

20 Years ENERDAY



20 Years Energy Research



Achievements and Challenges in the Energy Sector

Agenda

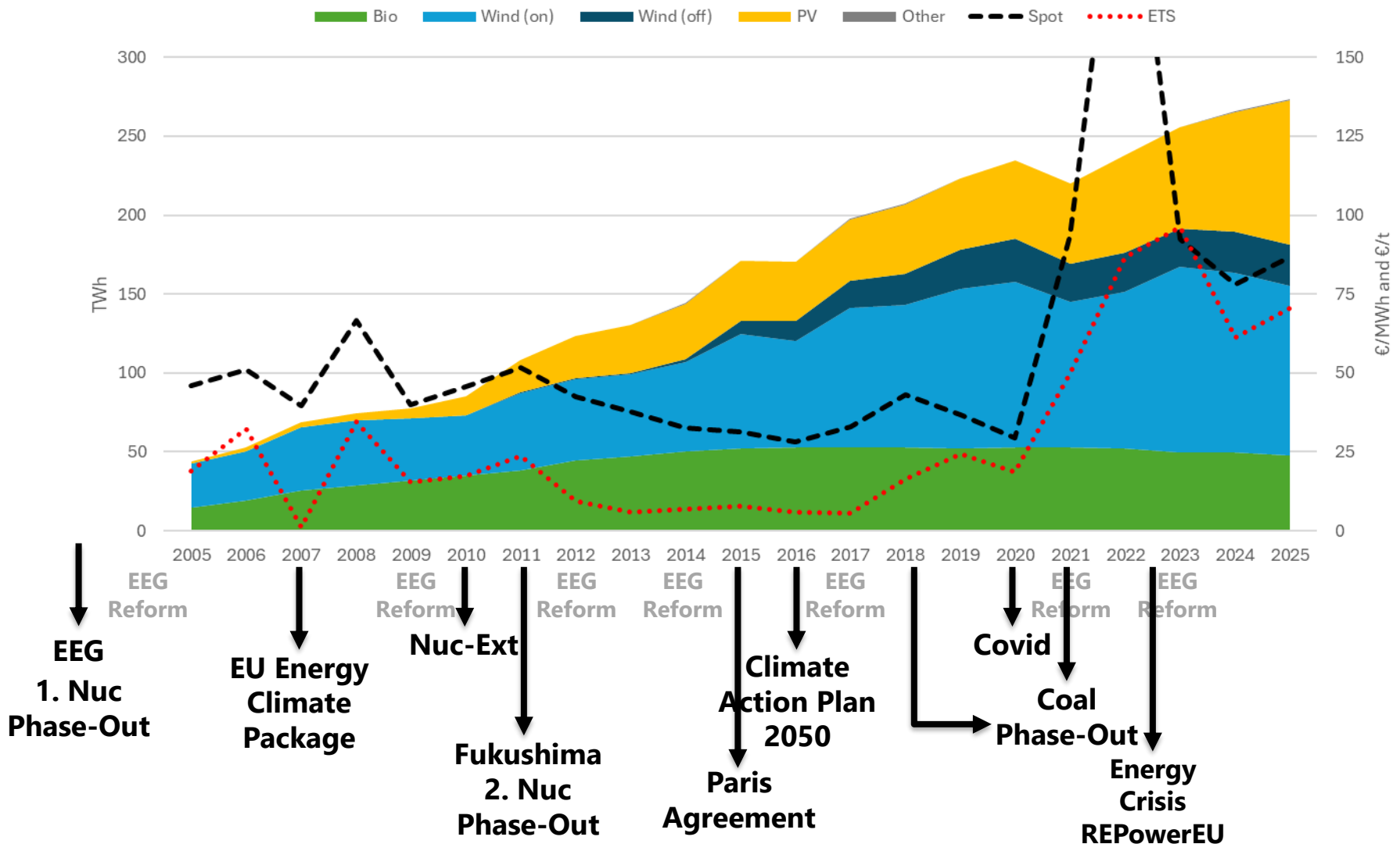
- **20 Years Ago**
- **20 Years Ahead**

The Year is 2006...

