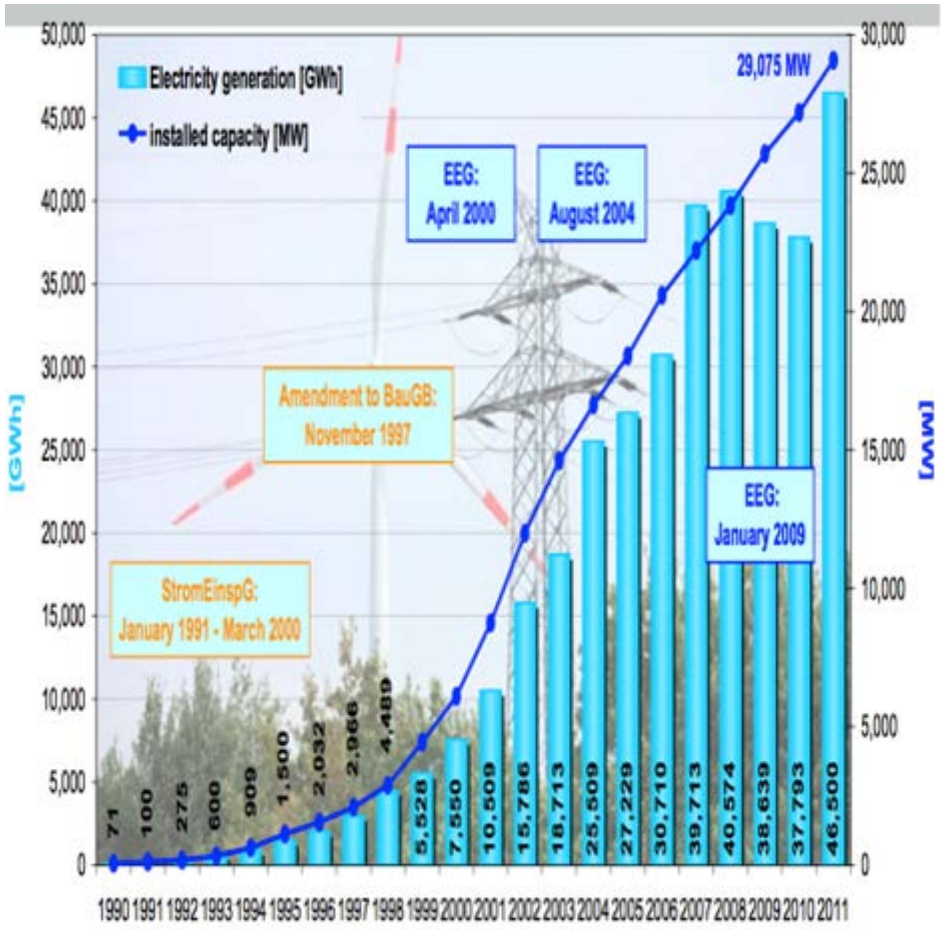
The future heat market → interlinked with the power market

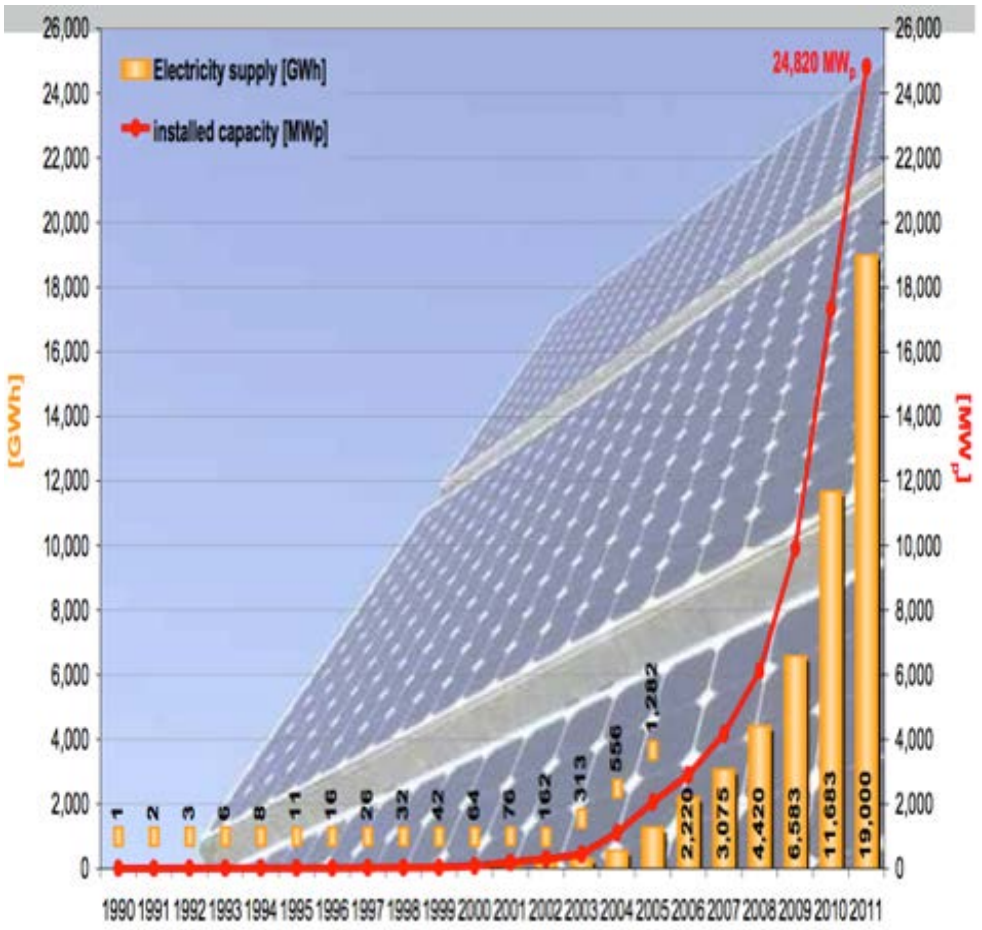
85% CO_2-Reduction Scenario



Feed-in law opens the markets for German green electricity
Steep learning curves and cost degression for wind and PV power

2015: Wind ca. 42 GW and PV ca. 40 GW; total share REN: 38%

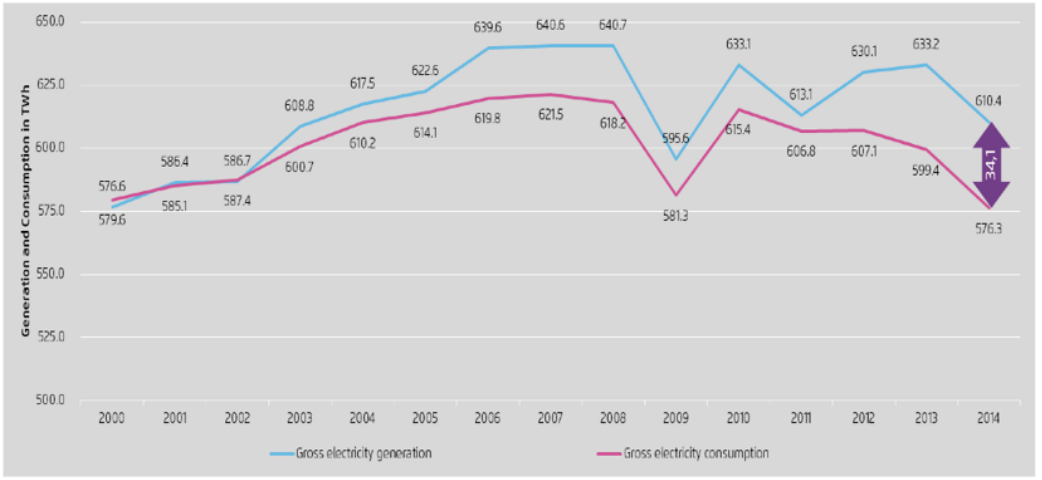




State of the affairs and $C0_2$-turnaround

The gap between electricity generation and demand is widening since 2001: Germany is power export champion in Europe

