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# **Challenges and opportunities for energy companies due to climate crisis and renewable energies**

**Input for the Energy Transition Dialogue  
in Luxembourg**

**Mondorf-les-Bains, October 24, 2019**

**Prof. Dr. Uwe Leprich**



# Uwe Leprich

- Professor at the business school of the University of Applied Sciences in Saarbruecken since 1995
- From 2008 till 2016 scientific head of the Institute for Future Energy Systems (IZES), a university based research institute focussing on renewable energies, energy efficiency and decentralised power generation
- From 04/2016 till 03/2018 head of the department for climate protection and energy in the Federal Environment Agency (UBA)
- Alternate member of the Administrative Board of ACER (Agency for the cooperation of Energy Regulators) since 2011
- Author and co-author of several books and numerous articles on liberalised electricity markets, economic instruments and measures for supporting sustainable options in the energy markets, and climate protection policies

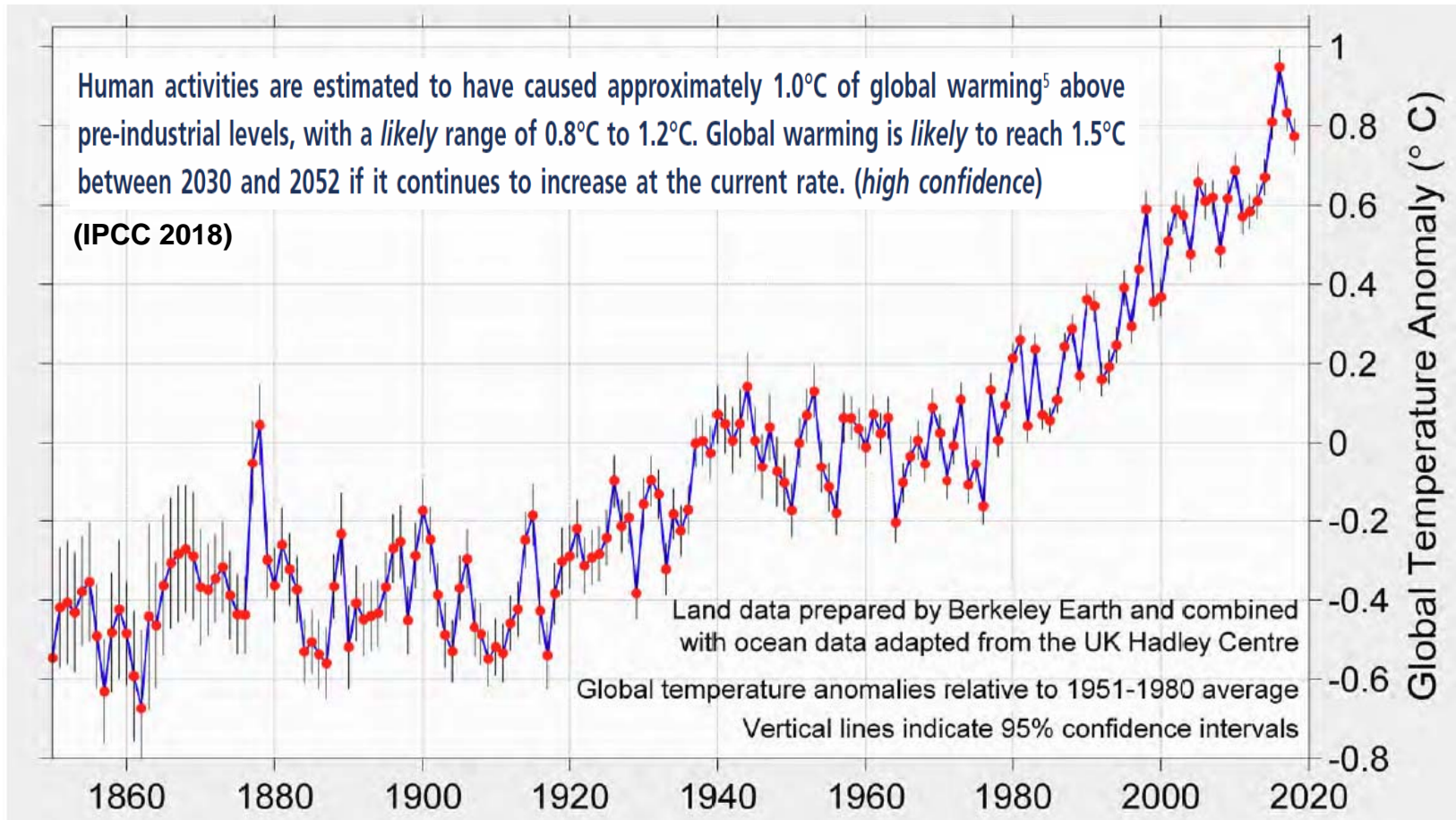


# 1. The climate crisis

Quelle:

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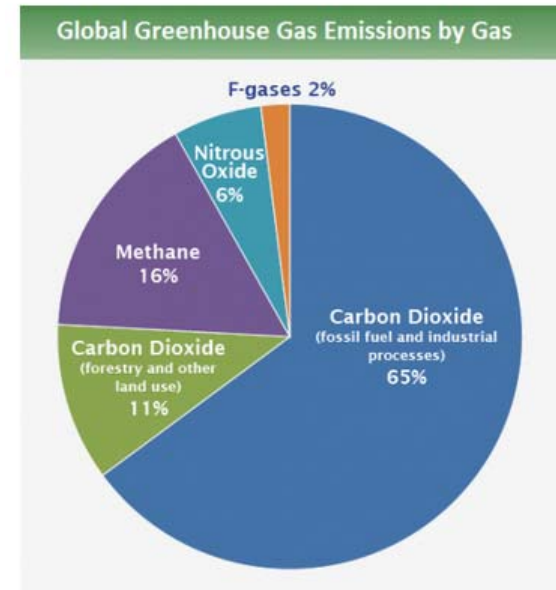
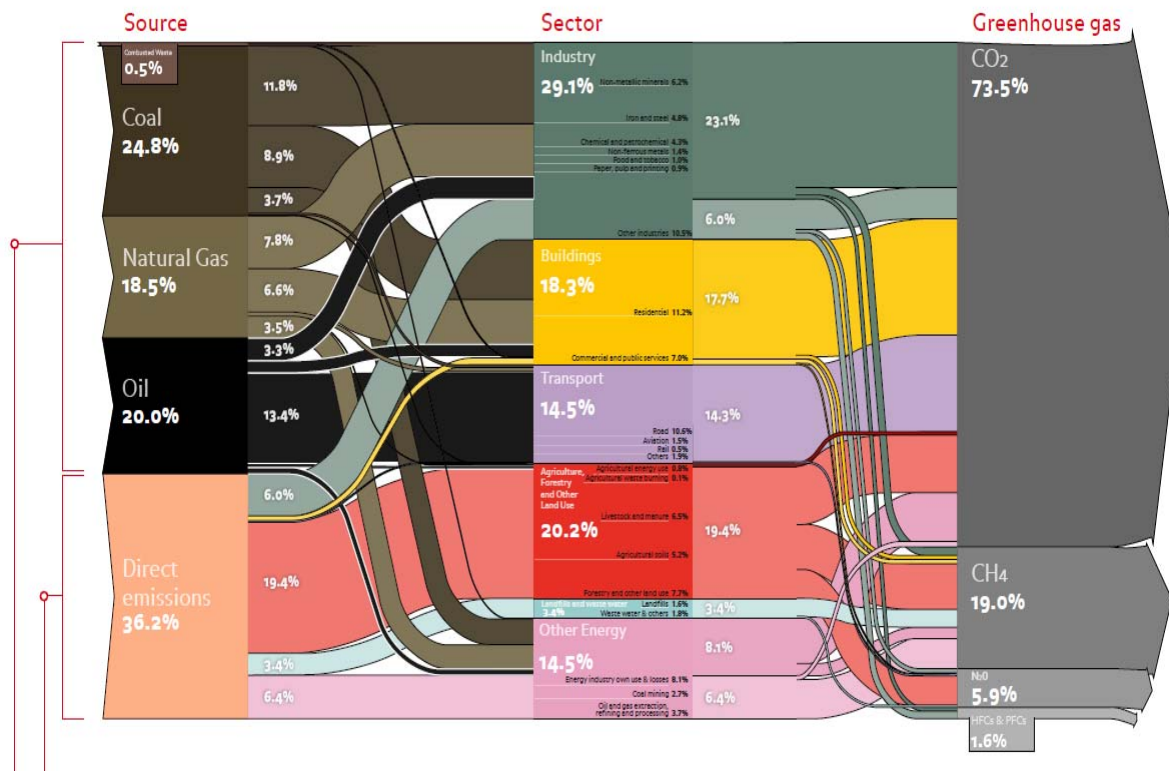
# Global Average Temperature 1860-2018: It's getting warmer!



