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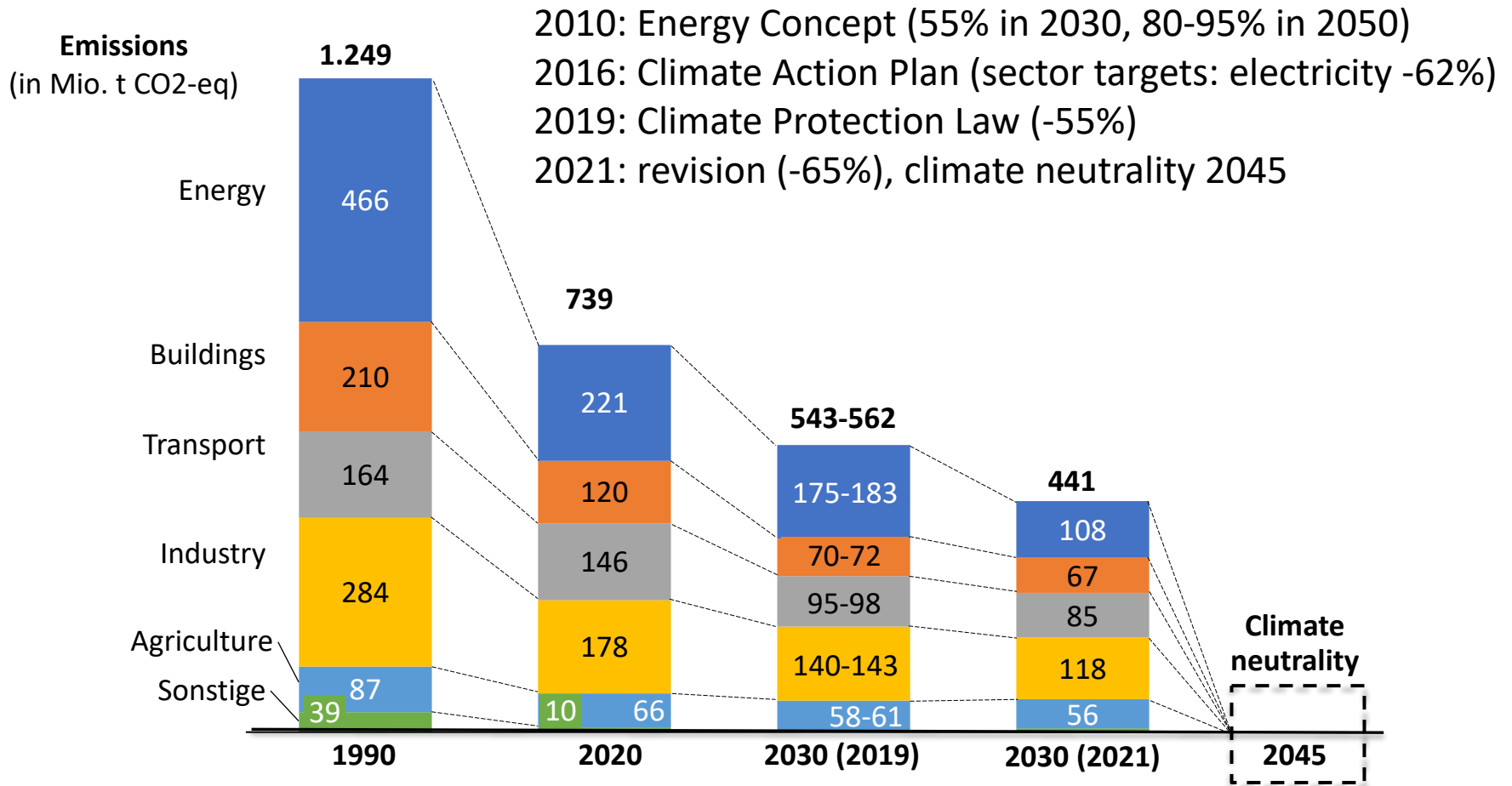
Coal Phase Out in Germany