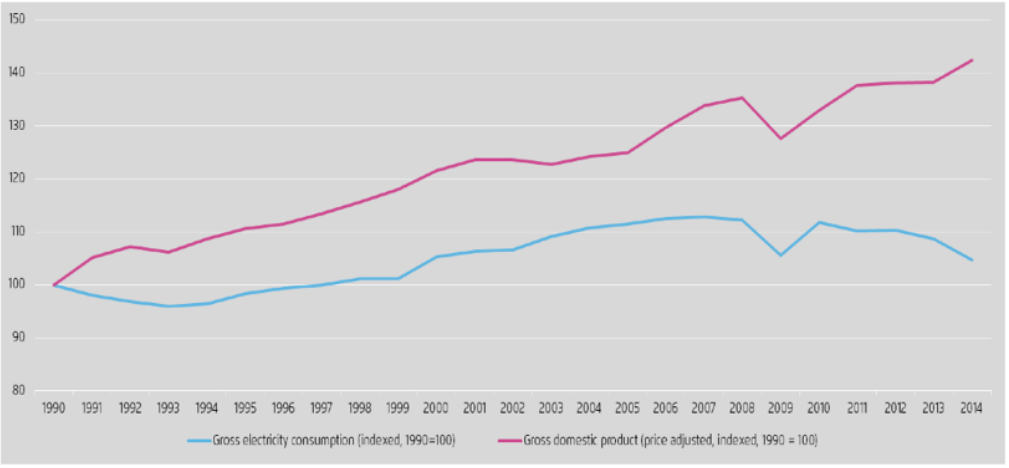
Gross electricity generation and production in TWh



AG Energiebilanzen 2014

Economic growth and electricity demand are no longer correlated: While the economy has grown more than 40% since 1990, electricity demand has been decreasing significantly since 2007

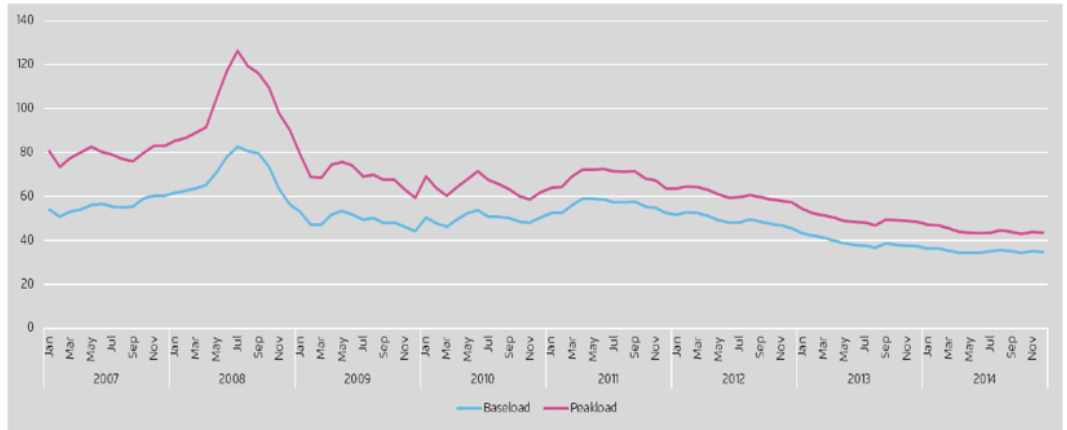
Indexed economic growth and electricity usage (1990=100)



Statistisches Bundesamt 2014

The power price at the electricity exchange has been falling almost continuously since 2008 – on average, power could be bought in 2014 for less than 40 EUR/MWh.

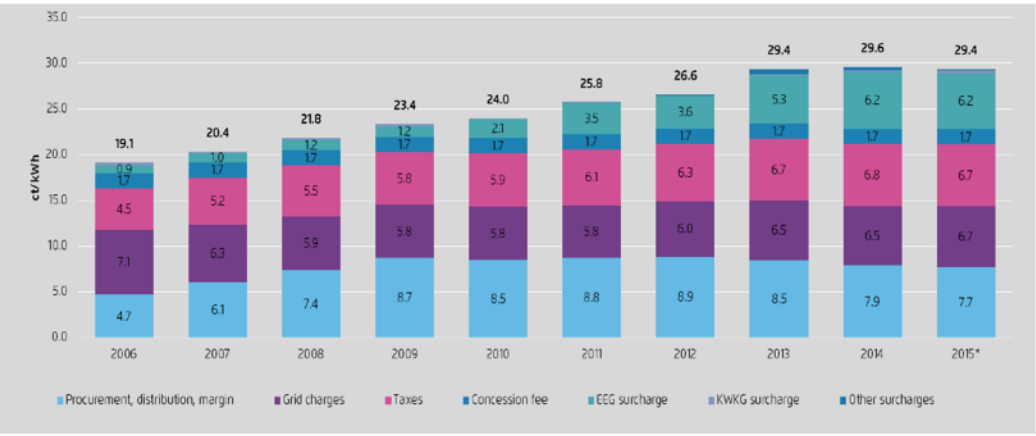
Annual Future for Power Delivery (roin Euro/MWh



EEX 2014

In 2015, the rise in household electricity prices will be suspended – on average, they should even slightly decline.

Composition of household electricity prices 2006-2015



BDEW 2014, BNetzA 2014, own calculations; *Prognosis for 2015

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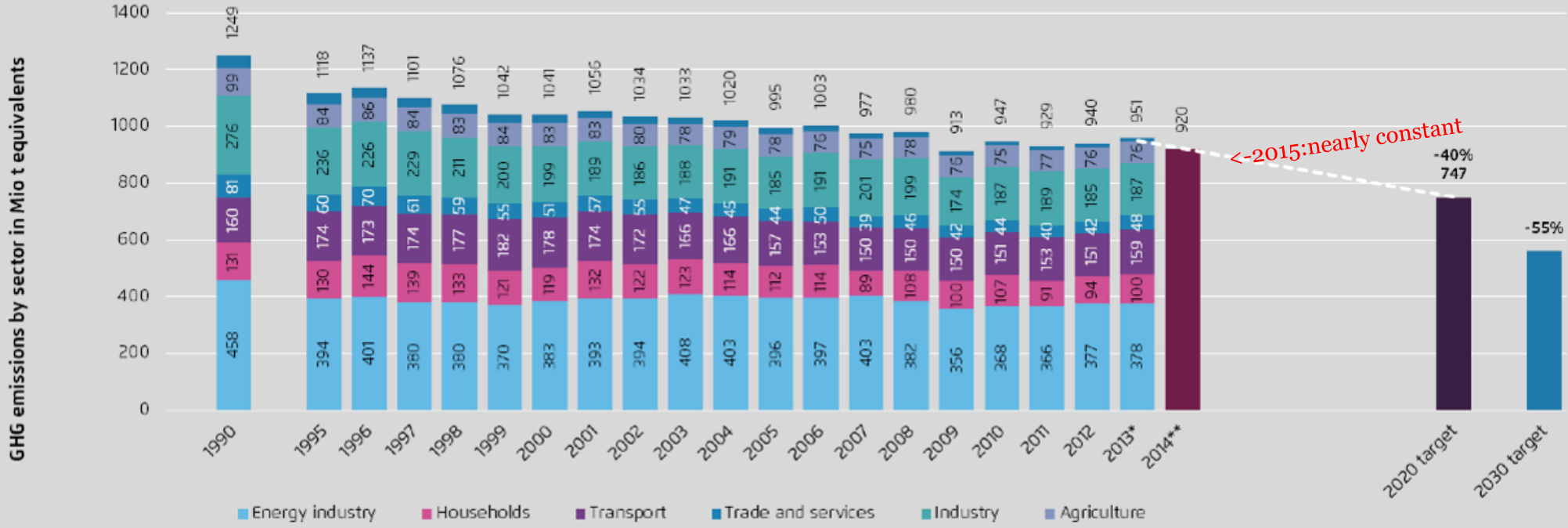
Agora Energiewende

Reduced emissions by the energy industry and the mild winter lead to a major decline in greenhouse gas emissions 2014. However, there is still a lot to do in order to reach the 2020 climate target.

