
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

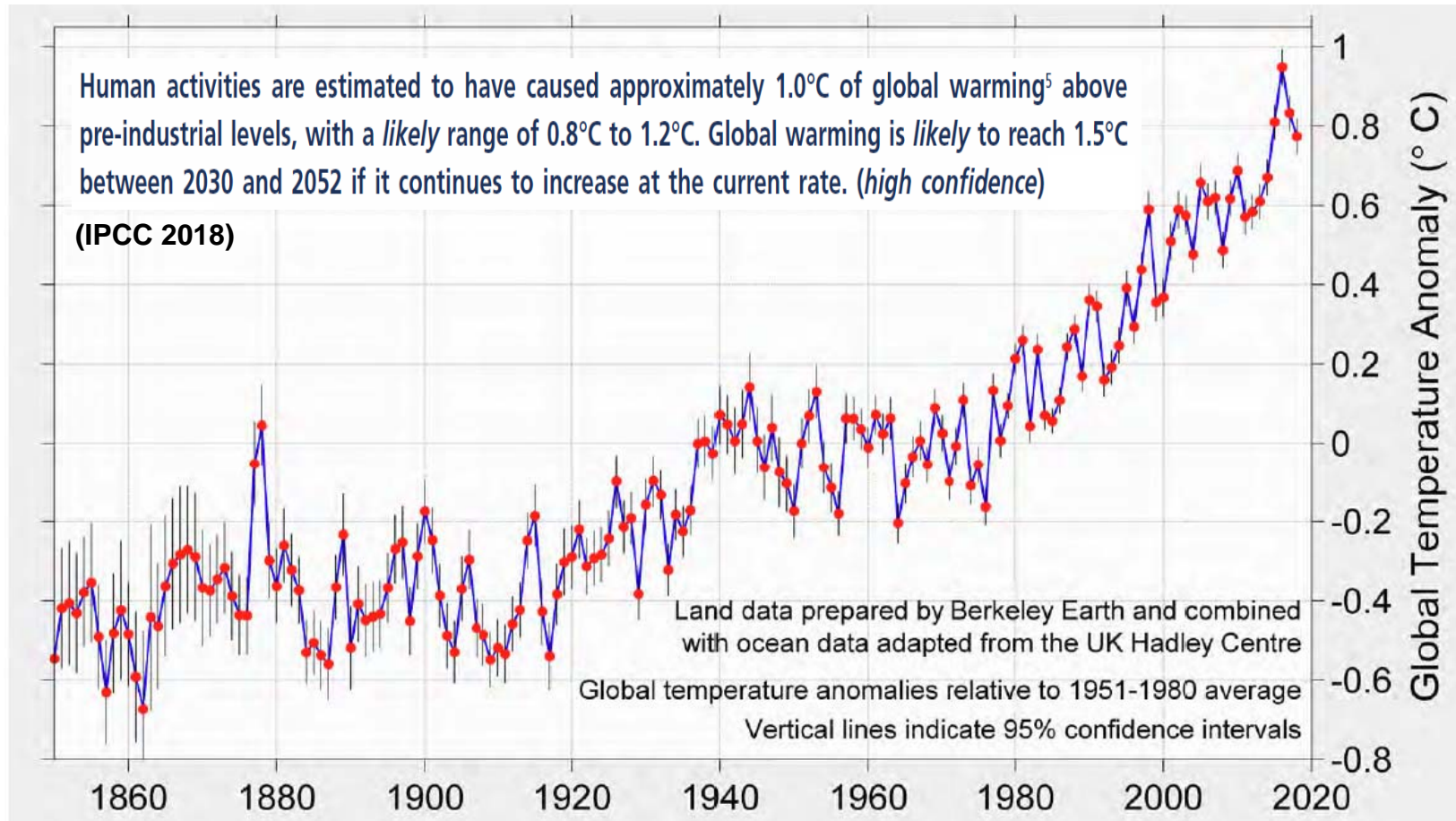


1. The climate crisis

Quelle:

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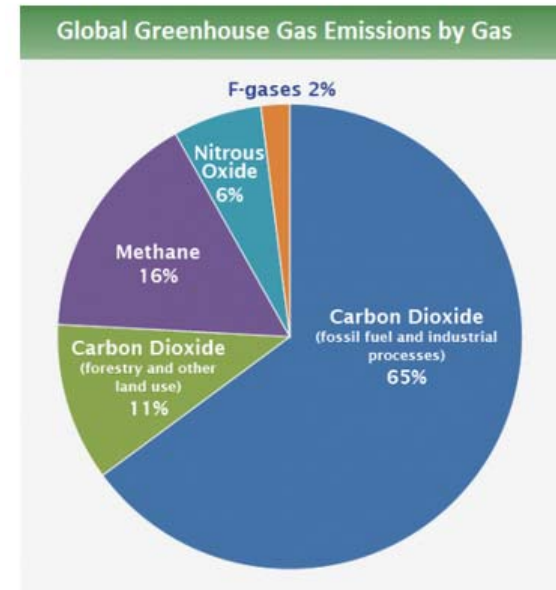
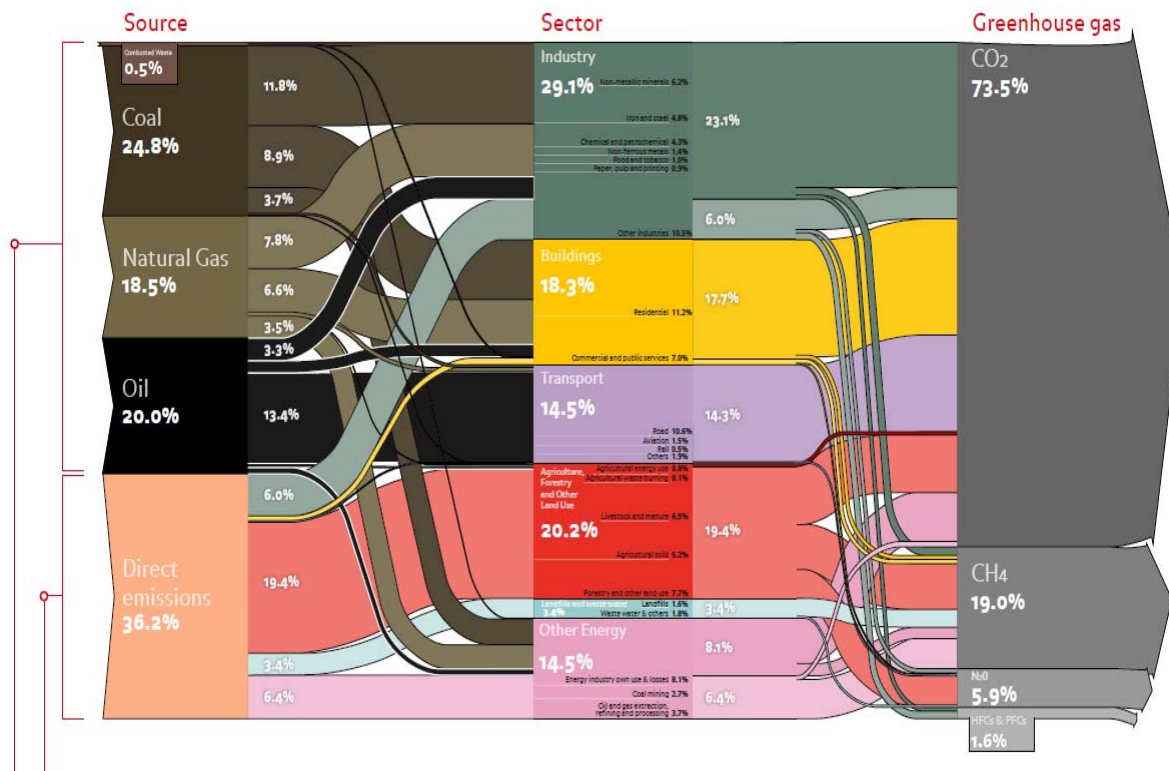
Global Average Temperature 1860-2018: It's getting warmer!