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Chair of the German Federal Government's Expert Commission "Energy of the Future"

Why phase out coal? German climate targets



Source: BMU (2019, 2021)

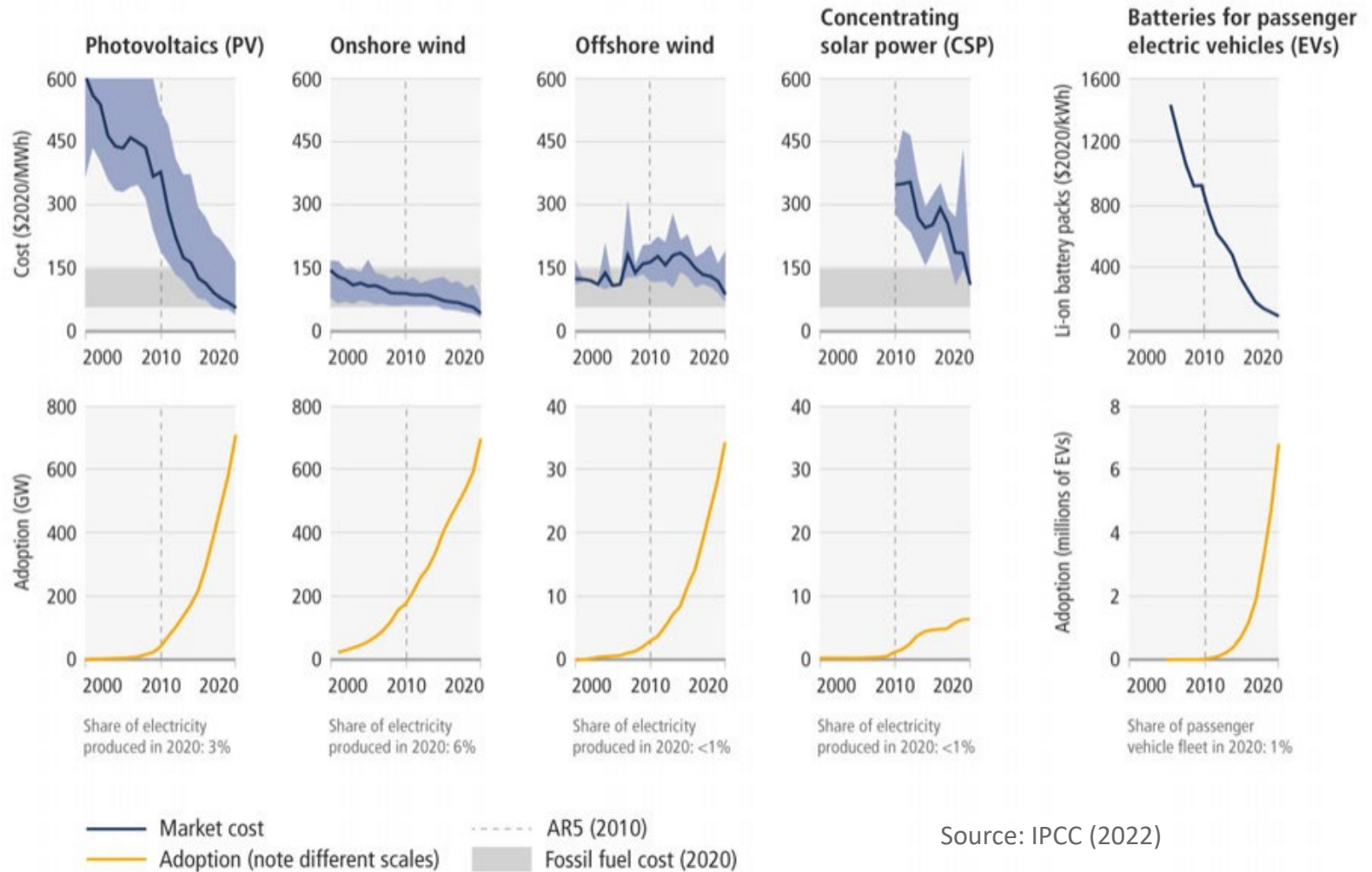
How to achieve climate neutrality

- Critical areas for net-zero energy system transition (IEA 2020):
 - Address existing assets in power generation (coal) and industry (steel)
 - Spur clean energy innovation: Strengthen markets for technologies at an early stage of adoption and boost support for research, development and demonstration