Greenhouse gas emissions by sector in mio. t CO_2-equivalents, as well as German government targets for 2020 und 2030



UBA 2014, own calculations, *preliminary, **own estimates

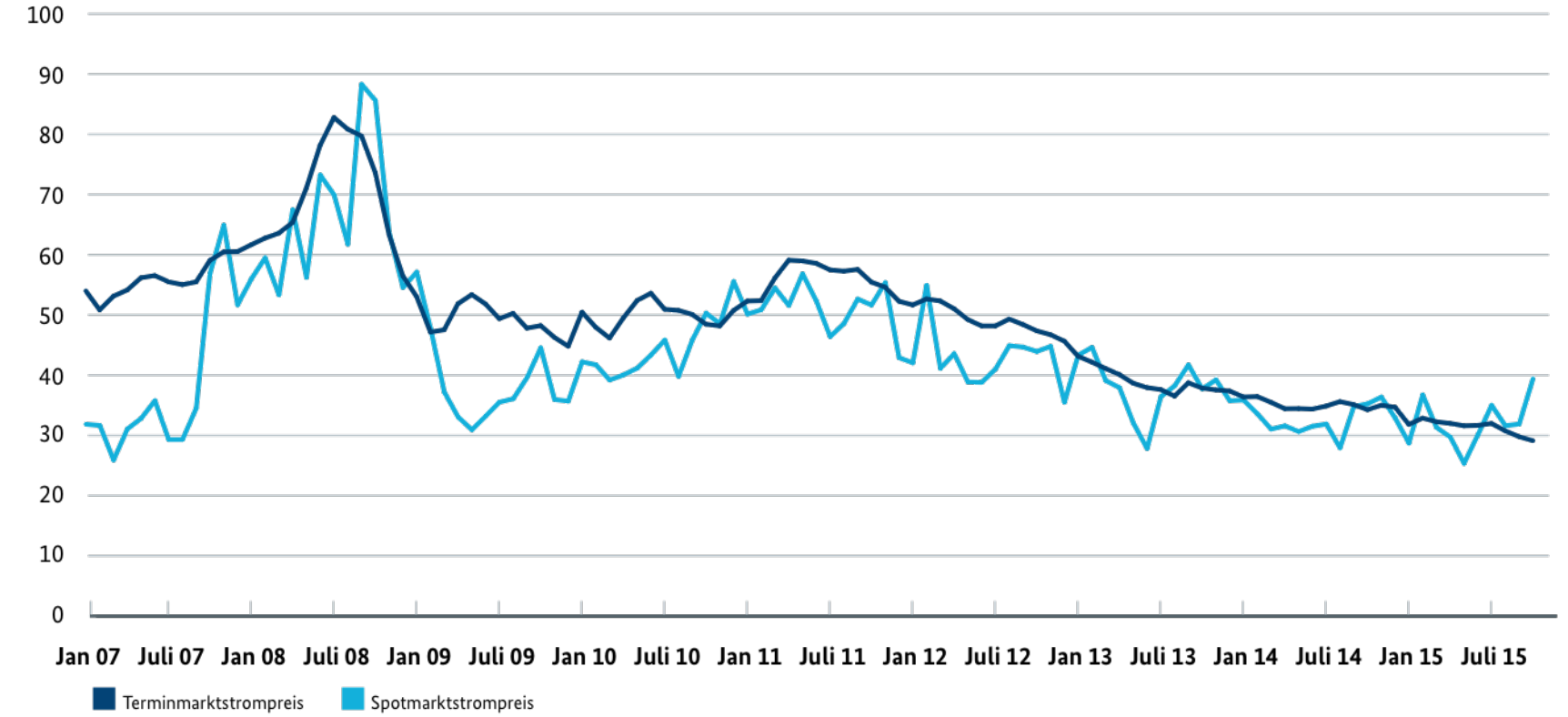
Controversial topics of the Energiewende

- **Costs: How much, how long, for whom?**
- **Security of power supply vs. system integration of intermittent power?**
- **When phasing out coal, how much increase and incentives for REN?**
- **Focus on power: system transformation of heat and transport sector?**
- **Supply side biased; how to foster energy (resource) efficiency?**
- **Decentralized („smart grids“) vs. centralized power („Coal“)?**
- **Citizens participation and democratization?**
- **Lifestyle changes: sustainable consumption and production?**
- **Political Leadership: Management and responsibilities?**

Decrease of Energy Stock Exchange Prices: Avantage for industry due to learning effects/EEG

→power intensive industry profits by direct purchase

Trading price of electricity in the spot market and futures trading in Euro/MWh

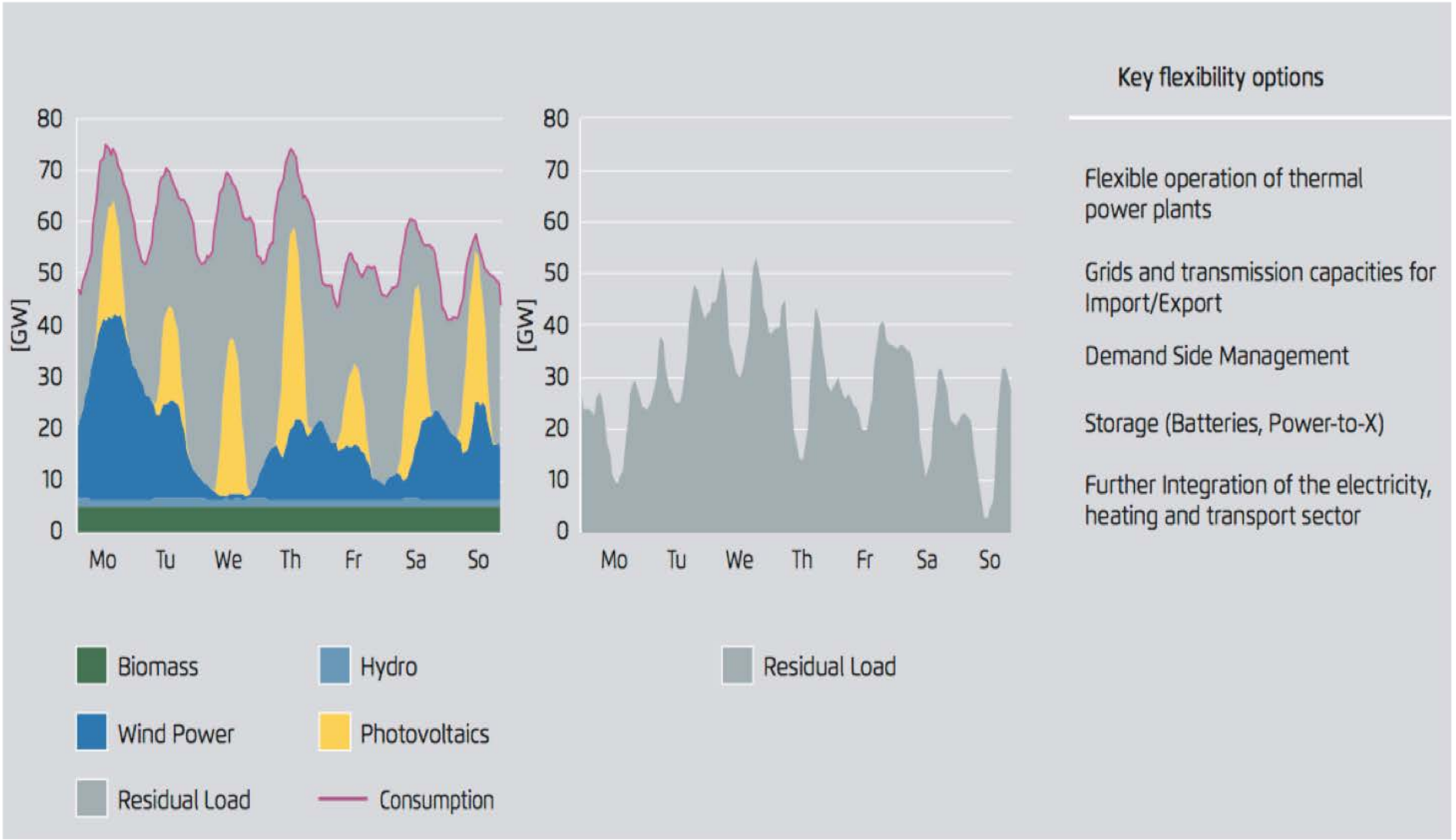


Quelle: European Energy Exchange 10/2015
Monatsmittelwerte für Produkte Day Base (Stundenkontrakte) und Phelix-Futures (Baseload, Year Future)

Gross electricity generation and residual load in Germany

One typical week in April 2022 with 50% renewables:

Forget base load – raise flexibility for security of supply!