# Shares of various greenhouse gases in the greenhouse effect: it's mostly CO<sub>2</sub>

WORLD GHG EMISSIONS FLOW CHART

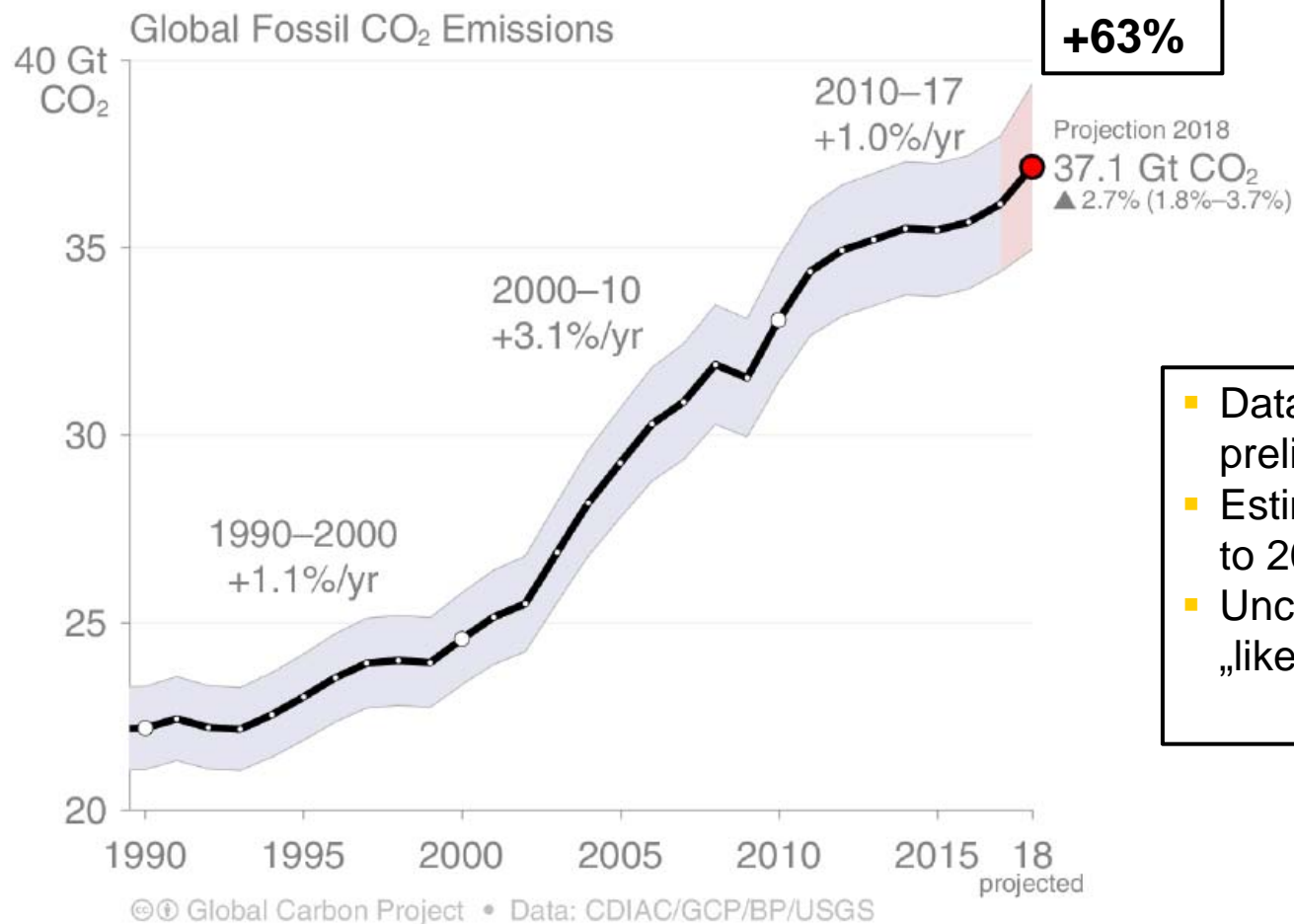
Total emissions worldwide (2012)  
**51,840**  
 MtCO<sub>2</sub> EQ



Source: [IPCC \(2014\)](#) EXIT based on global emissions from 2010. Details about the sources included in these estimates can be found in the [Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change](#). EXIT