	in GW	2021	EEG 2021	2022
➤ Electrification				
➤ H2/synfuels	Wind onshore	56	71	115
➤ CCS/CCU	Wind offshore	8	20	30
➤ bioenergy	Photovoltaic	59	100	215

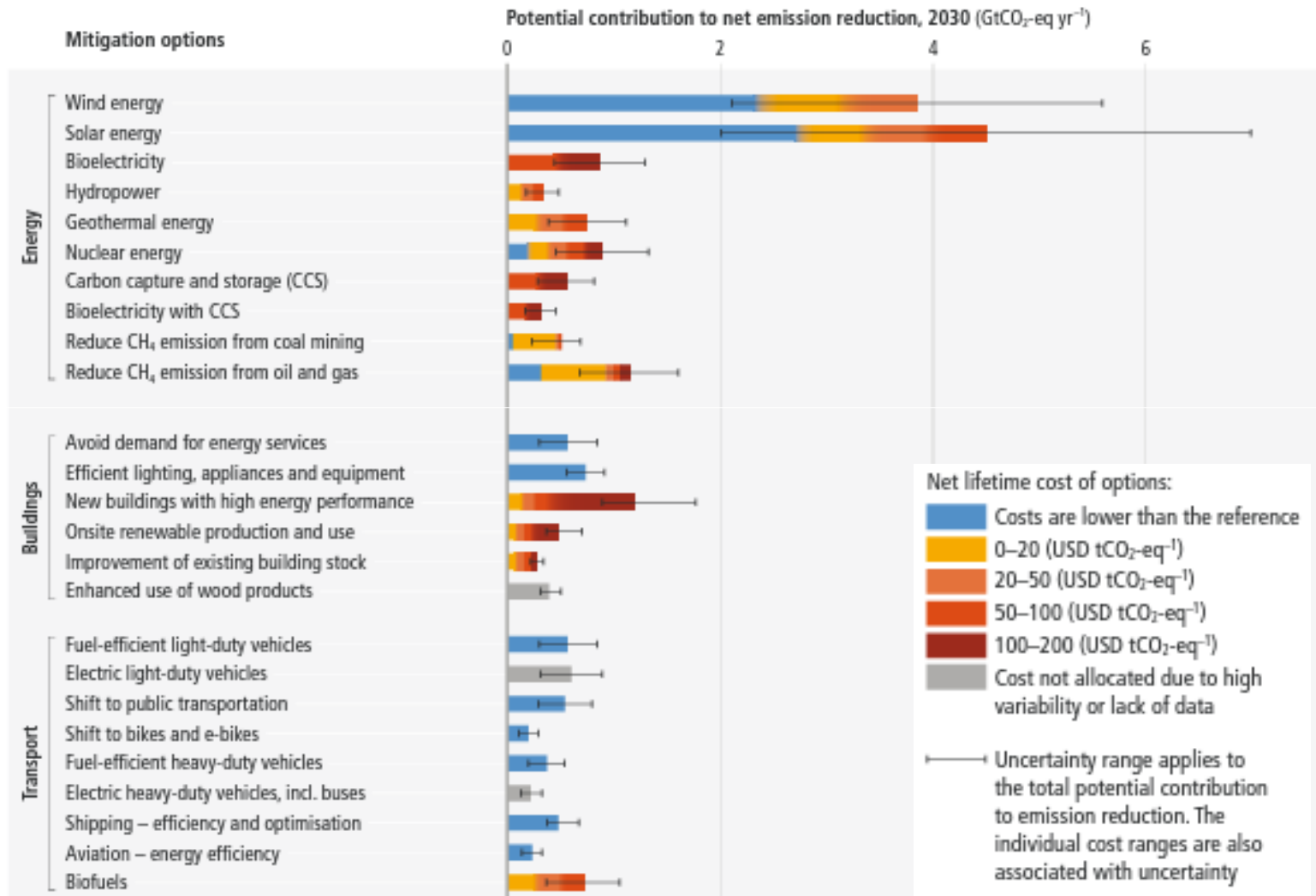
- Develop and upgrade infrastructure which enables technology deployment
 - Forster international cooperation
- Climate neutrality needs a regulatory framework, as markets alone do not function efficiently in climate protection, innovation and infrastructure:
Mix of instruments / complementary policies for pricing required
 - marked design of the future