Shares of various greenhouse gases in the greenhouse effect: it's mostly CO₂

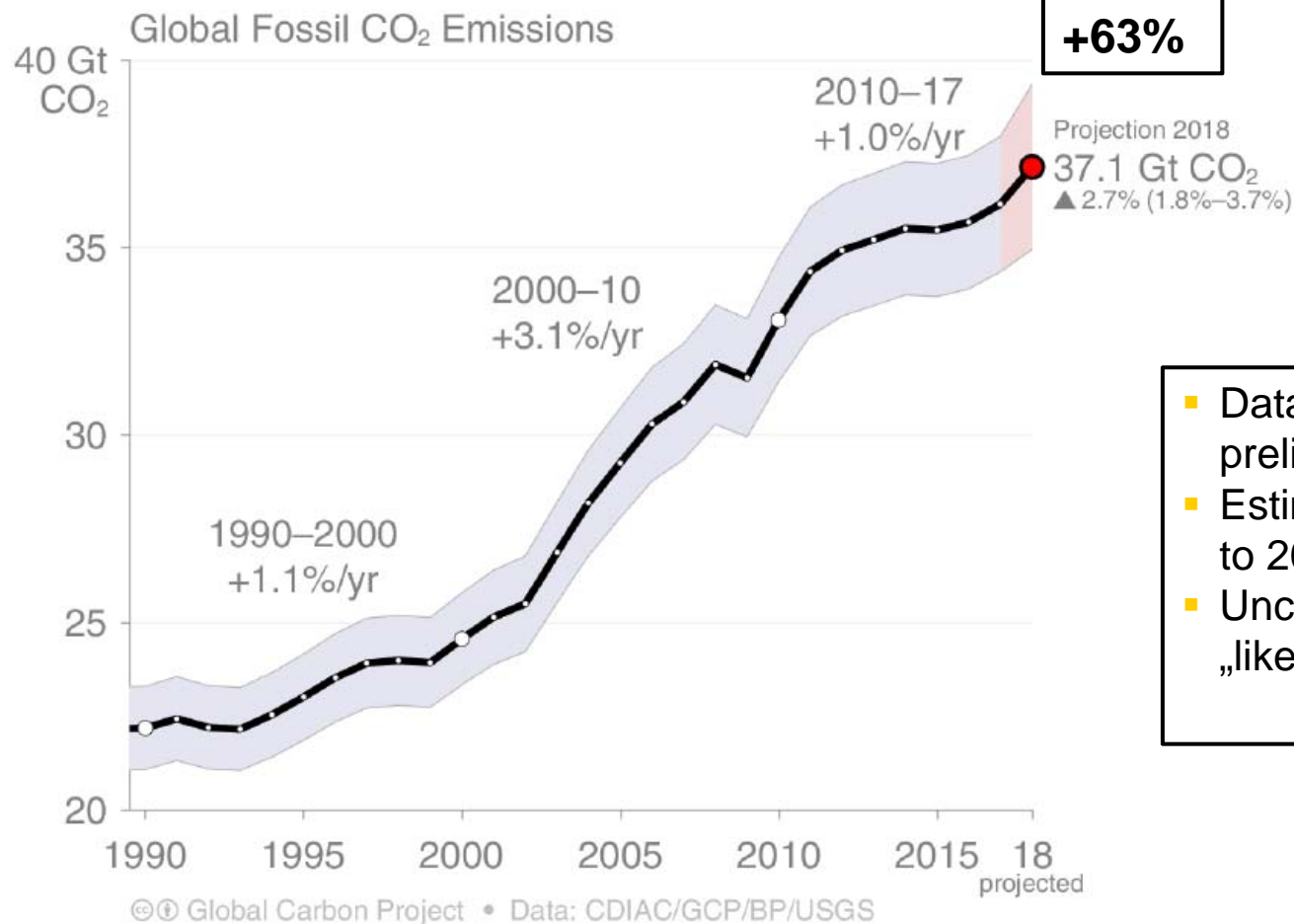
WORLD GHG EMISSIONS FLOW CHART

Total emissions worldwide (2012)
51,840
 MtCO₂ EQ



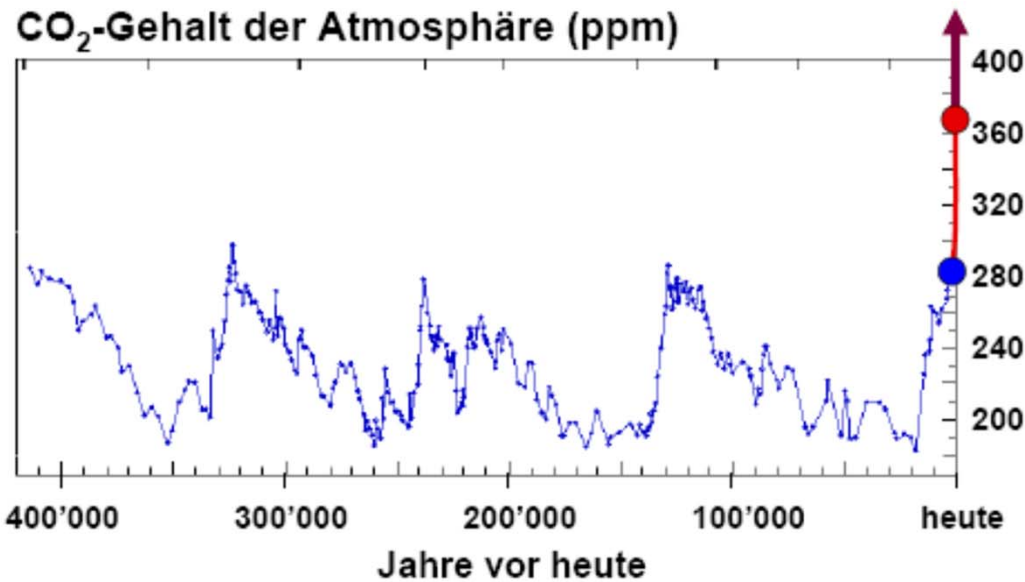
Source: [IPCC \(2014\)](#) [EXIT](#) based on global emissions from 2010. Details about the sources included in these estimates can be found in the [Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change](#). [EXIT](#)