- **Angela Merkel** just won the 2005 election (remember the 'Elefantenrunde'?)...
- ...and a **grand coalition** was formed (remember when that actually meant something like a 66+% share)
- There was a delayed vote in Dresden with clear strategic voting
- And the right wing NPD got close to 5% in Sachsen

- The **EU ETS** was just starting
- The **Nuclear Phase Out** was continued under a CDU/SPD coalition
- The **EEG** was continued despite opposition (and PV feed-in tariffs were 50+ €ct/kWh)
- There was a **natural gas conflict** between Russia and Ukraine with feedbacks for Europe

20 Years of German Energiewende (a selection)



Sources: Umweltbundesamt
Energy-Charts, World Bank

20 Years of Energy Research

Incumbents:

RES support, Wind and Solar focused studies, Energy Efficiency topics, ETS and Climate Policy, Nuclear phase-out (albeit done now, maybe...)

New Market Entrants:

E-Mobility (from 2010+), Digitalization/Smart Meter (2013+), Auctions (2016+), H2 (first in long term studies, since 2020+ core aspect), Energy Crisis (2022+), AI (2023+)

Market Exits:

Hard Coal, CDMs, CCS

Market Trend:

Shift towards more social science perspective (experiments, acceptance, justice)

20 Years of ENERDAY

Core Topics:

Regulation and Market Design, Energy Modeling, Natural Gas, RES Integration, Electricity Prices and Price Formation

Faded out:

CCS, Coal and Lignite, Long-Term Gas Contracts

Emerged over time:

Electric Mobility, Demand Response and Flexibility, Hydrogen and Power-to-X, Sector Coupling, Negative Emissions and DAC, Prosumers and Local Energy Communities, Social and Behavioral Dimensions

Agenda

- **20 Years Ago**
- **20 Years Ahead**

Looking into the Future is Hard!

Proof by Example:

Own Data Assumption for Wind Capacities in 2020 back in 2006ish

	2006	WEO	WF 12
GER	20.6	31.3	48
EU-GER	23.3	83.2	133
Total	43.9	114.5	181

Leuthold, F., Jeske, T., Weigt, H., & Von Hirschhausen, C. (2009). When the wind blows over Europe: A simulation analysis and the impact of grid extensions.