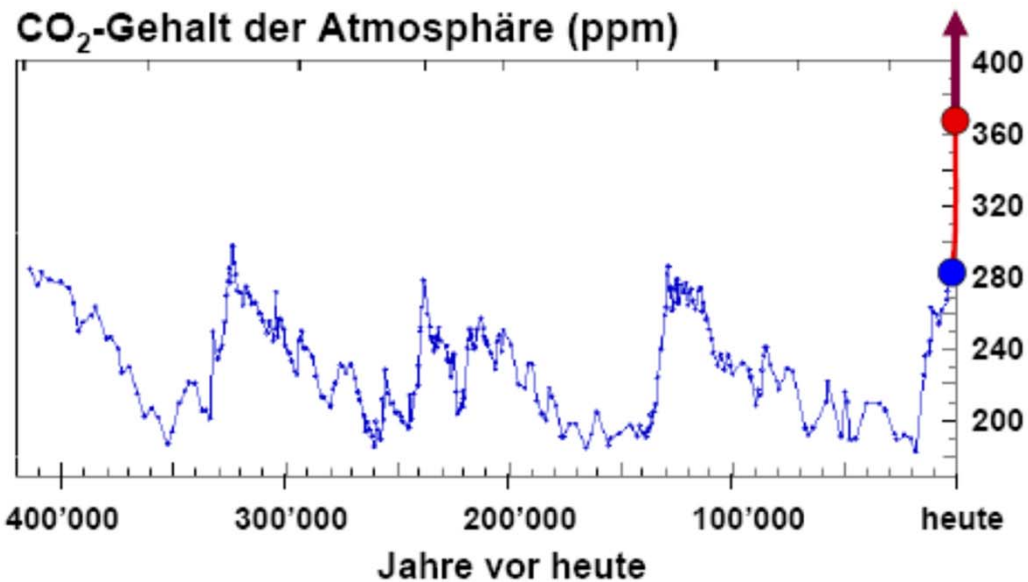
Quelle: Ecofys ASN 2016 / IPCC 2014

# Development of the global CO<sub>2</sub> emissions

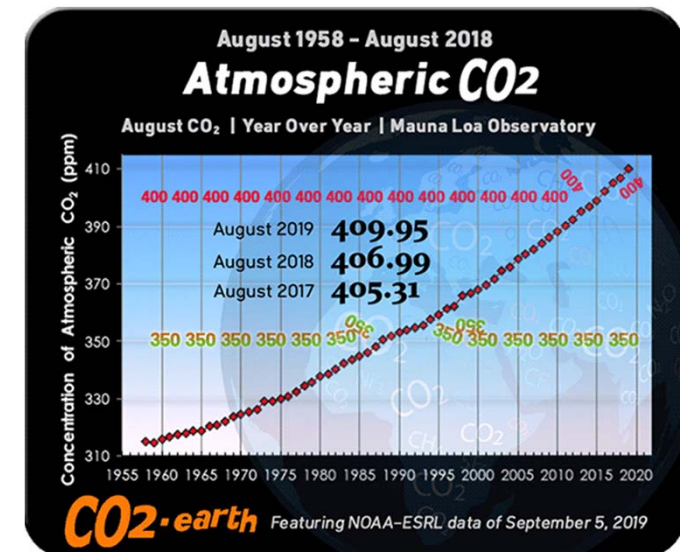


- Data for 2015-2017 are preliminary
- Estimate for 2018: +2,7% to 2017
- Uncertainty  $\pm 5\%$  (IPPC „likely“ range)

# Global CO<sub>2</sub>-concentration on the rise



The global CO<sub>2</sub> concentration increased by about 46% between 1750 (~277 ppm) and 2017 (405 ppm). 2016 was the first year to exceed the 400 ppm mark.



# Global warming consequences

**Quelle:** [http://www.joboneforhumanity.org/the\\_financial\\_costs\\_and\\_consequences\\_of\\_the\\_escalating\\_global\\_warming\\_emergencies](http://www.joboneforhumanity.org/the_financial_costs_and_consequences_of_the_escalating_global_warming_emergencies)  
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## Global Warming Consequences Destabilizing our Climate and Lives



- A** - Conflict & War
- B** - Increased Water Vapor
- C** - Rising Sea Levels
- D** - Methane Time Bomb
- E** - Financial Loss & Collapse
- F** - Animal Attacks
- G** - Tsunamis
- H** - Increased Volcanic Activity
- I** - Toxic Air Pollution
- J** - Increased Heat
- K** - Droughts
- L** - Less Food
- M** - Water Costing More
- N** - Desertification
- O** - Fires & Wildfires
- P** - Ocean Acidification & Marine Death
- Q** - Loss of Biodiversity
- R** - Loss of Breathable Air (From Phytoplankton)
- S** - Mass Migrations
- T** - Jet Stream Disruption
- U** - Shrinking Sea Ice & Ice Shelves
- V** - Shrinking Glaciers & Snowpack
- W** - Flooding
- X** - Melting Tundra & Permafrost
- Y** - Disease & Pandemic



# Sea-level rise in the Nile delta

Quelle: Kromp-Kolb 2018 / The Guardian, 3. November 2017



Sources: Otto Simonett, UNEP/GRID Geneva; Prof. G. Sestini, Florence; Remote Sensing Center, Cairo; DIERCKE Weltwirtschaftsatlas.



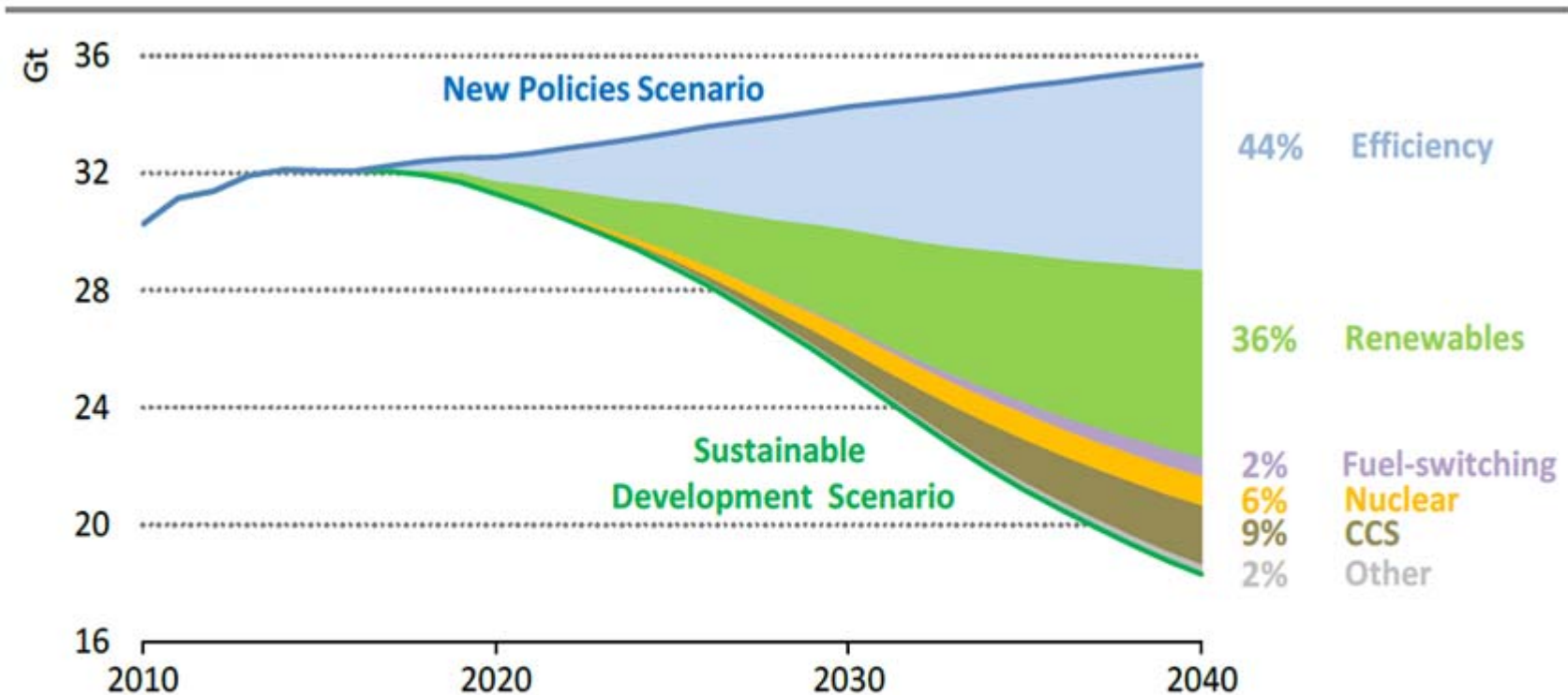
The IPCC reported that Alexandria's beaches would be submerged even with a 0.5-metre sea-level rise, while 8 million people would be displaced by flooding in Alexandria and the Nile Delta if no protective measures are taken. A 3C world threatens far greater damage than that.