Development of the global CO₂ emissions

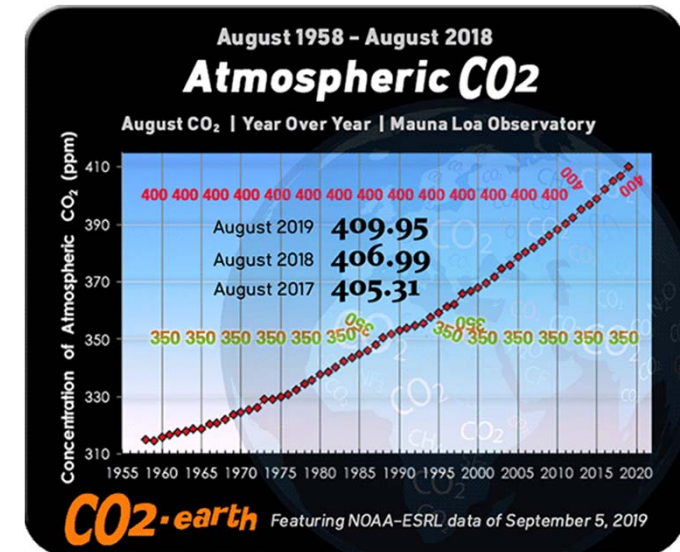


- Data for 2015-2017 are preliminary
- Estimate for 2018: +2,7% to 2017
- Uncertainty $\pm 5\%$ (IPPC „likely“ range)

Global CO₂-concentration on the rise



The global CO₂ concentration increased by about 46% between 1750 (~277 ppm) and 2017 (405 ppm). 2016 was the first year to exceed the 400 ppm mark.



Quelle: <https://www.co2.earth/daily-co2>

Global warming consequences

Quelle: http://www.joboneforhumanity.org/the_financial_costs_and_consequences_of_the_escalating_global_warming_emergencies
ncy

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.

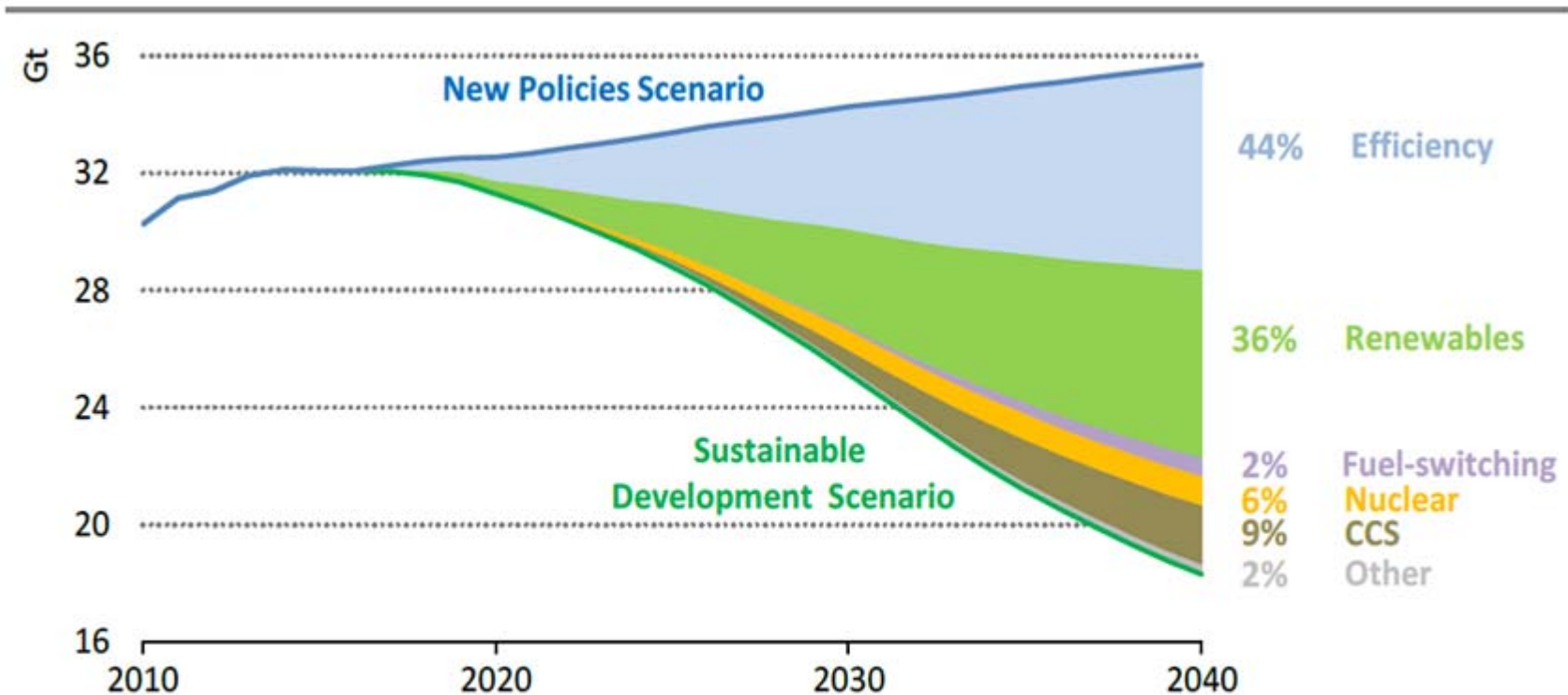


The IPCC reported that Alexandria's beaches would be submerged even with a 0.5-metre sea-level rise, while 8 million people would be displaced by flooding in Alexandria and the Nile Delta if no protective measures are taken. A 3C world threatens far greater damage than that.

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2. What can be done, and how fast?