Costs and adoption of renewables and batteries



Source: IPCC (2022)

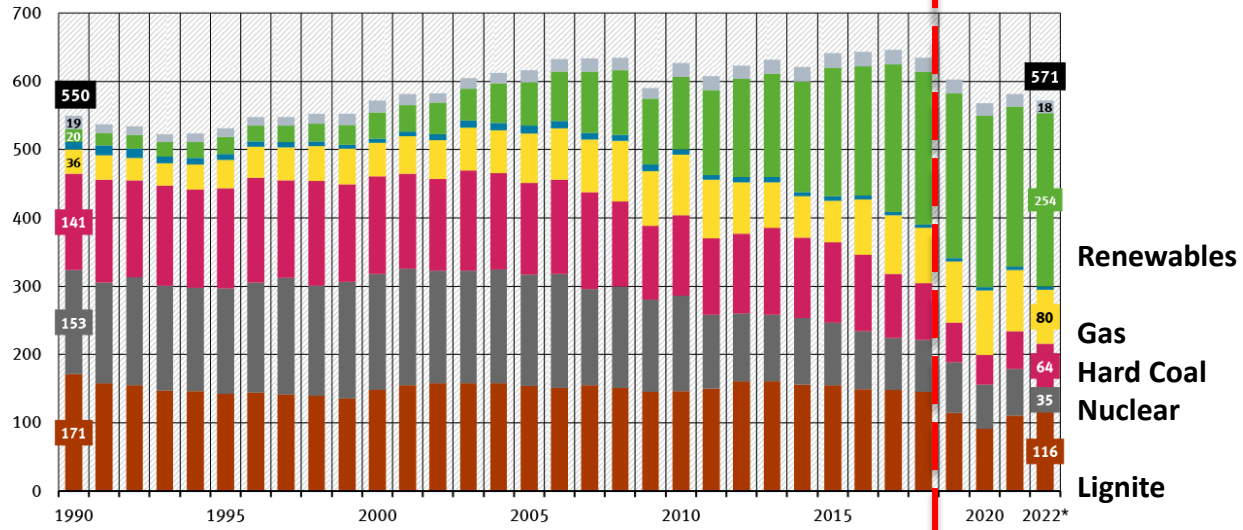
Mitigation options and costs and potentials in 2030



Status quo in Germany

Electricity generation

in bn. kWh



Quellen: Umweltbundesamt (2023)

	2014	2015	2016	2017	2018	2019	2020
Lignite	21,1	21,4	21,3	21,1	20,9	20,9	20,6
Hard coal	26,2	28,7	27,4	24,0	23,8	22,7	23,8