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## 2. What can be done, and how fast?

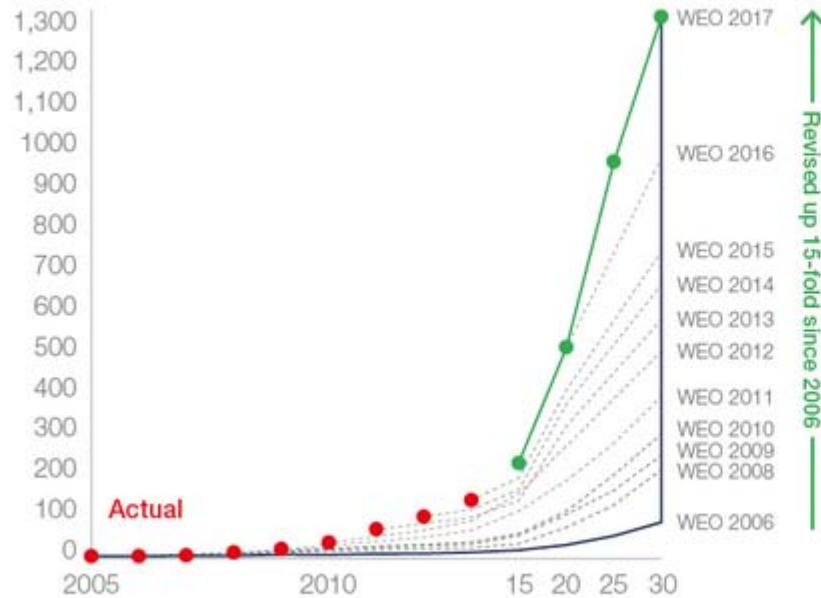
# World Energy Outlook (WEO) 2017 as a compass



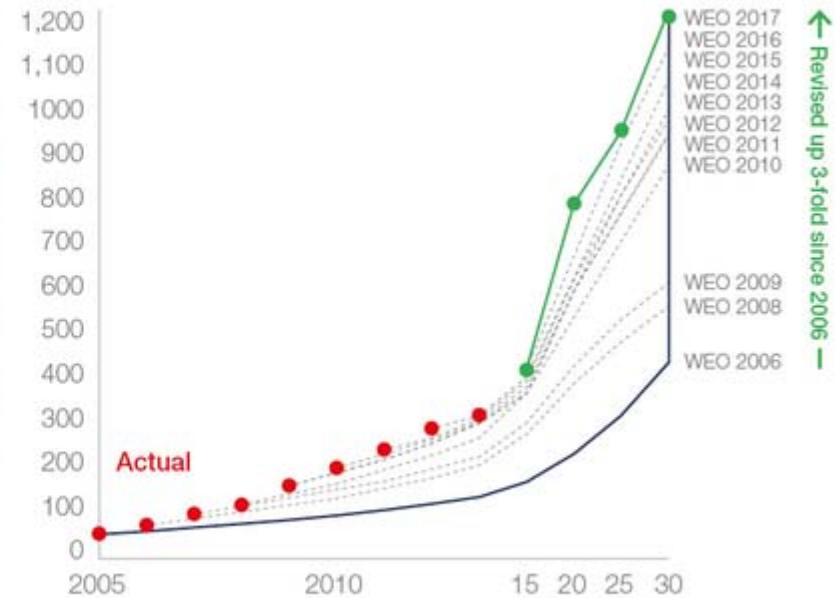
Energy efficiency and renewables account for 80% of the cumulative CO<sub>2</sub> emissions savings in the Sustainable Development Scenario