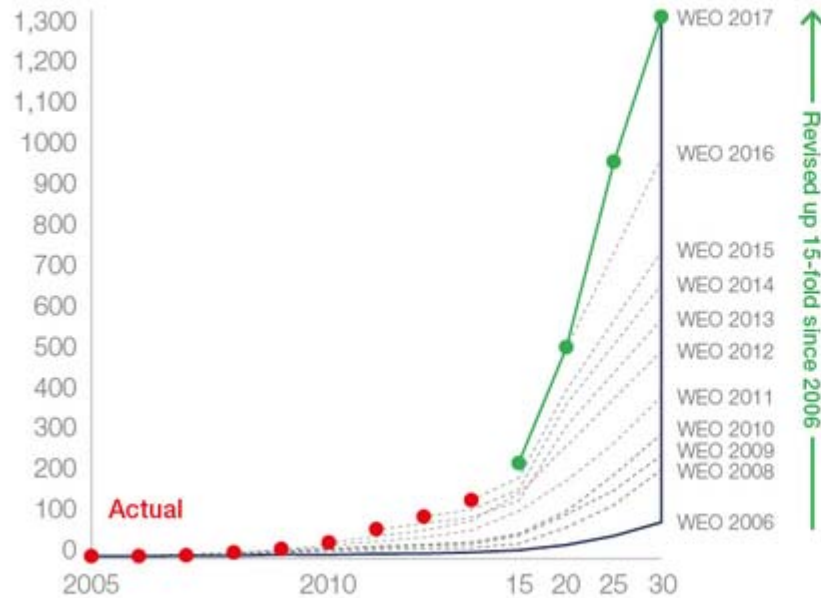
World Energy Outlook (WEO) 2017 as a compass



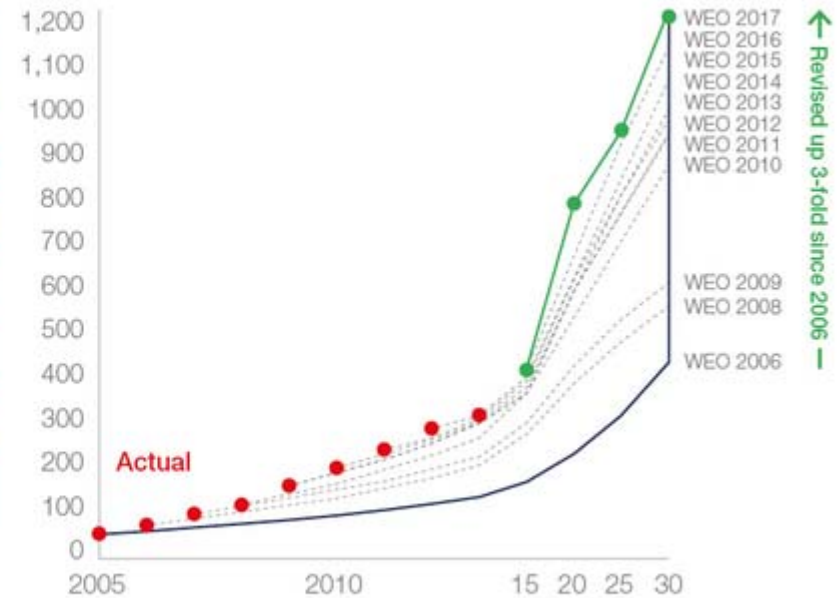
Energy efficiency and renewables account for 80% of the cumulative CO₂ emissions savings in the Sustainable Development Scenario