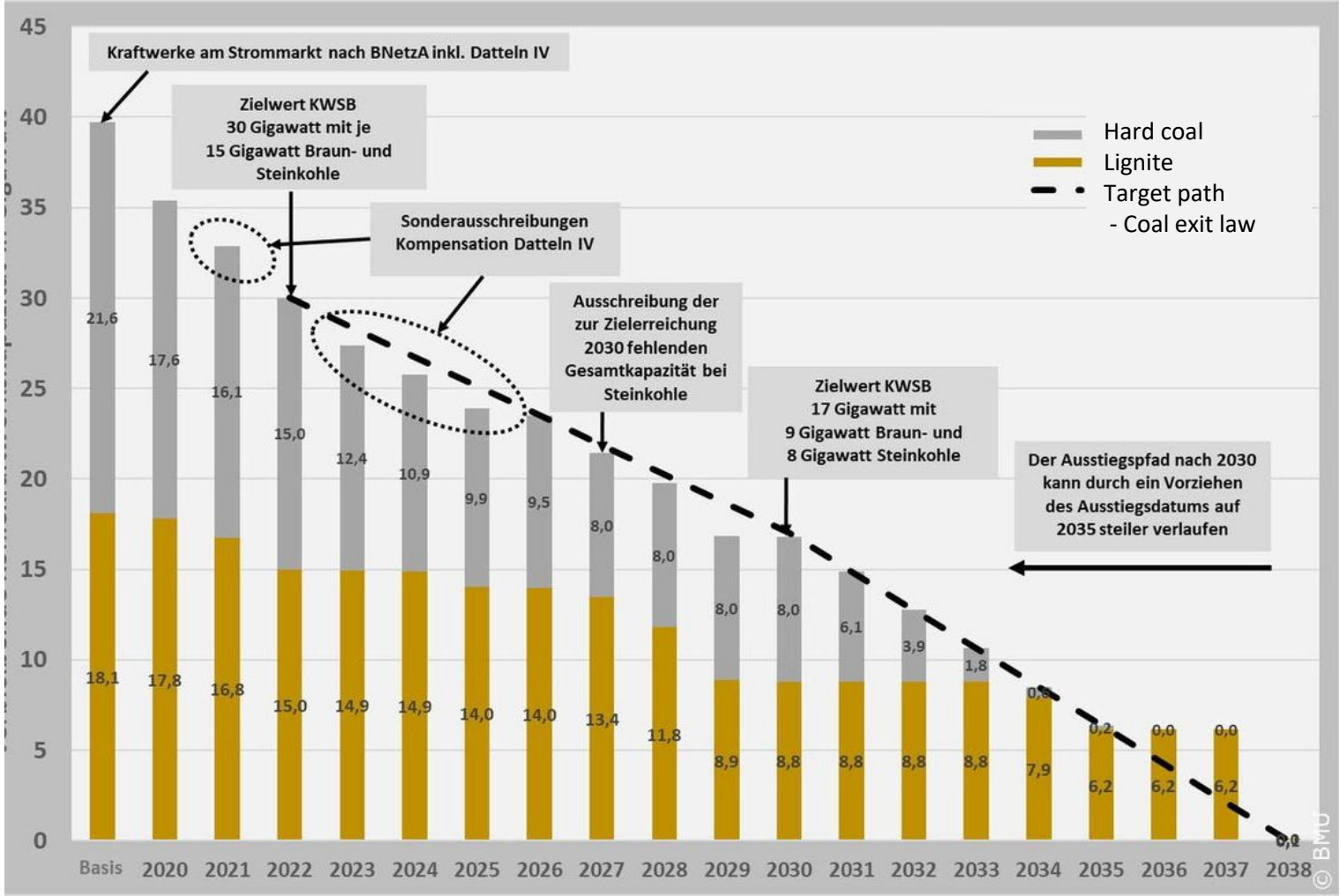


Commission on Growth, Structural Change & Employment

- Commission for growth, structural change and regional development appointed by the German government initiated in 2018
- consensus-oriented dialogue between stakeholders: representatives of utilities, electricity users, trade unions, local communities, NGOs, academics and state and federal governments
- Aims of the commission
 - “concrete prospects” and transition plans for lignite-mining regions → reconcile climate policy with economic growth
 - measures to ensure 2030 climate target in the energy sector (61 to 62 %)
 - roadmap and end date to phase out coal-fired power plants
- recommended that Germany phase out the use of coal for electricity by 2038 or perhaps 2035, starting with a rapid reduction in coal power plant capacity of about a third by 2022. By 2030, almost two-thirds of coal generation should have left market; economic transition in the affected regions is to be strengthened (up to 40 bn)