# The „learning curve“ of the World Energy Outlook

Solar: global forecast of cumulative installed capacity  
GW



Wind: global forecast of cumulative installed capacity  
GW

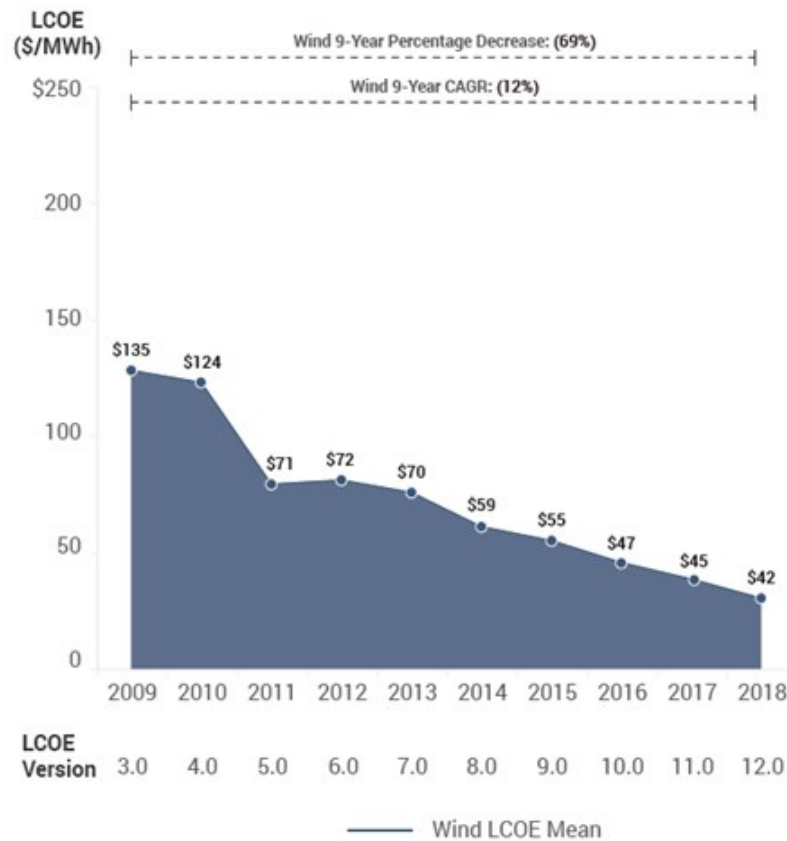


Source: IEA World Energy Outlook – New Policy Scenario

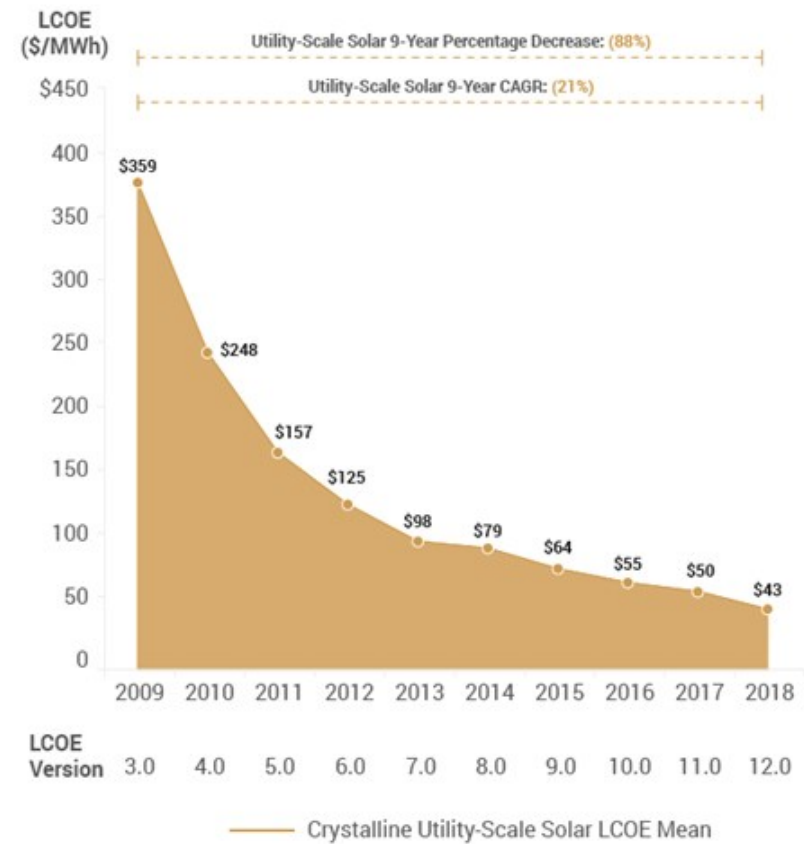
# The unbelievable cost degradation of wind and solar

Quelle: <https://www.lazard.com/perspective/levelized-cost-of-energy-and-levelized-cost-of-storage-2018/>