The „learning curve“ of the World Energy Outlook

Solar: global forecast of cumulative installed capacity
GW



Wind: global forecast of cumulative installed capacity
GW

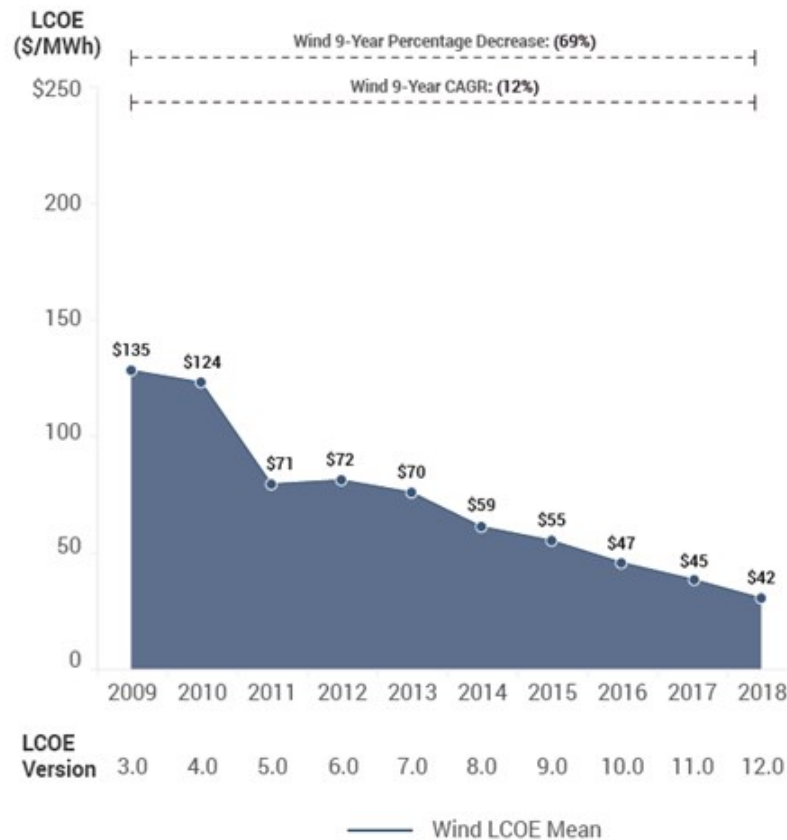


Source: IEA World Energy Outlook – New Policy Scenario

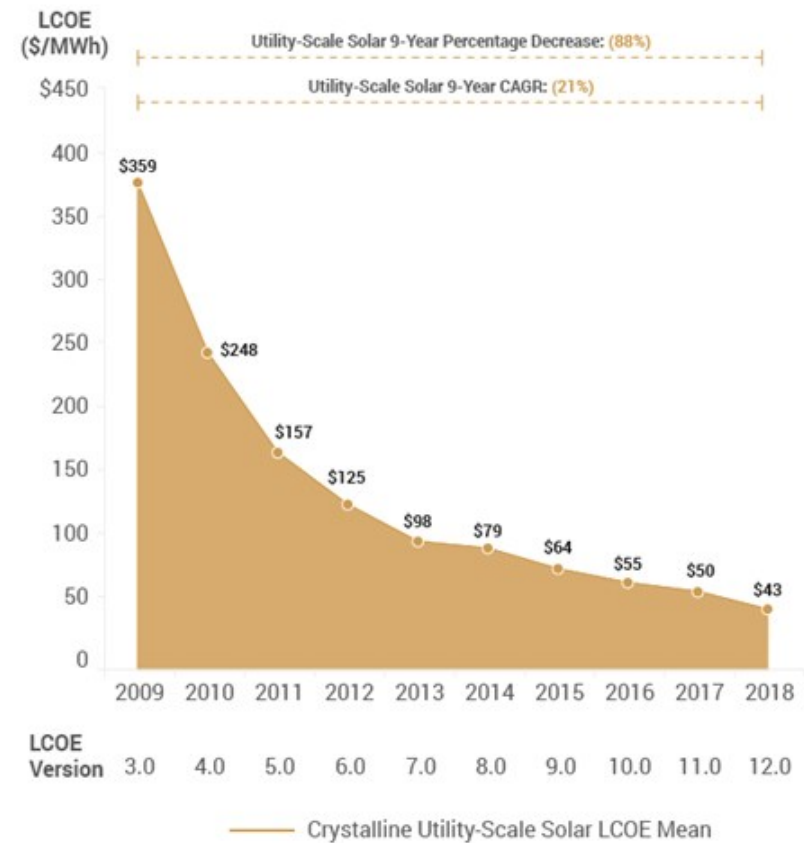
The unbelievable cost degradation of wind and solar