Source: Agora 2016

Connecting wind (north) and PV (south) by transmission lines one cost-effective way to raise security of power supply

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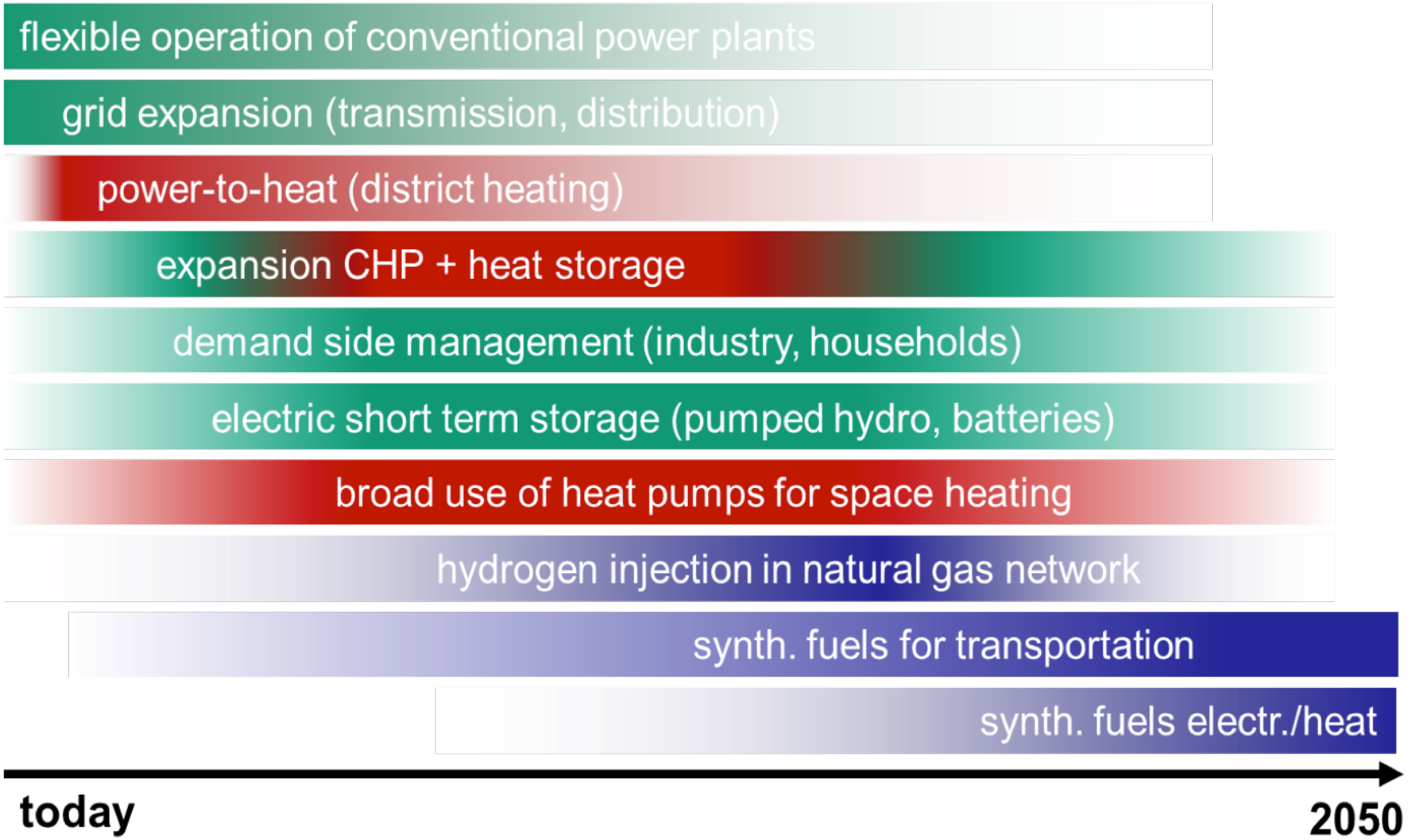
Monthly power production from PV and Wind in Germany (2012 and 2013)

Source: Fraunhofer ISE 2015; Samadi 2016.

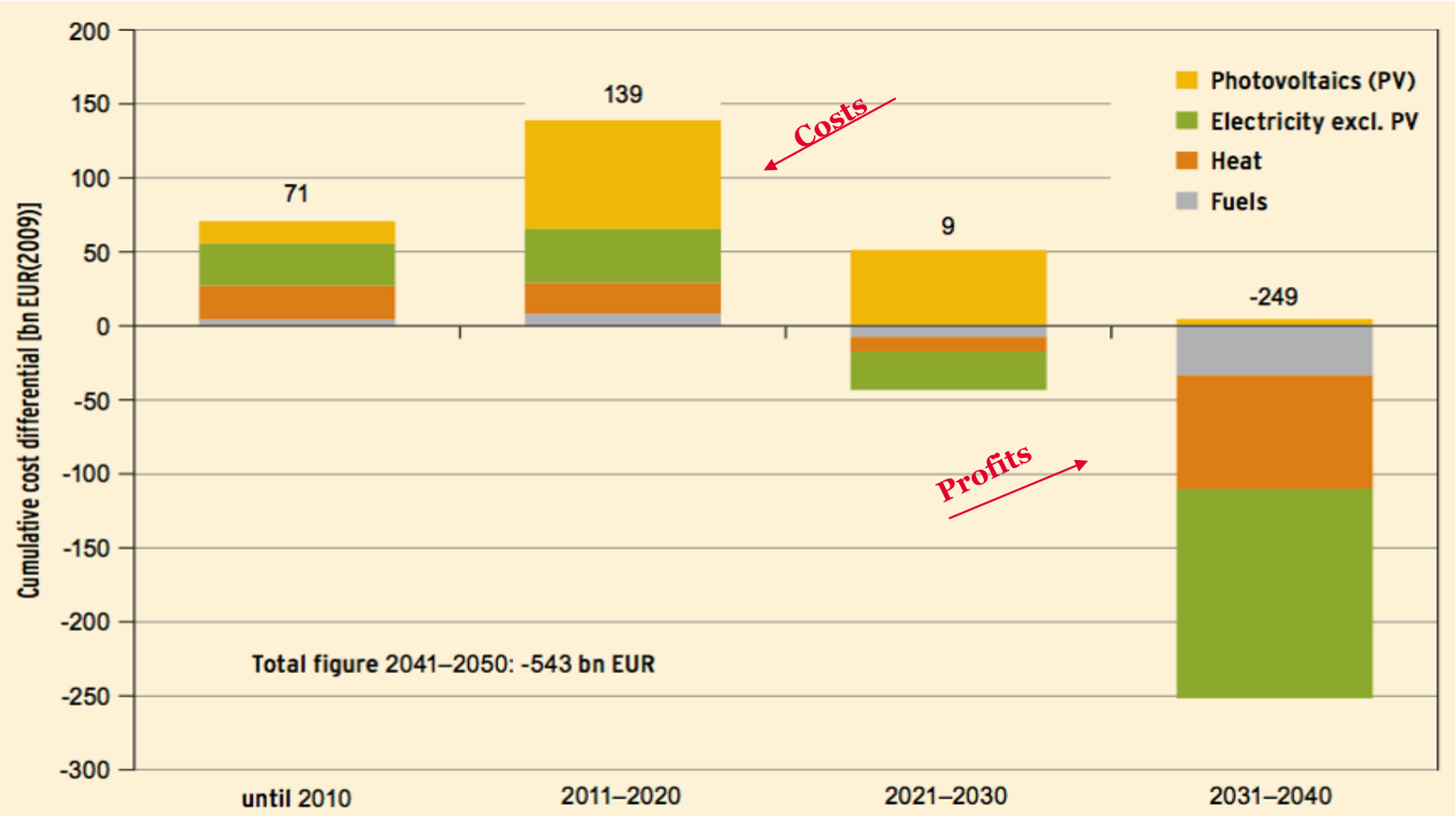
Major flexibility options on the transition timeline to 2050
Enough potential to manage fluctuating power (PV, Wind)



Source: Henning 2016.