Coal Phase Out

GW



Quelle: BMU (2020)

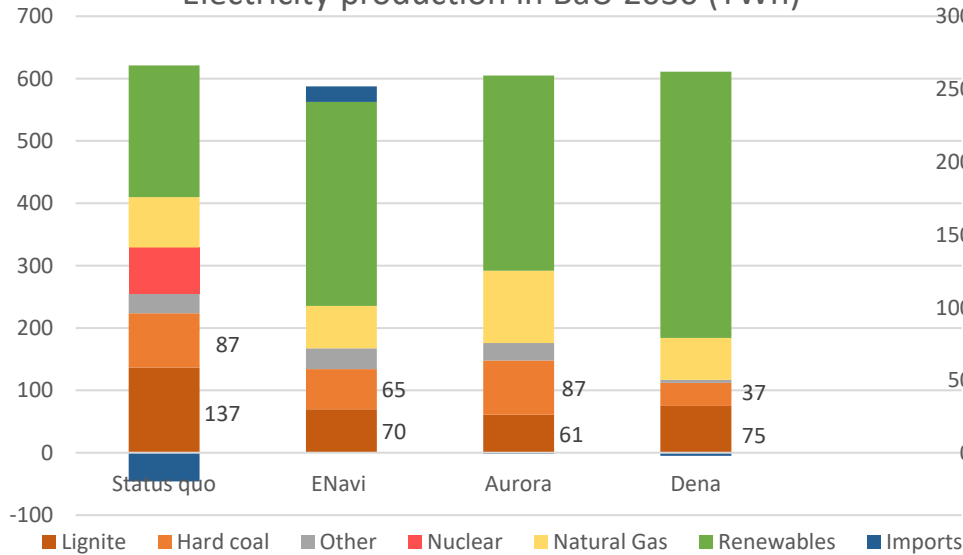
Implementation crucial

- Negotiated phase out – or regulatory phase out w/o agreement; probably auctions for closure in the 2020s → inefficient from an economic perspective
- CO₂ pricing the most economically sensible approach for achieving climate protection targets: market-based exit via energy pricing minimises system costs
- regulatory coal phase-out without accompanying measures problematic
 - new construction/extension of gas-fired power plants and higher emissions from gas utilisation
 - utilization of remaining coal-fired power plants increases (coal rebound; Aurora: can even lead to higher emissions if hard coal is closed before lignite)
 - emissions abroad increase (EU waterbed: Aurora 40% of German reduction)
 - minimum price in EU ETS or national CO₂ price
 - certificate cancellation and market stabilisation reserve (ENavi 1300 Mt CO₂)
- energy security concerns better reflected in market based approach
 - response to the energy crises after Russia's invasion of Ukraine