Unsubsidized Wind LCOE

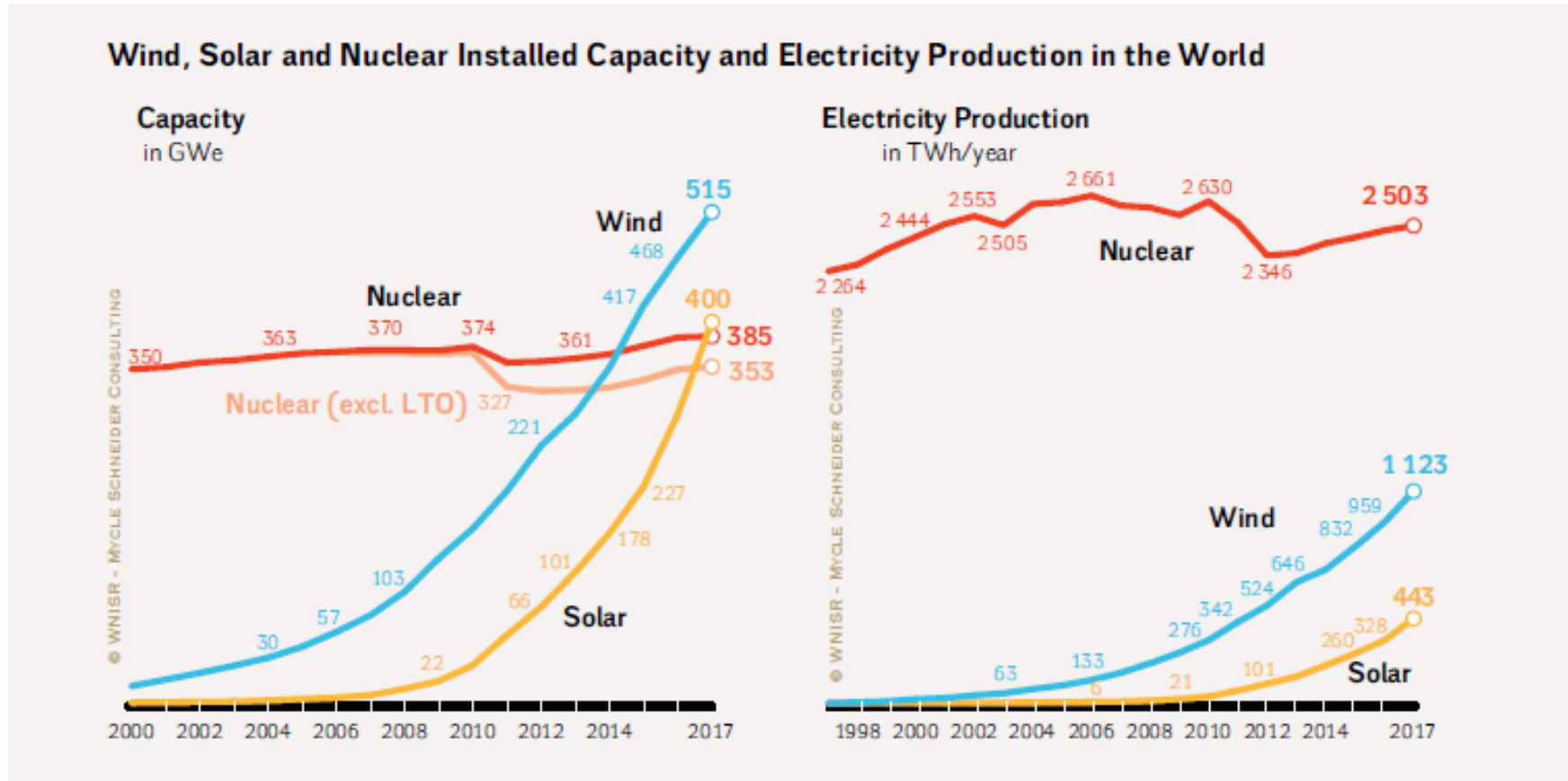


Unsubsidized Solar PV LCOE



# Comparison of electricity capacities and generation: nuclear, wind and solar energy

Quelle: World Nuclear Industry Status Report 2018



Source: WNISR, IAEA-PRIS, BP Statistical Review, 2018

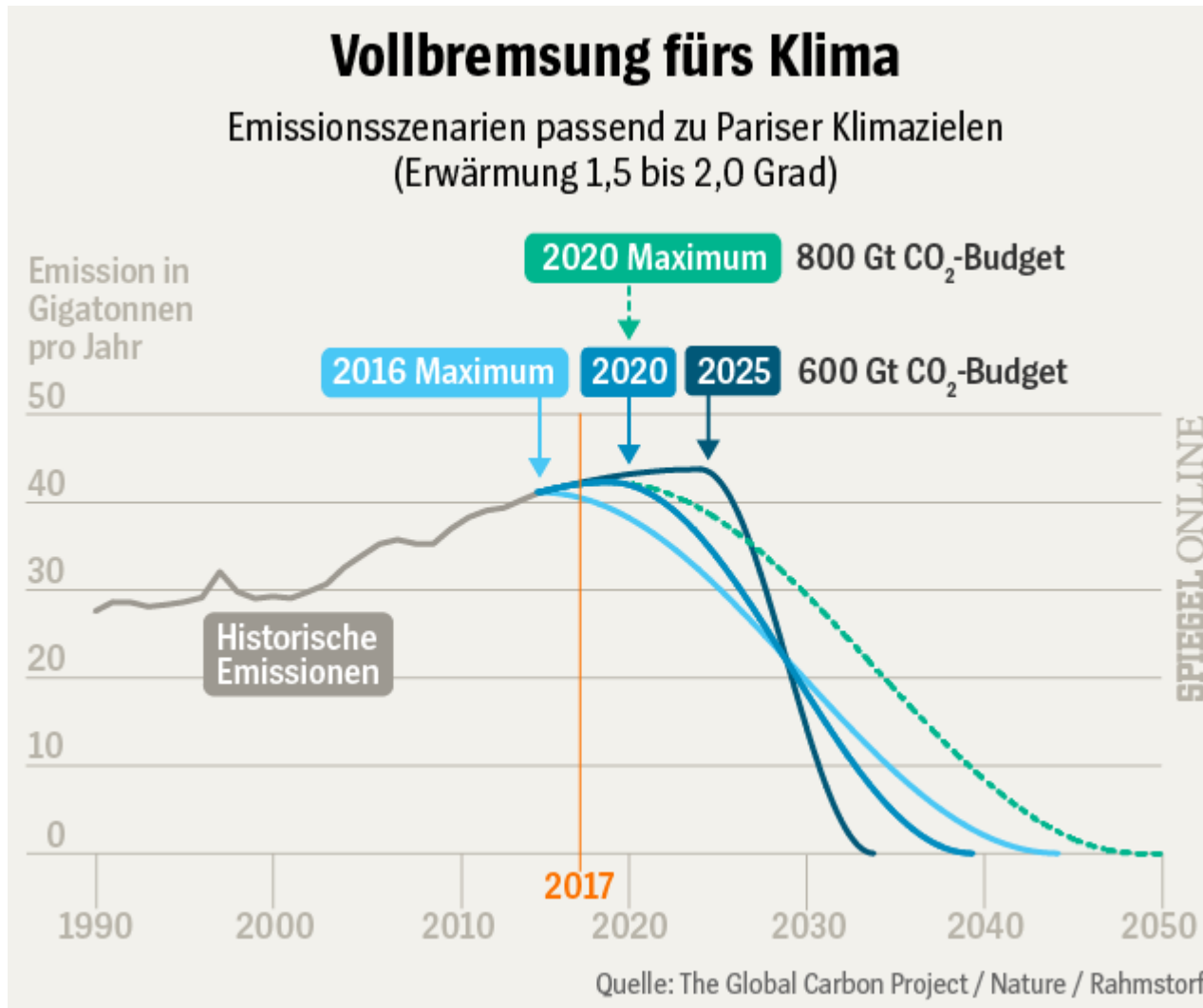
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# Renewable Energy Policies

		2017	2018
<b>POLICIES<sup>5</sup></b>			
Countries with national/state/provincial renewable energy targets <sup>6</sup>	#	179	169
Countries with 100% renewable energy in primary or final energy targets	#	1	1
Countries with 100% renewable heating and cooling targets	#	1	1
Countries with 100% renewable transport targets	#	1	1
Countries with 100% renewable electricity targets	#	57	65
States/provinces/countries with heat obligations/mandates	#	19	18
States/provinces/countries with biofuel mandates <sup>7</sup>	#	70	70
States/provinces/countries with feed-in policies	#	112	111
States/provinces/countries with RPS/quota policies	#	33	33
Countries with tendering (held in 2018)	#	29	48
Countries with tendering (cumulative) <sup>8</sup>	#	84	98

# We have to be even faster!

Quelle: <http://www.spiegel.de/wissenschaft/natur/bild-1237234-1195806.html>



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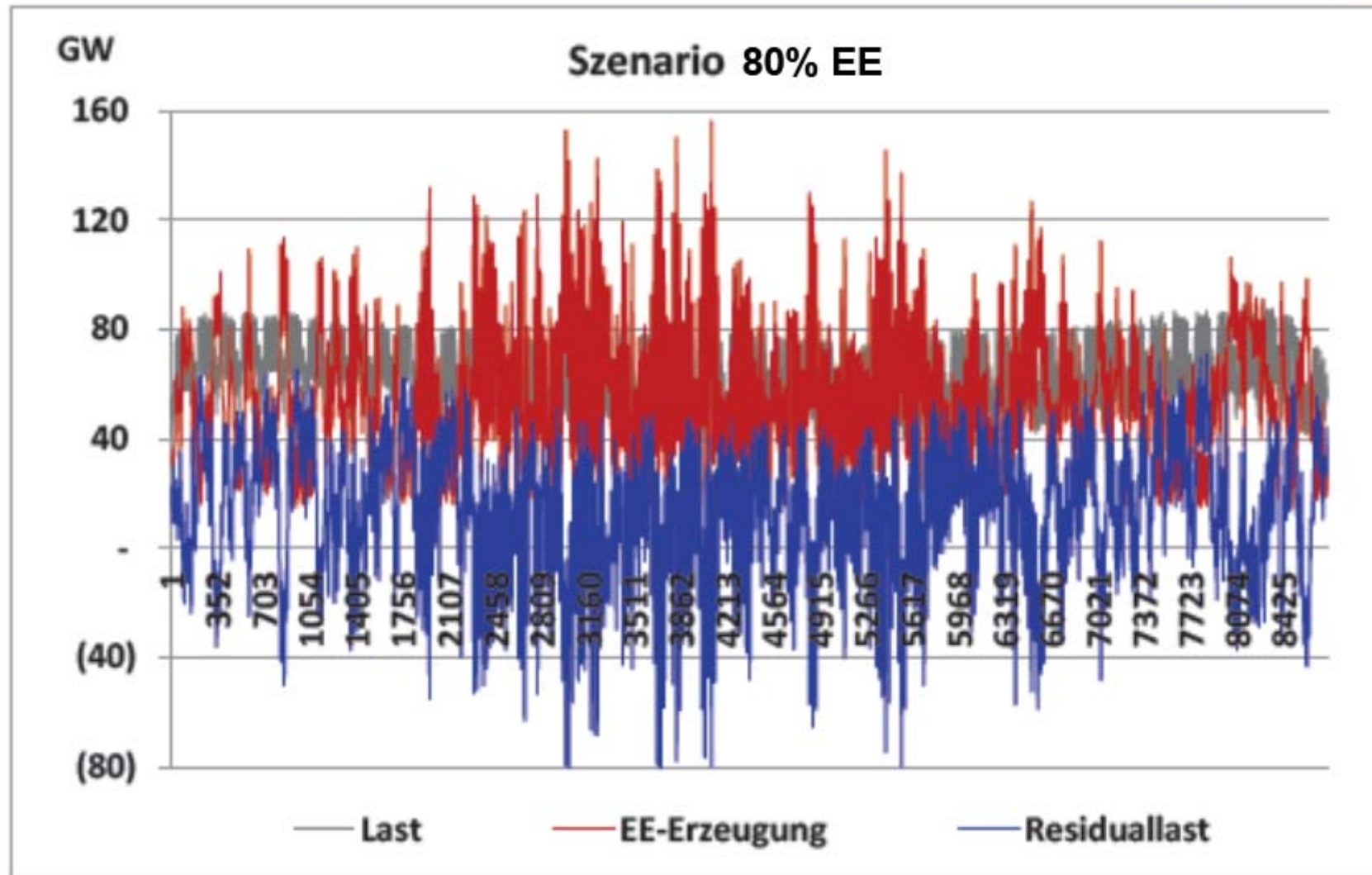
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### **3. Challenges and opportunities for energy companies**

Quelle:

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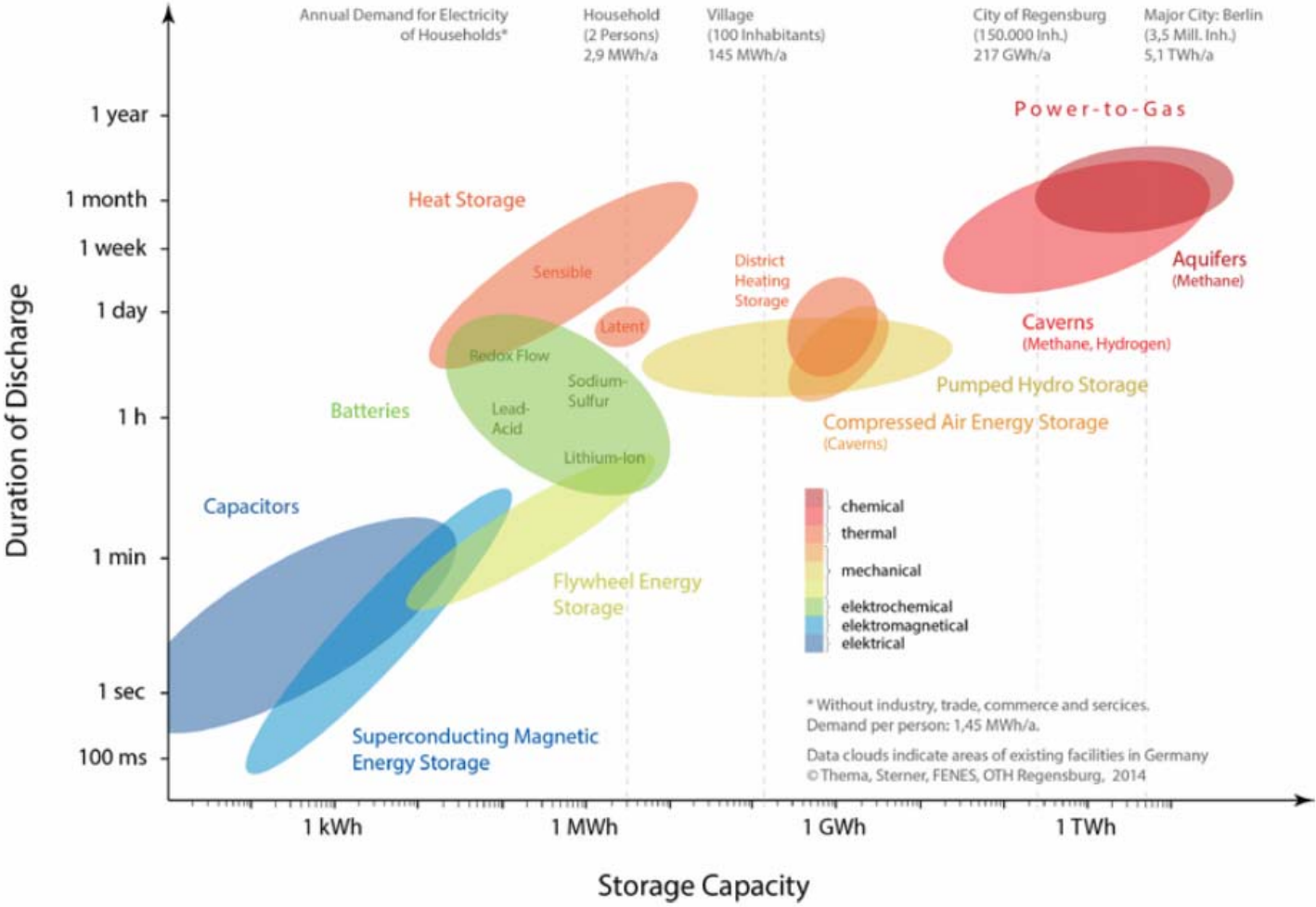
# Residual load in a scenario with 80% renewables



Quelle: Krzikalla 2013

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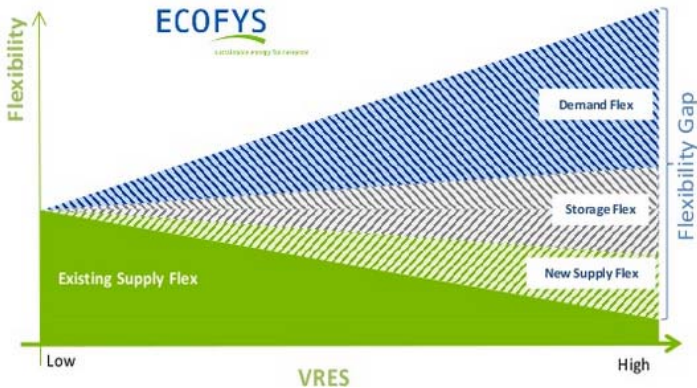
# First approach: storages



Quelle: Stadler/Sterner 2014

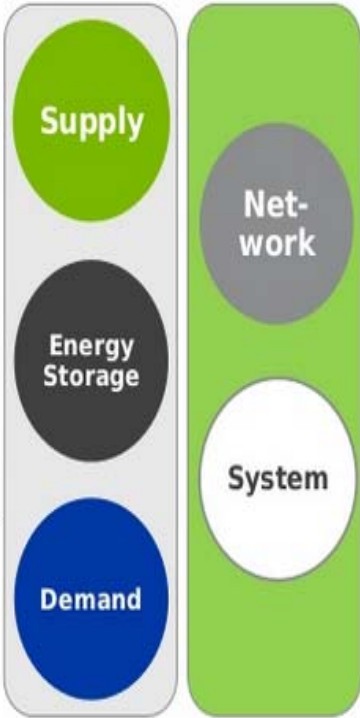
# Broader approach: flexibility options

The Flexibility Gap

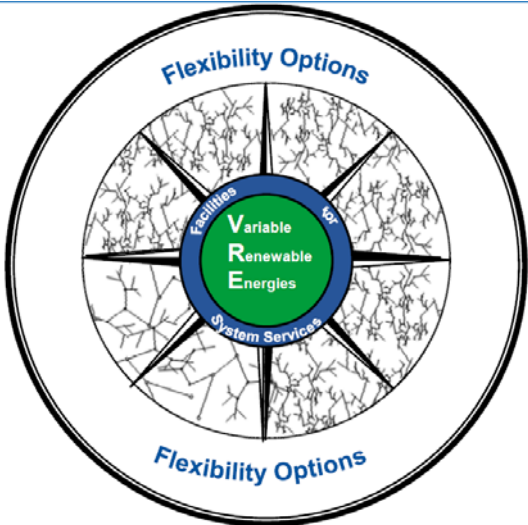


Overview of flexibility options

- 1. Flex Coal, 2. Gas
- 3. Oil, 4. Biogas,
- 5. CHP, 6. Nuclear
- 7. VRES
- 8. Pump storage,
- 9. (AA-)CAES
- 10. Flywheels
- 11. Batteries
- 12. Hydrogen (Power to Gas)
- 13. Demand Response
  - Energy intensive industries
  - Services
  - Smart applications
- 14. Electric vehicles
- 15. Heat pumps
- 16. Resistance heating