Macroeconomic benefits

Projections of the differential costs of the“Energiewende”
All sectors; according to German “Lead Scenario 2011”



Note: Compared with a fossil energy system, assuming a future increase in fossil fuel prices in line with price path A: “Marked”.
1) Scenario 2011A for 10-year periods

Source: BMU 2012.

Additional investments in climate and resource protection – A core strategy to raise the investment and innovation rate

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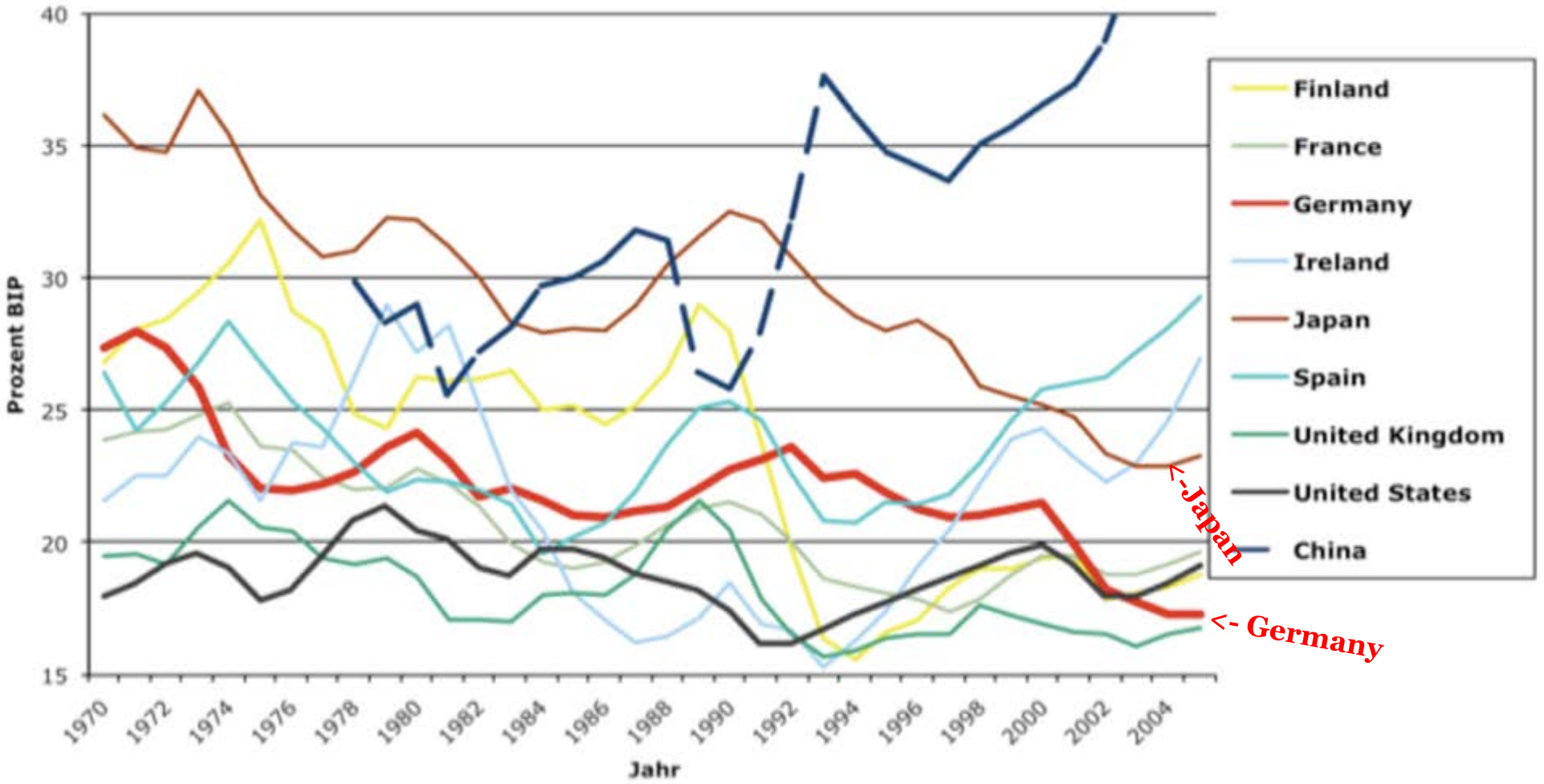
International comparison of gross investment rates (1970-2006)



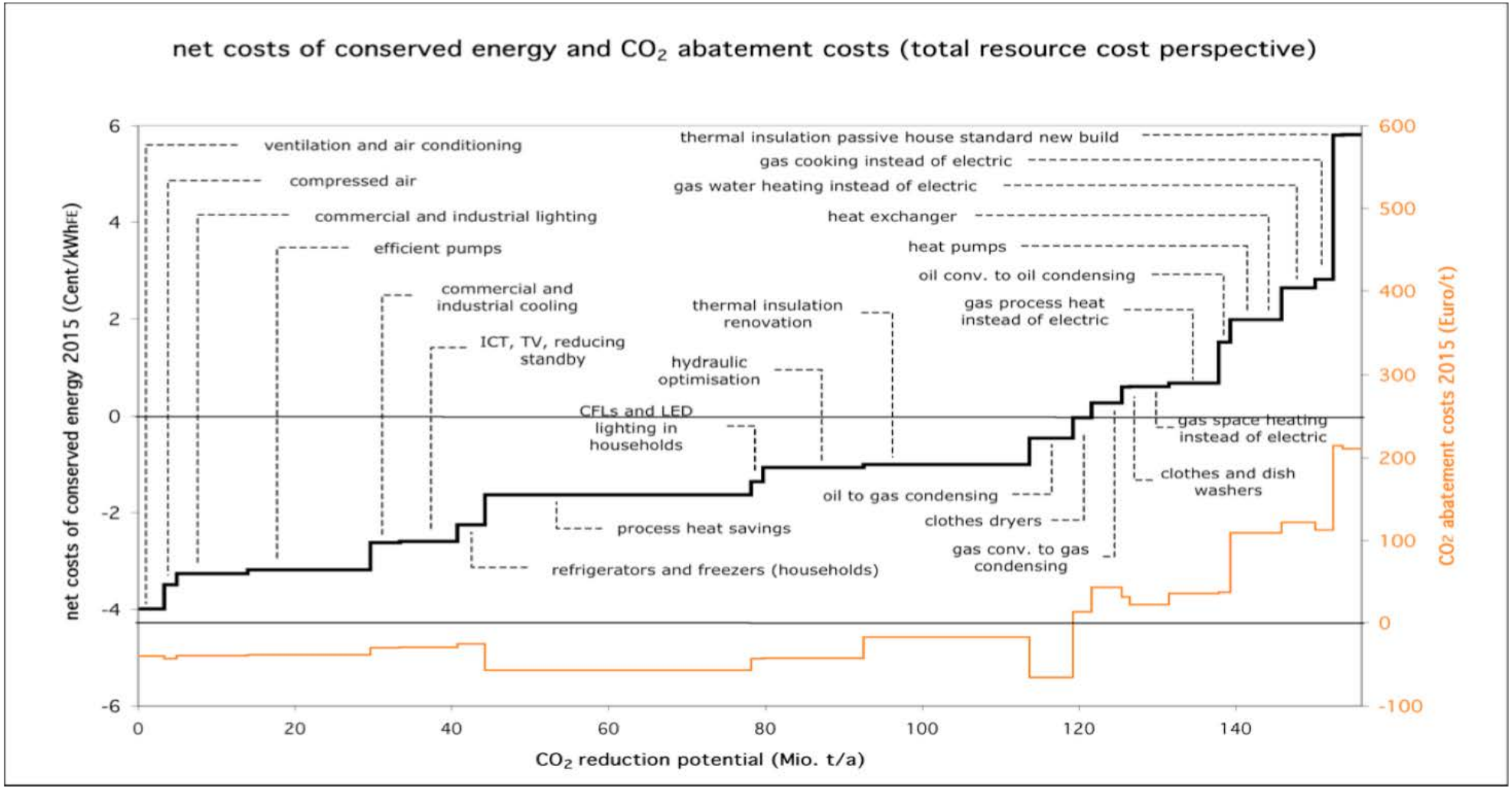
Source: C. Jäger, PIK, 2009.