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

Unsubsidized Wind LCOE

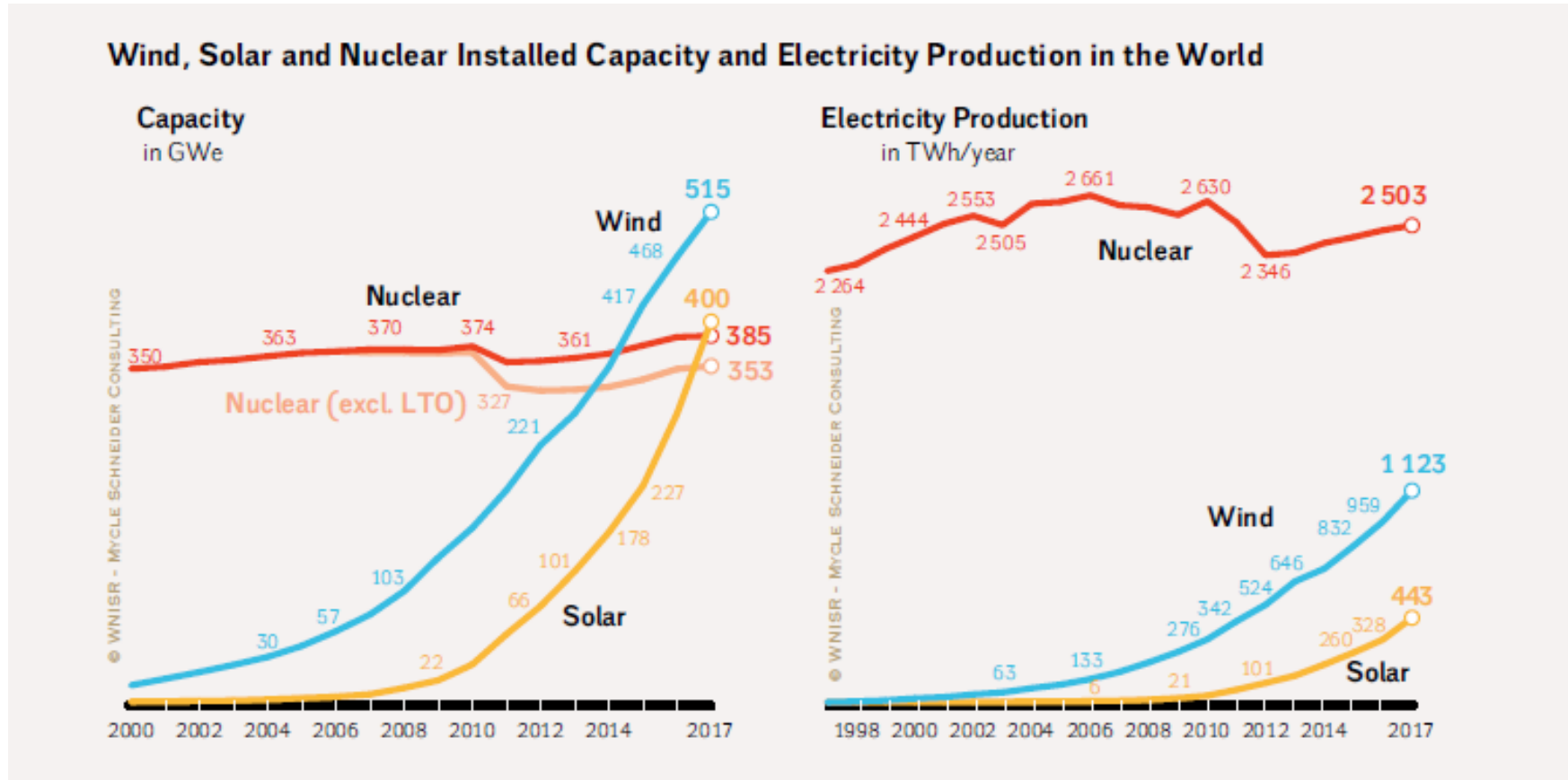


Unsubsidized Solar PV LCOE



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

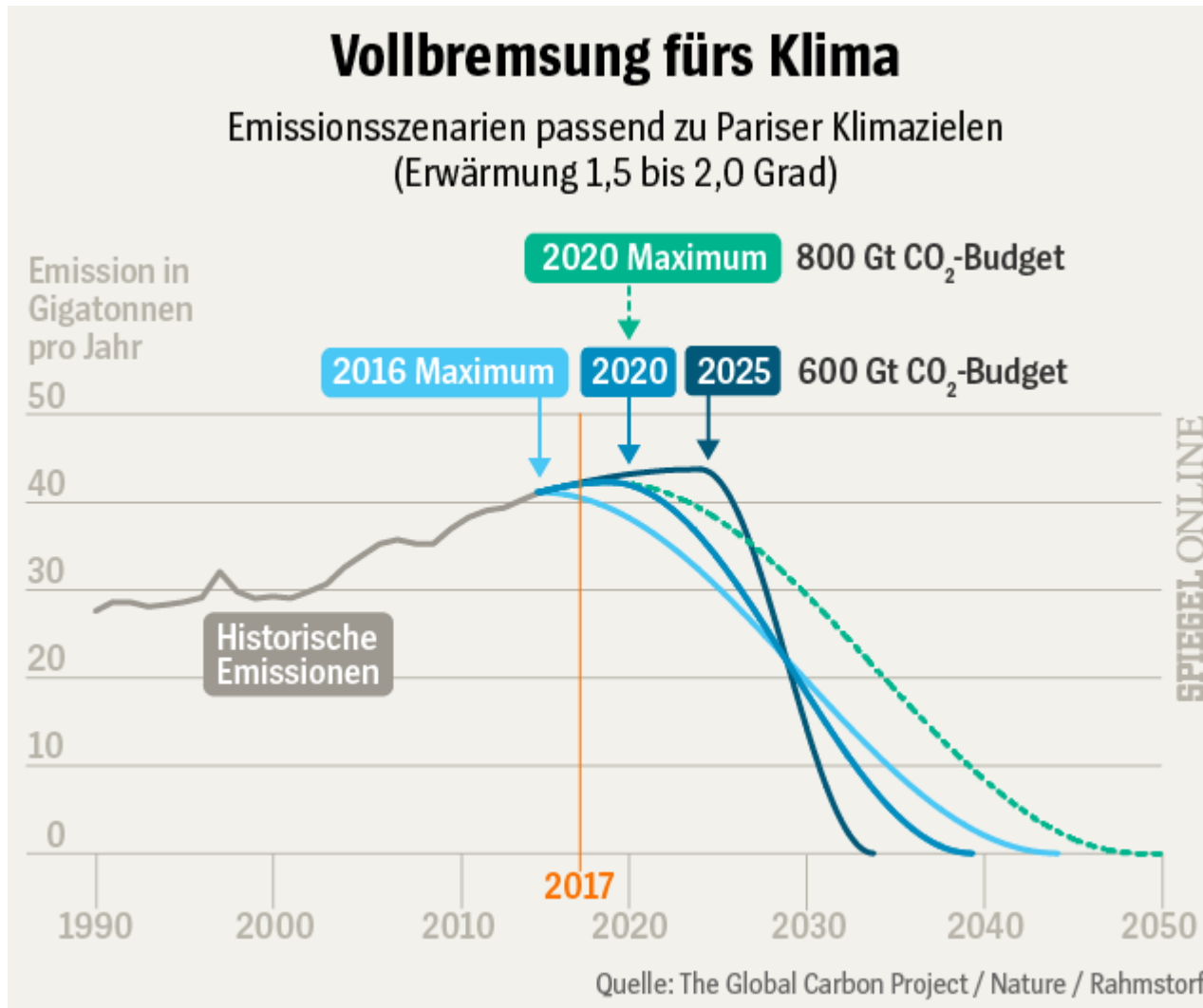
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Renewable Energy Policies

		2017	2018
POLICIES⁵			
Countries with national/state/provincial renewable energy targets ⁶	#	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 ⁷	#	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) ⁸	#	84	98

We have to be even faster!

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



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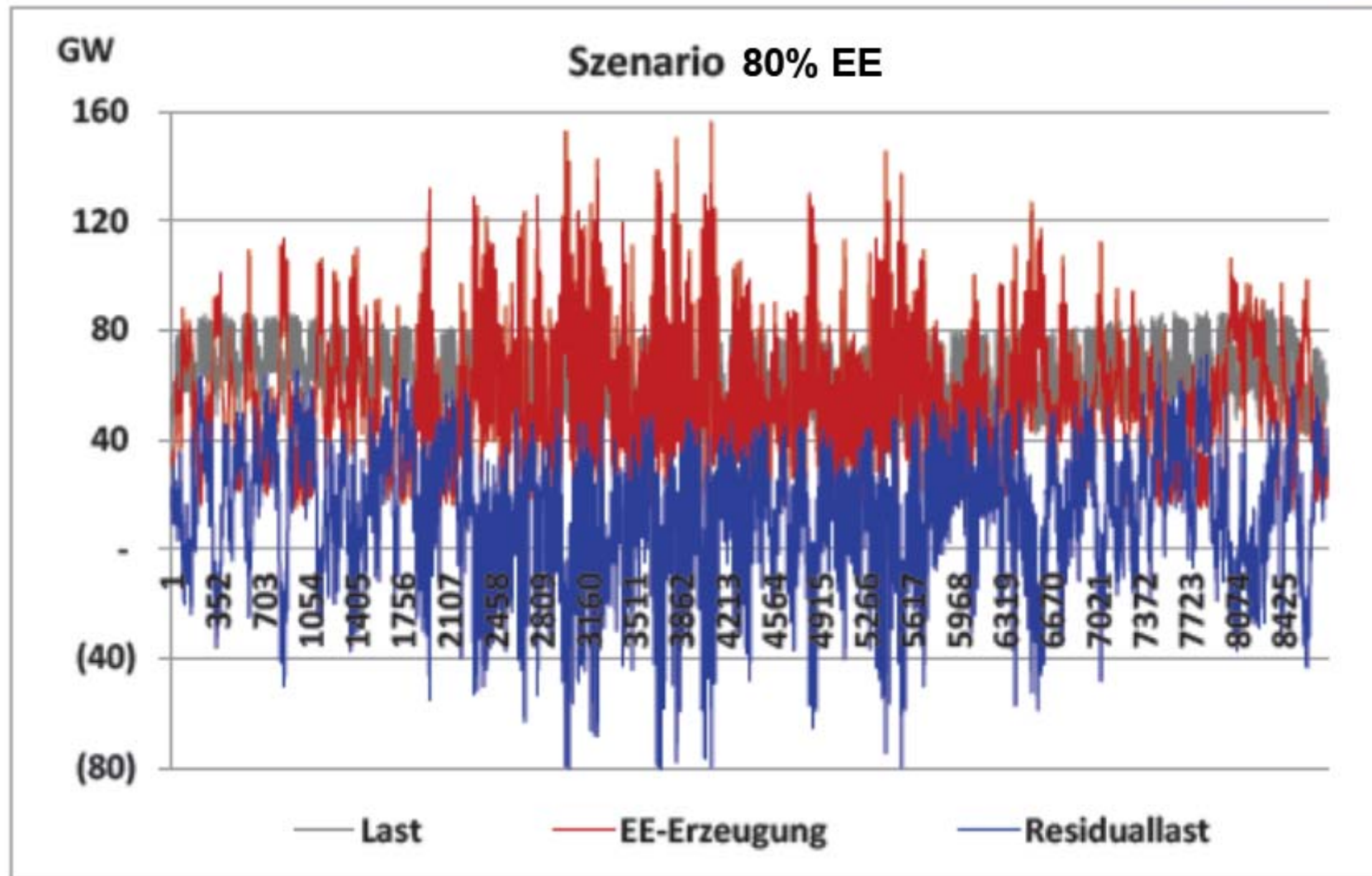