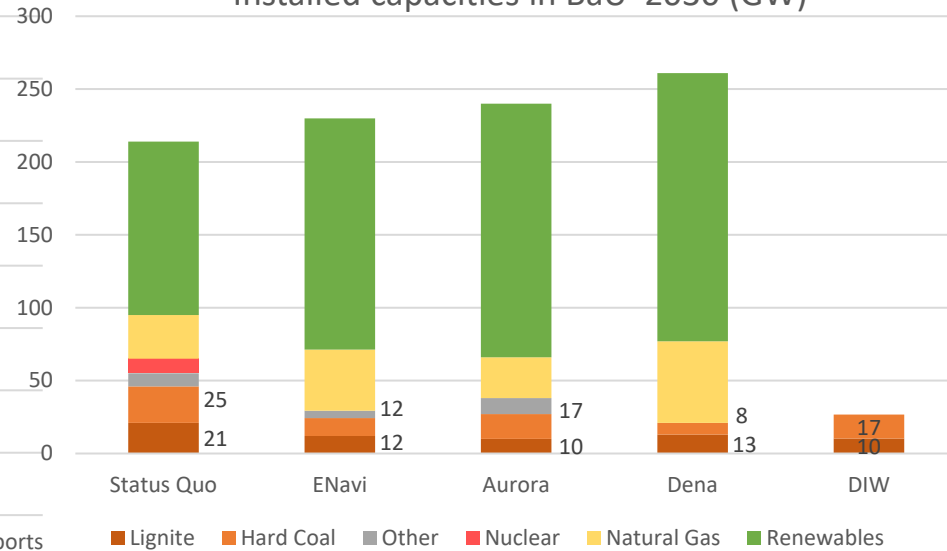
Expected BaU

2018

Electricity production in BaU 2030 (TWh)



Installed capacities in BaU 2030 (GW)



- substantial economic phase out
- moderate effects on wholesale prices
- Germany to become net importer

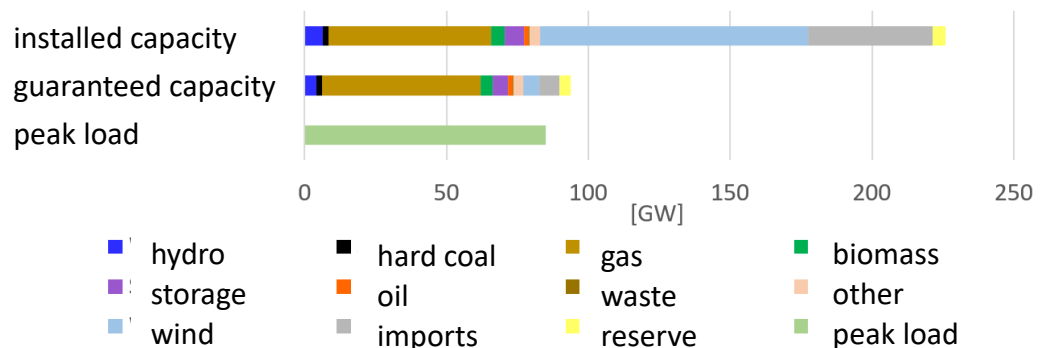
2022

- substantial economic phase out unclear
- phase out possible, but back-up more important

Expected Security of Supply / Energy Security Issue in 2018

- reduction of electricity exports and transition to net electricity imports by 2030 at the latest in all ENavi scenarios → to what extent is this tolerable (stochastic balancing effects, systemic possibilities, political agreements)?
- security of supply determined by annual peak load and Dunkelflaute (dark lull, 14 days): annual peak load rises due to increased electrification (Dena 94-160 GW) and thus demand for secured power, fewer options to cover the Dunkelflaute
- replacement of coal and nuclear energy by renewables and especially gas: by 2050 at least doubling of installed capacities necessary (ENavi 46-67 GW by 2050, DENA 55-117 GW by 2050), electricity generation from gas-fired power plants increases (ENavi 53-136 TWh, Dena 69-250 TWh incl. climate-neutral green gases)