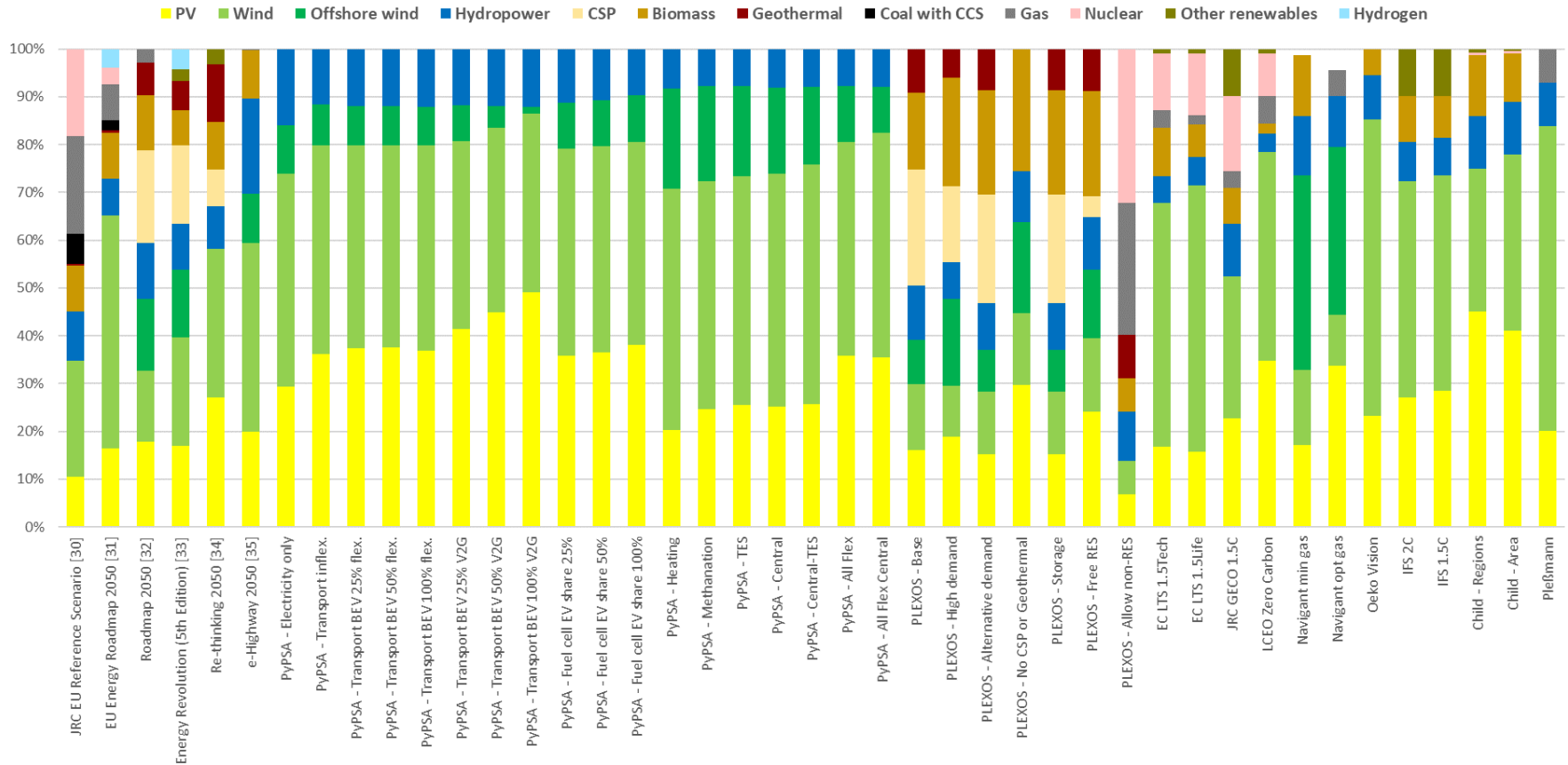
Real Wind Capacities in 2020

	2020 (on)	2020 (off)
GER	55	8
EU-GER	140	17
Total	195	25

WindEurope (2021) Wind energy in Europe 2020 Statistics and the outlook for 2021-2025

Make an educated guess which RES technology we did not even bother to include into our future scenario assessments back in 2006?