Highest priority for energy efficiency – makes the transition to sustainable energy quicker and cheaper

The economics of “Negawatts” compared to “Megawatts”

140 TWh can be saved with a profit – when barriers are removed!

Example for Germany



Source: Wuppertal Institute 2006

State of the art: Buildings used as power plants

“Plus-Energy-Houses” in Freiburg/Germany: supply more energy than they use!

Caption: Plus energy houses are designed to produce more energy than they consume in the course of the year.

Subsidies for retrofitting the building stock needed!
- economic multiplier and self-financing effects arepromising!

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Promotional effects

kfw BANKENGRUPPE

	2009	2010	2011
Commitments (in millions of EUR)	8,863	8,746	6,510
housing units (in 1.000)	617	953	282
reduction of CO_2 (in 1.000 Tonnen p.a.)	1,452	1,049	567
jobs * (in 1.000)	292	342	247
investments (in millions of EUR)	18,335	21,330	18,427
federal budget (in millions of EUR)	2,033	1,337	934
leverage	9.0	16.0	19.7

* safeguarded employment for one year

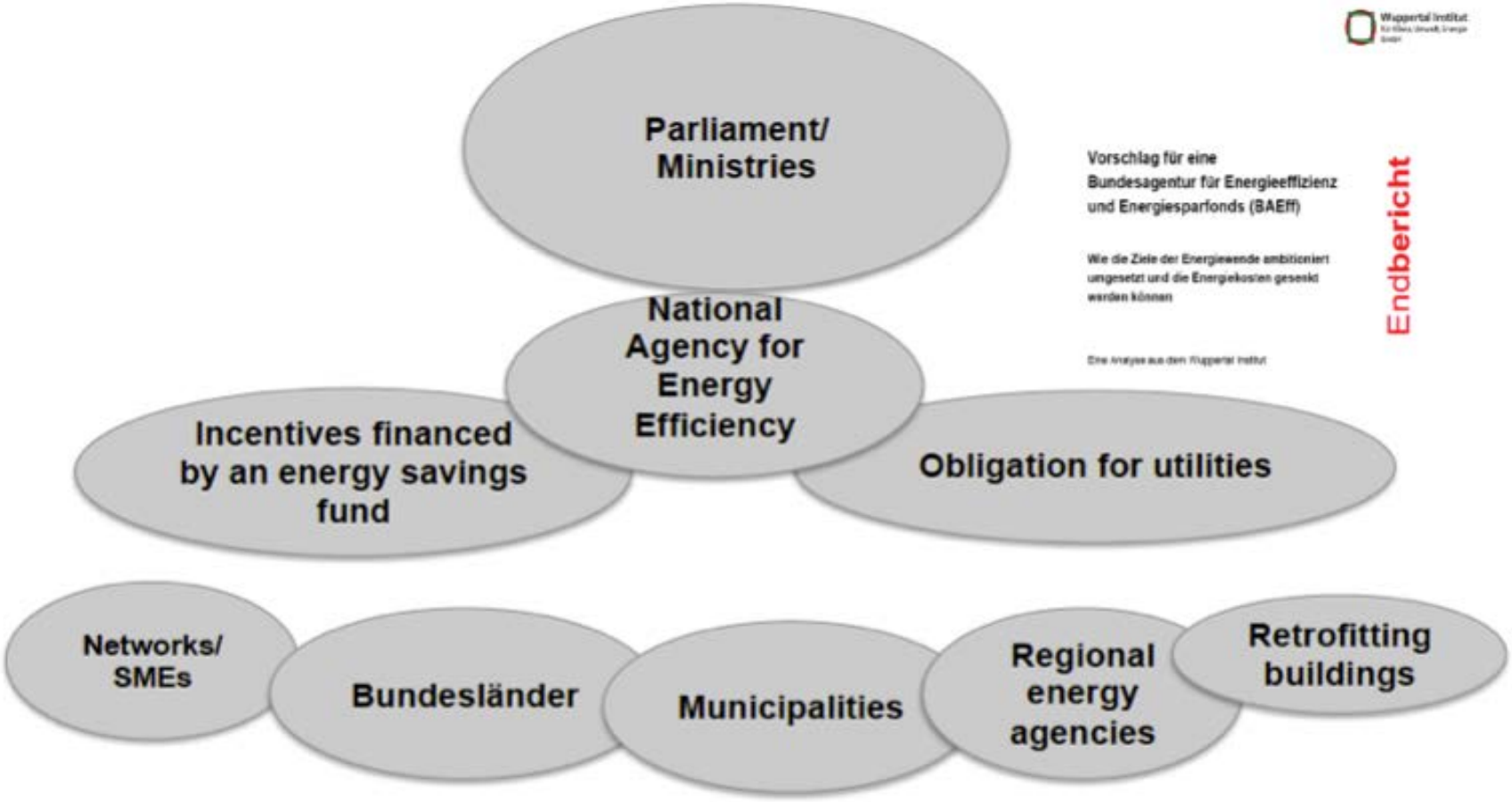
Effects of promotion

- Increase of retrofitting ratio
- Sustainable reduction of CO_2-emissions
- Promotion for SMEs and creation of employment
- Substantial investments in buildings be triggered

Budget funds being recovered by additional revenues of taxes

National Agency for Energy Efficiency + Savings Fund

A proposal for a new "policentric governance" of energy efficiency policies

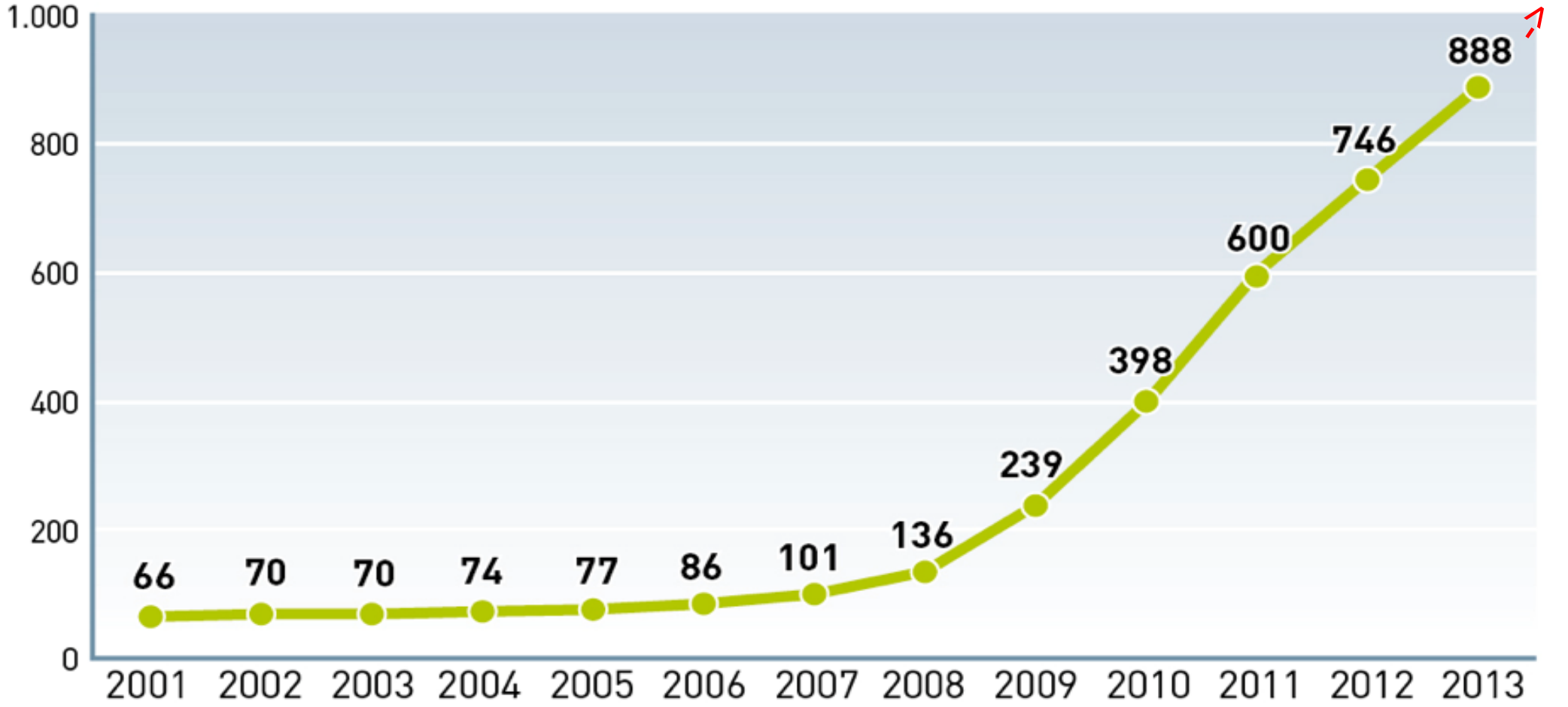


Quelle: Wuppertal Institut 2014

Decentralization:
The role of cities, municipalities, cooperatives, citizen financing, …

Energy Co-operatives in Germany: A Success Story

Over the last few years the number of energy co-operatives has increased sharply.