3. Challenges and opportunities for energy companies

Quelle:

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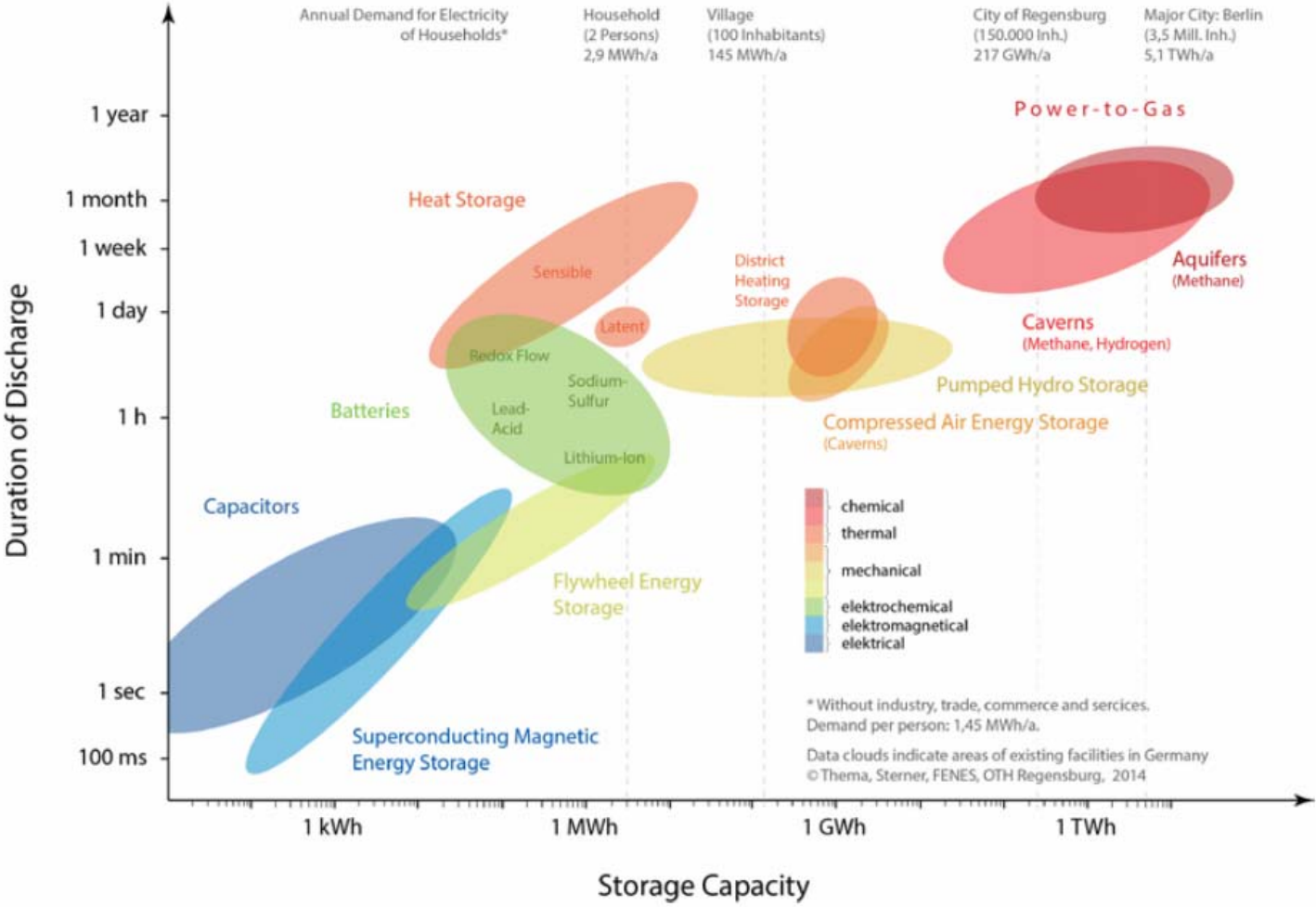
Residual load in a scenario with 80% renewables



Quelle: Krzikalla 2013

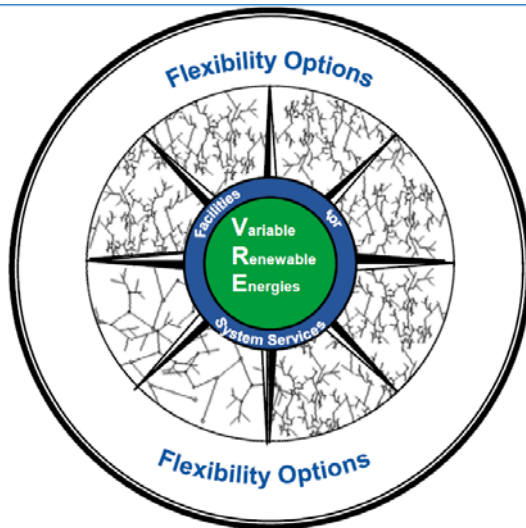
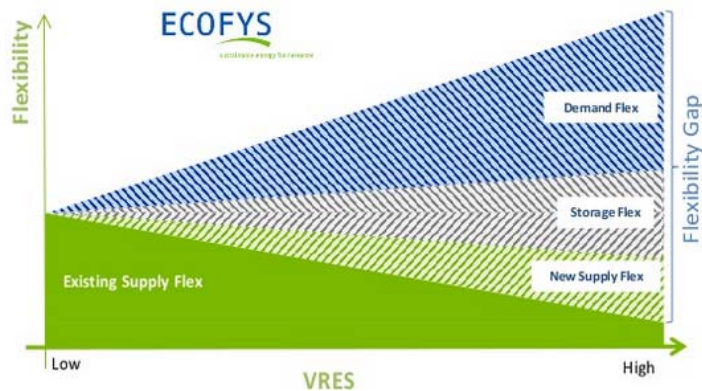
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First approach: storages