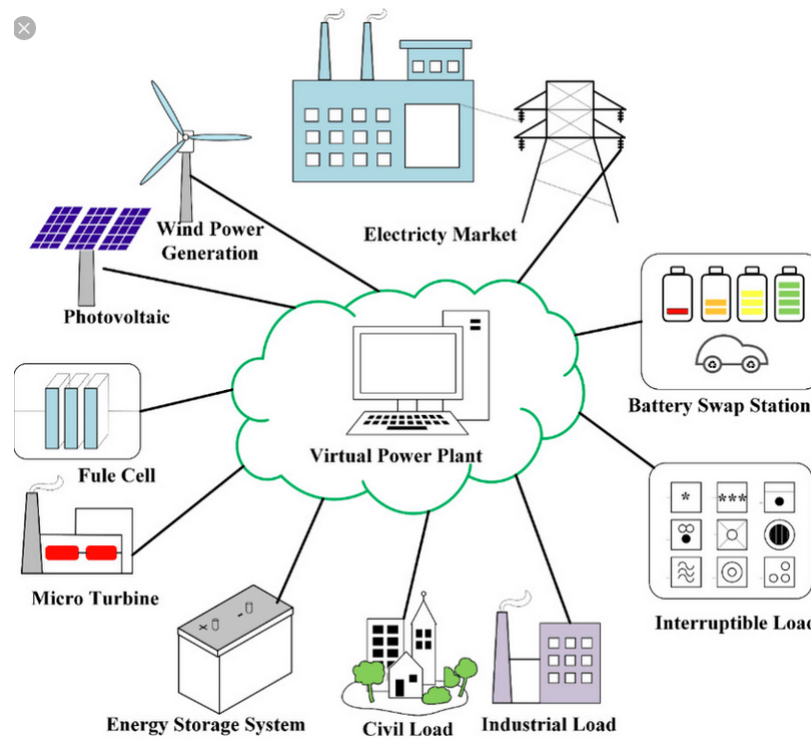


- 17. Network expansion (Installation of lines)
  - Add transmission capacity (HVAC /HVDC)
  - Increase meshing, alleviate congestions
- 18. Power flow control ("smart" devices)
  - Flow control devices: PST, FACTS, HVDC
- 19. Market Rules
- 20. Market integration:
  - Expansion of markets
  - Expansion of control zones



Quelle: Ecofys 2014

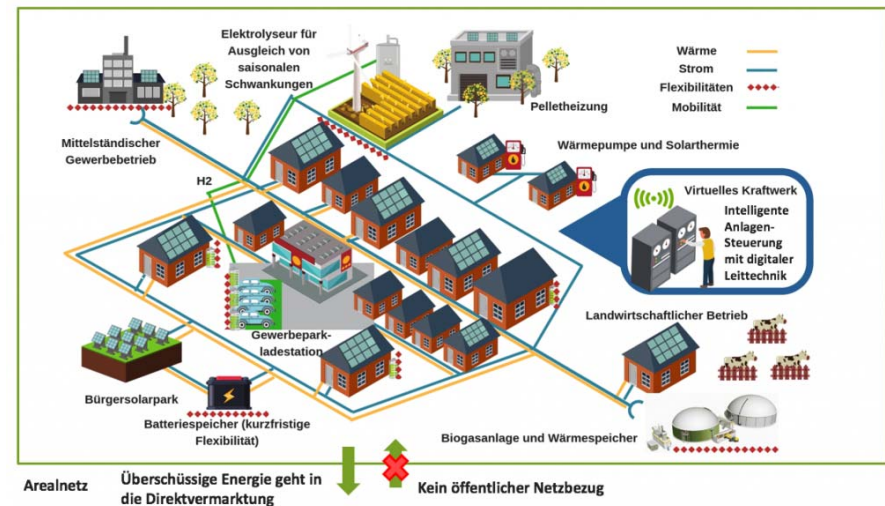
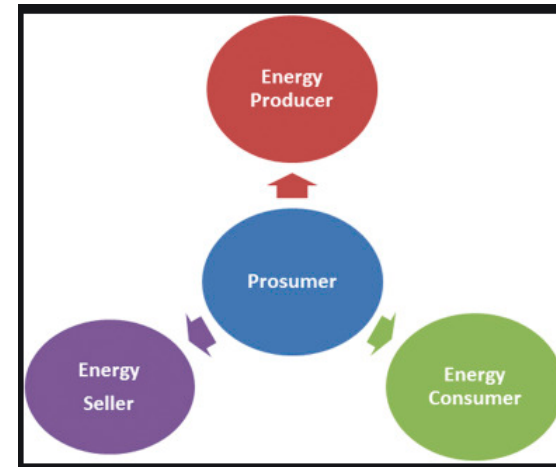
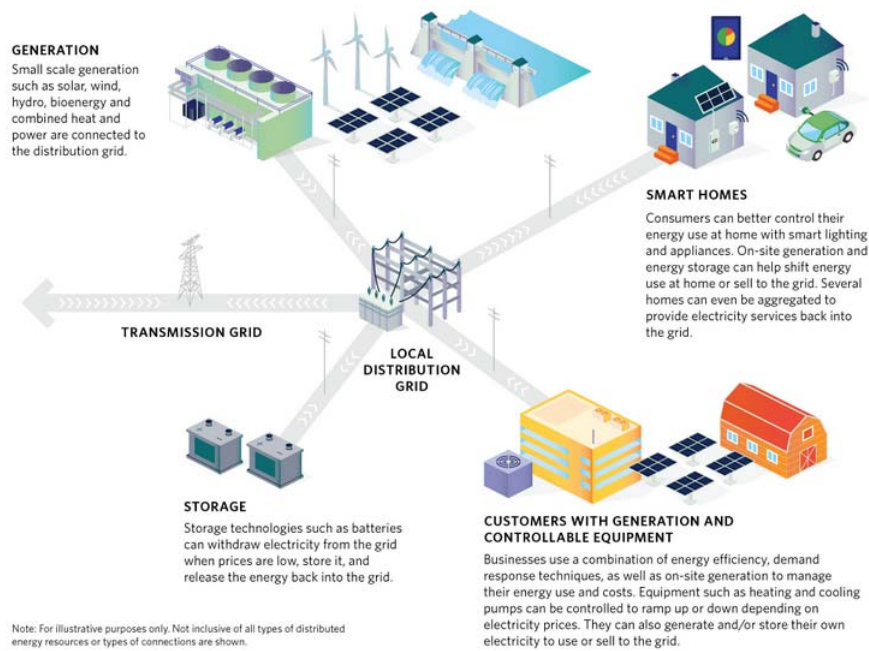
# Aggregation and markets



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# Energy systems with higher autonomy and prosumers

**Quelle:** <http://www.ieso.ca/en/Powering-Tomorrow/Technology/Momentum-Grows-For-a-More-Networked-Decentralized-Energy-System-in-Ontario-and-Globally>



<https://www.ecowert360.com/energetische-quartierskonzepte/>

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# Prospects

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- The climate crisis is the most important driver for the transformation of energy systems
- Beside energy efficiency, renewable energies - especially wind and solar - are the most important building blocks for meeting the climate protection targets
- Wind and solar as variable renewable energies fundamentally change energy systems
- Only flexible supplementary options have a chance to play a role in the future
- Great opportunities in future energy systems arise for aggregators, decentralized networkers, sector couplers and prosumers supporters
- In this workshop we will get to know two of these companies, their conceptual approaches and some business cases



# Thank you very much for your attention!

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