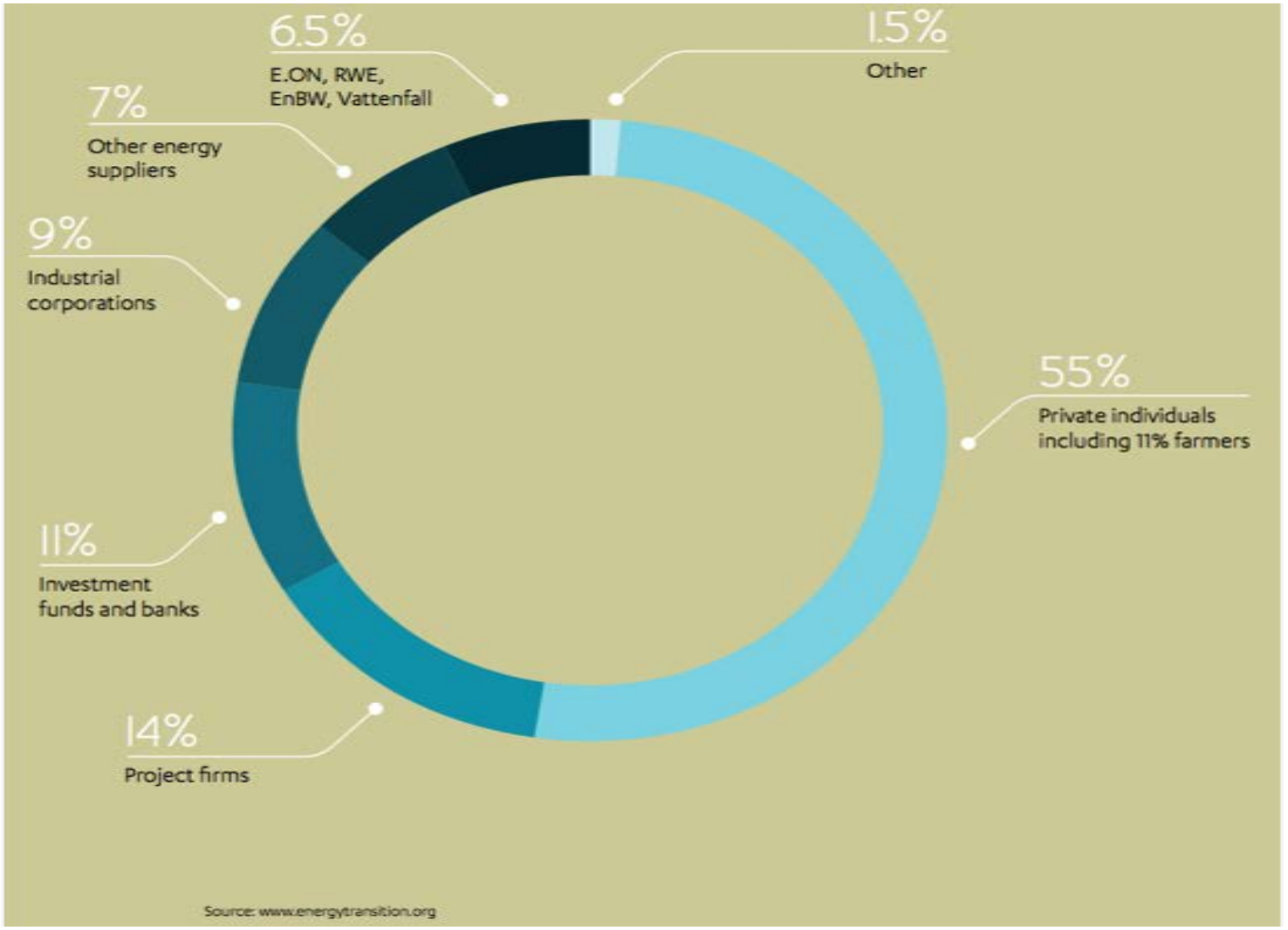


Source: Klaus Novy Institut; as of 01/2014

www.renewables-in-germany.com

Renewable Energies Agency

Ownership of installed renewable power capacities in Germany 2010



Source: Greenpeace International 2013.

The split of E.ON: “A matter of survival”

FR 12.03.2015: “Tottering giants. Billions of losses for RWE and E.ON”!

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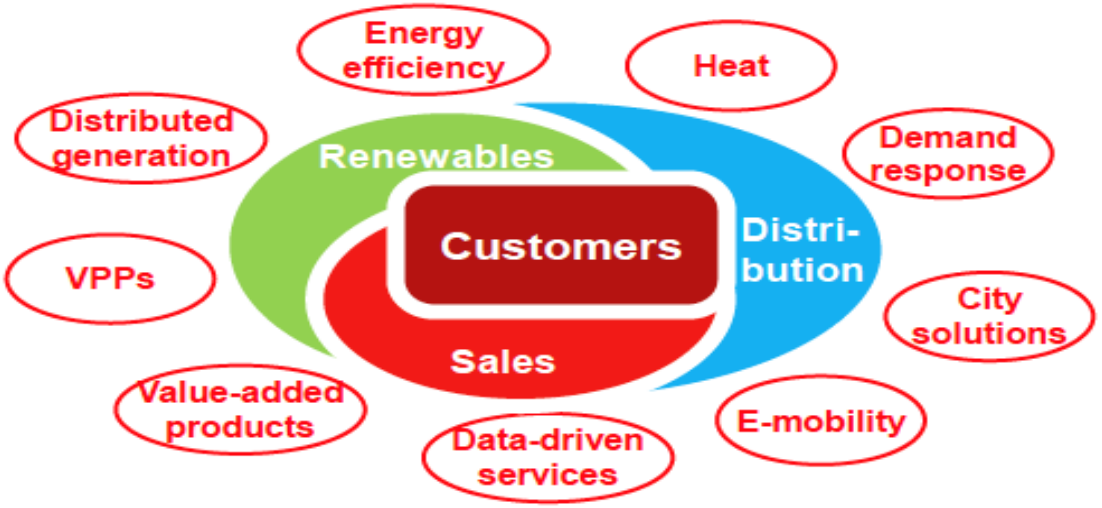
Two very different energy worlds emerging



Conventional energy world

- System-centric
- Security of supply
- Global/regional perspective
- Large scale, central
- Conventional technologies