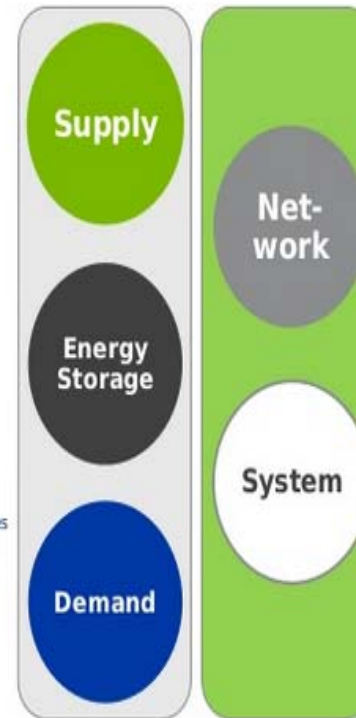
Broader approach: flexibility options

The Flexibility Gap



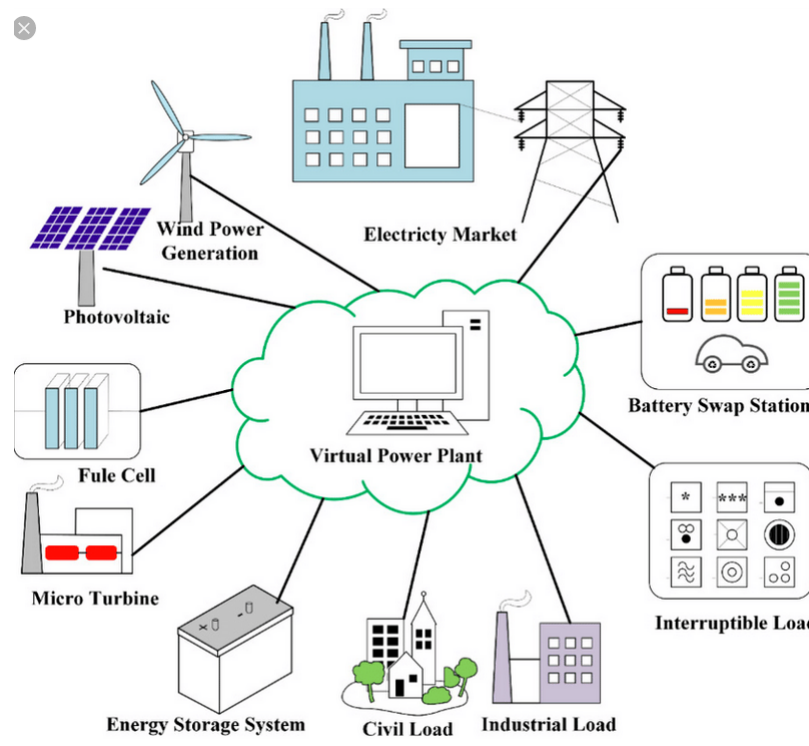
Overview of flexibility options

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

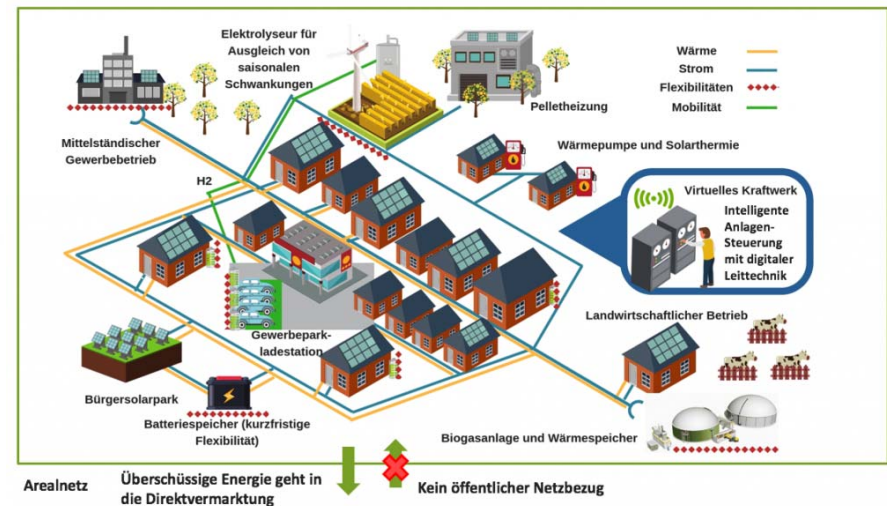
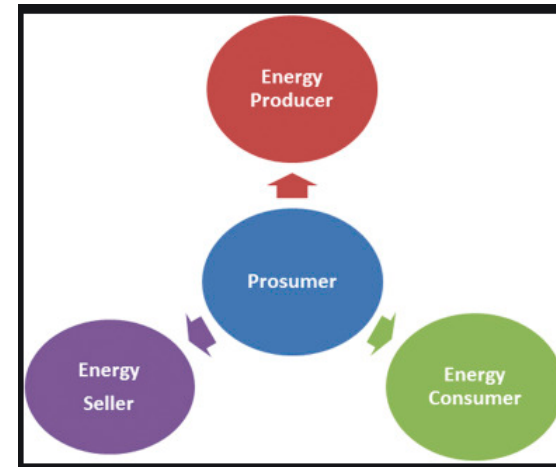
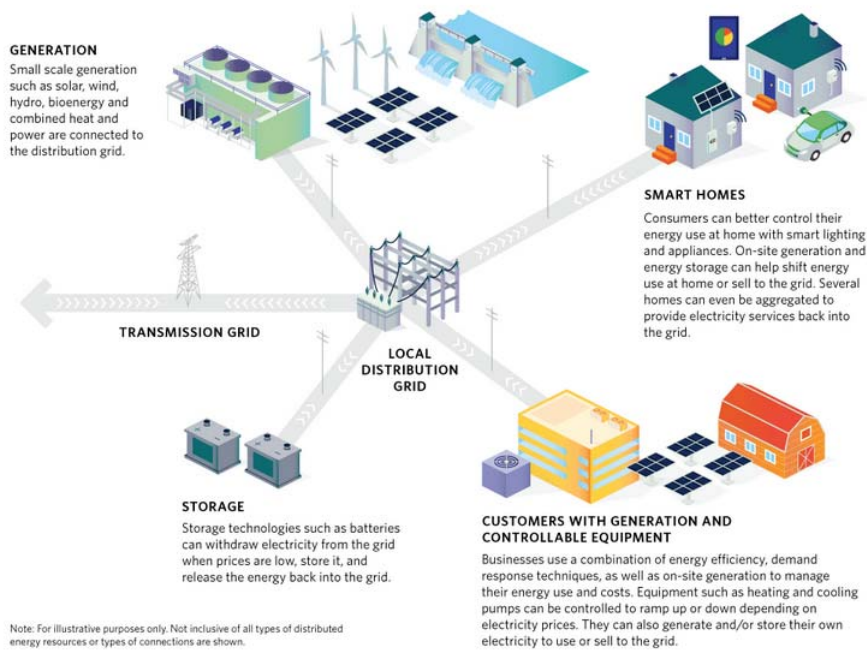
Aggregation and markets



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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

- 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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