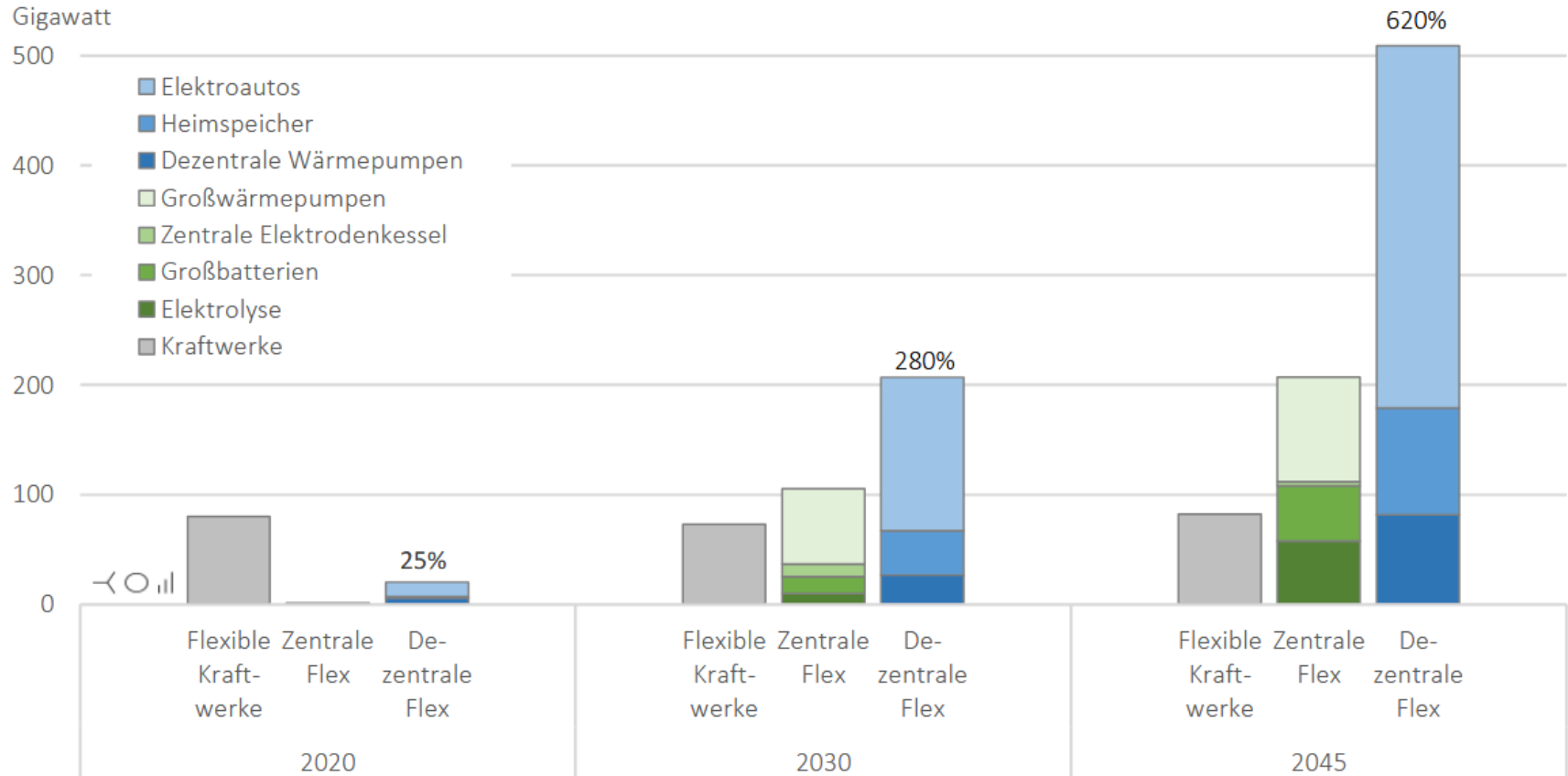
2050 is Windy with a High Chance of Sun



Source: [Darudi und Weigt \(2024\)](#)

And the System will be Bursting with Flexibility

Installierte flexible Leistung



Source: [Eike et al. \(2024\)](#)

How do we Get There?

We have plenty of technical solutions already, main drivers/barriers are socio-economic in nature

Central Challenge

→ Market Design! Market Design!! Market Design!!!

Ranging from wholesale markets to tariff design, from balancing to networks, from minerals to synthetic fuels

Problem: who trusts markets?