New energy world

- Customer-centric
- Sustainability
- Local proximity
- Small scale, distributed
- Clean technologies

e·on

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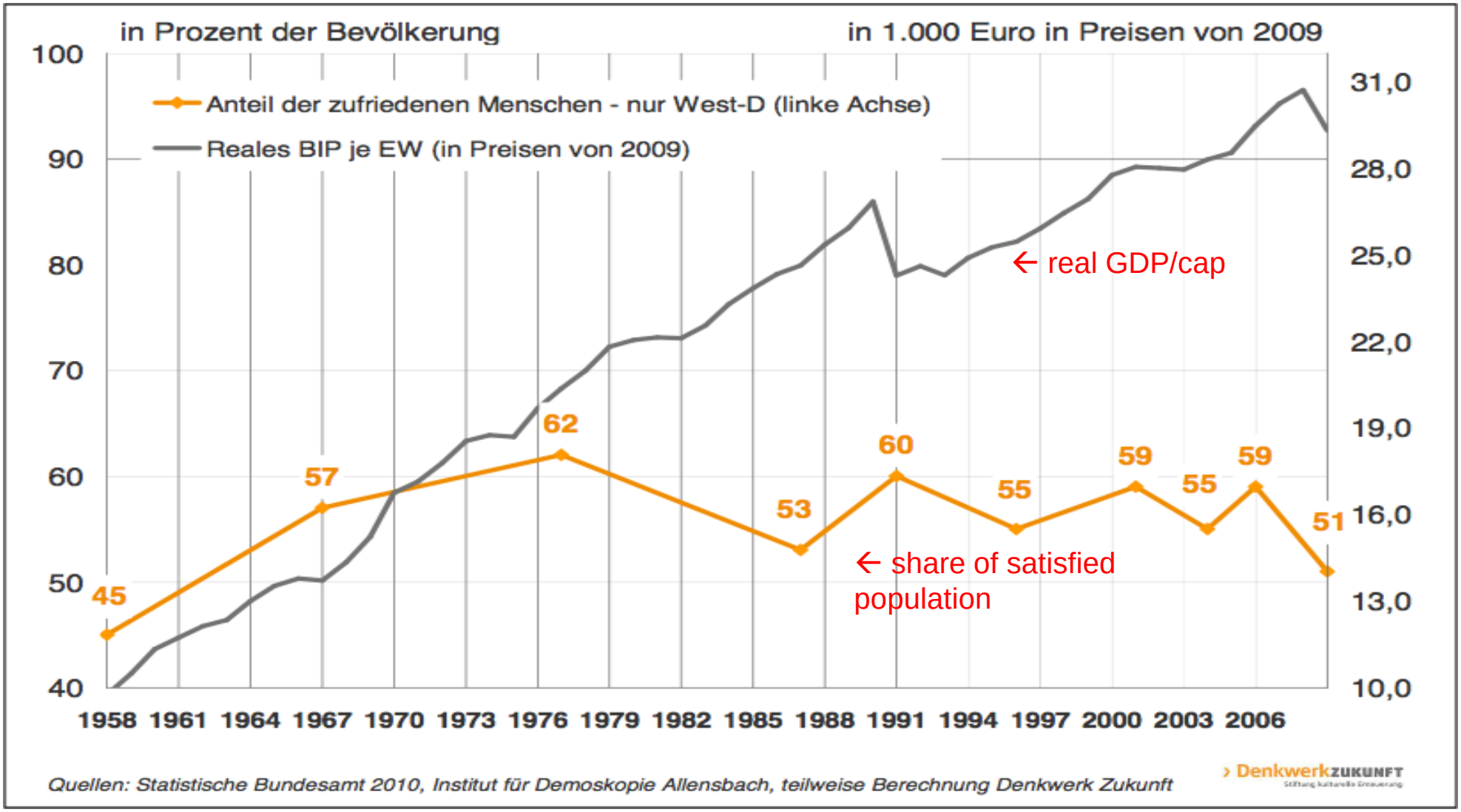
Is efficient sufficient?

Increase in GDP has decoupled from life satisfaction

GDP/capita in life satisfaction in Germany 1958 until 2009



Source: Denkwerk Zukunft 2010.

A strong plea to combine efficiency and sufficiency policies – to reduce rebound effects and encourage lifestyle changes!

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„The older I get the more I like regulation“
Eoin Lees, Former Head of Energy Savings Trust/UK

System adjustments

- **Direct:**
  - Binding energy saving targets (EU 2011/2012)
  - Energy efficiency obligations for utilities (EU ESD 2012)
  - Reduction of subsidies and internalizing ext. cost of fossil fuels/nuclear
  - Caps, e.g. dynamic standards for fleet consumption of cars (EU)
  - Bonus/Malus regulations e.g. for cars (“feebates”)
  - More ambitious targets for EU ETS
  - Progressive standards (e.g. ICT)
  - Ecotax
- **Indirect:**
  - Structural change to less resource intensive sectors (i.e. services)
  - Promotion of renewable energy in coordination with energy efficiency
  - “ProgRess” (German Program Resource Efficiency)

Behavioral change

- Sustainable consumption, promotion of common goods, education, ...
- Reducing societal disparities (e.g. income, wealth, access), ...

Outlook:
Strengthen international cooperation on the energy transition

Structure of the Energy Transition Council (GJETC)
First meeting in Tokyo 28./29. September 2016

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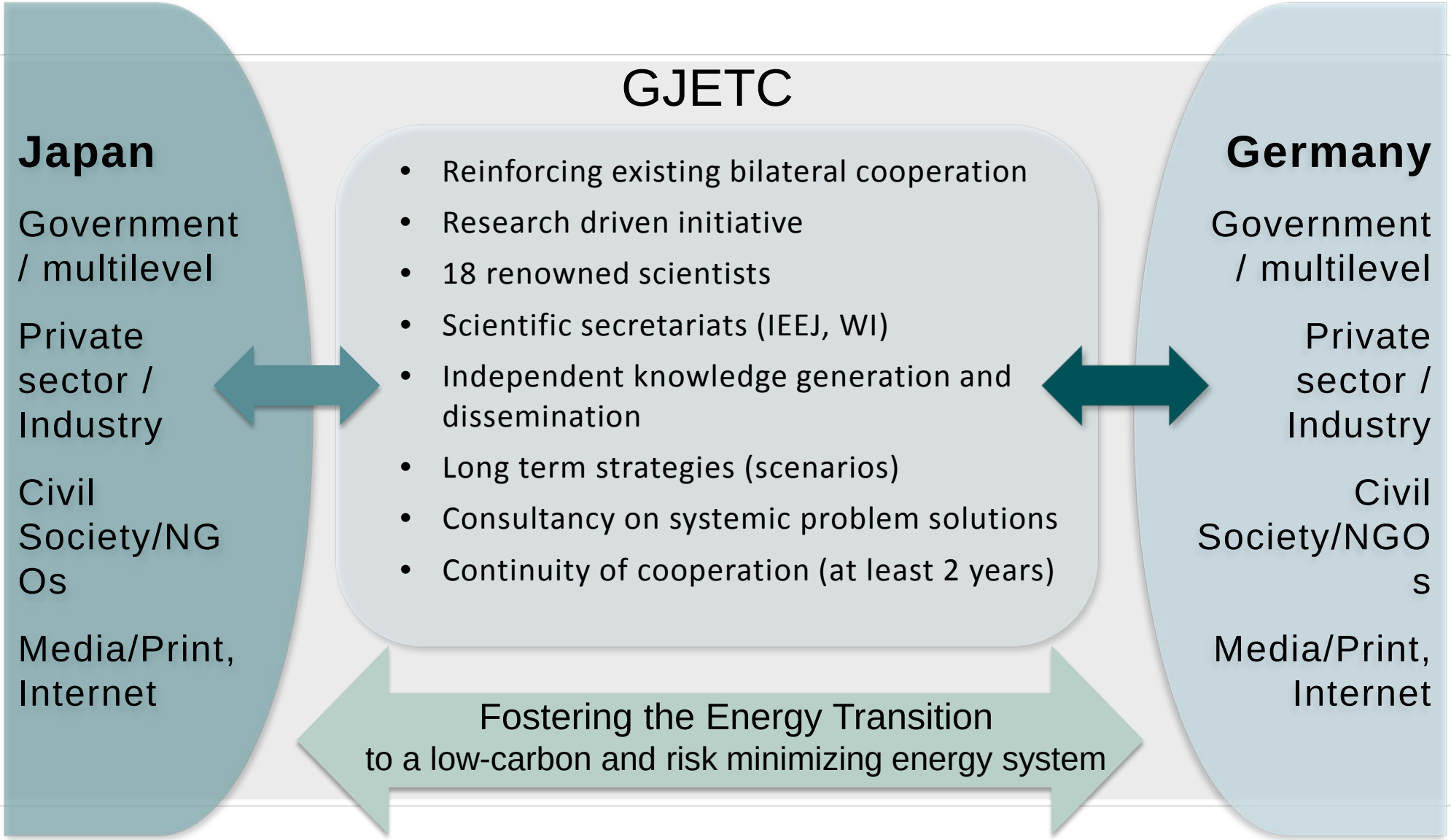
Enabling international knowledge exchange and mutual learning



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Prof. Dr. Peter Hennicke

Thank you for your attention!

New publication:

The Energiewende
Available under: http://wupperinst.org/info/details/wi/a/ad/3319/