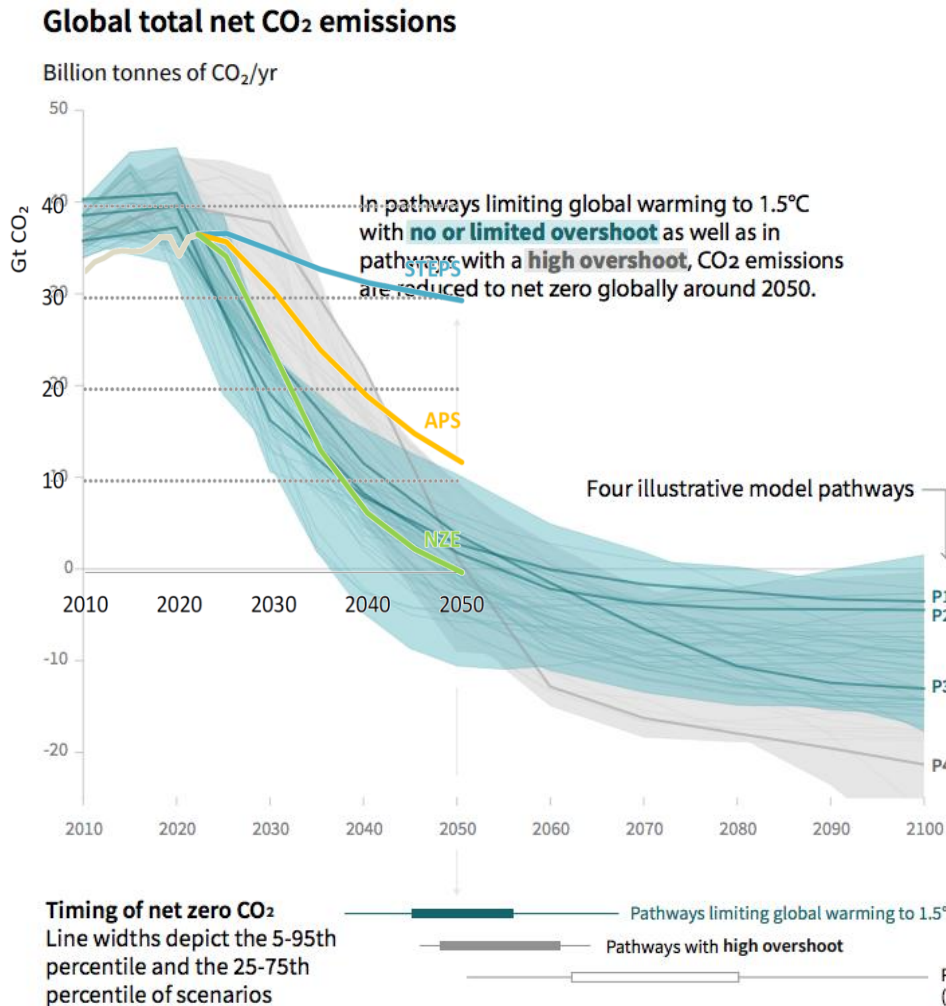
PPAs, CFDs, government credits or credit securities, etc.

And there is a Long List of other Open Questions

- **Energy Security/Global Risk** has reemerged as central theme
- **Digitalization** will become even more important
- **Heating Transformation** (heat pumps are a given no matter what politicians say, but industrial heat is more complicated)
- **Hydrogen? Backbone? How, Who, When?**
- **Socio-Economic Impacts and Political Feasibility**
(feel free to also check out www.sweet-cosi.ch)

And don't Forget the Climate is still Changing

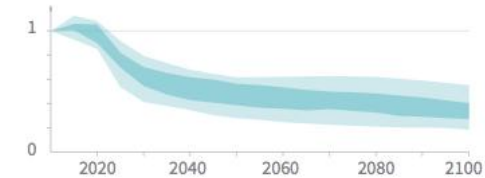
Future Burden: Negative Emissions!



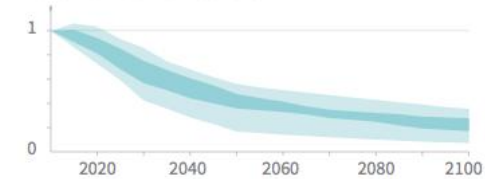
Non-CO₂ emissions relative to 2010

Emissions of non-CO₂ forcers are also reduced or limited in pathways limiting global warming to 1.5°C with **no or limited overshoot**, but they do not reach zero globally.

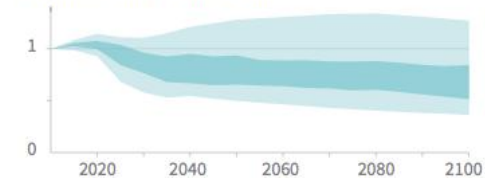
Methane emissions



Black carbon emissions



Nitrous oxide emissions



Source: IPCC, WEO