- Example: System stability
ENavi - KAS 2035



Stress test in 2022 – market re-entry

Stress test transmission system operator

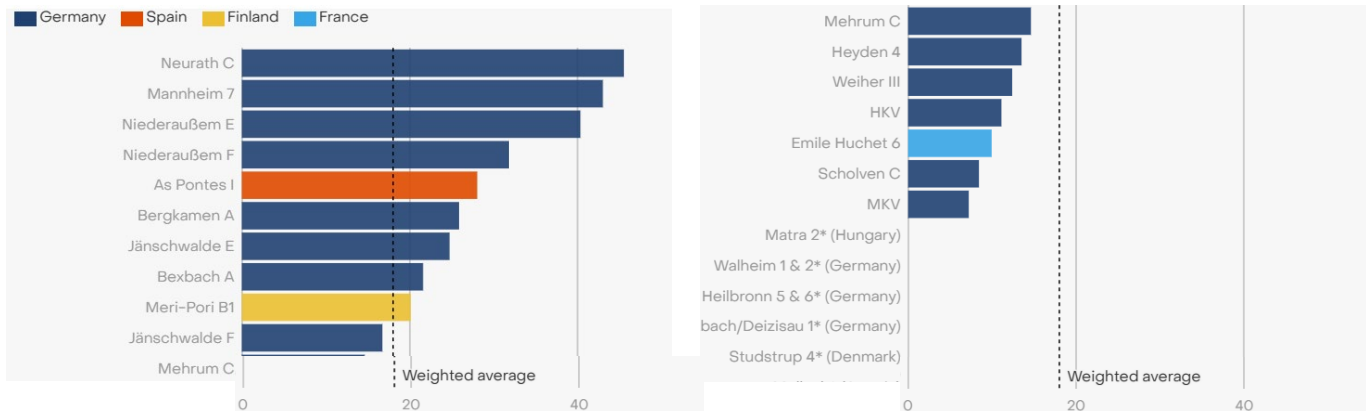
Betreiber	Kraftwerk	Brennstoff	Leistung [MW]	Regime	früheste Marktrückkehr
STEAG GmbH	Kraftwerk Bergkamen A	Steinkohleanlage	717	KVBG 3. Ausschreibung	01.11.2022
Uniper Kraftwerke GmbH	Kraftwerk Scholven Block C	Steinkohleanlage	345	KVBG 3. Ausschreibung	01.11.2022
Uniper Kraftwerke GmbH	Heyden 4	Steinkohleanlage	875	Netzreserve	ab Meldung + 5 Werktage
Kraftwerk Mehrum GmbH	KW Mehrum 3	Steinkohleanlage	690	Netzreserve	28.07.2022
Uniper Kraftwerke GmbH	Staudinger 5	Steinkohleanlage	510	KVBG 4. Ausschreibung	22.05.2023
Onyx Kraftwerk Farge GmbH	Onyx Steinkohlekraftwerk Farge	Steinkohleanlage	350	KVBG 3. Ausschreibung	01.11.2022
Evonik Operations GmbH	Kraftwerk I	Steinkohleanlage	225	KVBG 3. Ausschreibung	01.11.2022
SUMME			3712		

Hard coal

Betreiber	Kraftwerk	Brennstoff	Leistung [MW]	Regime	früheste Marktrückkehr
LEAG	Jänschwalde E	Braunkohle	465	Sicherheitsbereitschaft	01.10.2022
LEAG	Jänschwalde F	Braunkohle	465	Sicherheitsbereitschaft	01.10.2022
RWE Power AG	Niederaußem E	Braunkohle	295	Sicherheitsbereitschaft	11.10.2022
RWE Power AG	Niederaußem F	Braunkohle	299	Sicherheitsbereitschaft	11.10.2022
RWE Power AG	Neurath C	Braunkohle	292	Sicherheitsbereitschaft	11.10.2022
RWE Power AG	Neurath E	Braunkohle	604	KVBG Anhang 2	01.01.2023
RWE Power AG	Neurath D	Braunkohle	607	KVBG Anhang 2	01.01.2023
SUMME:			3027		

Lignite

Utilisation of reactivated coal units (operating at only 18% EU-wide)



Monitoring the Coal Phase Out

- Monitoring process "Energy of the Future" to review the progress of the energy transition and the implementation status of measure
- appointment of an independent expert commission to review and comment on the monitoring reports prepared by the BMWK
- law therefore provides for special precautions:
 - impact of the gradual closure of coal-fired power plants on security of supply will be regularly reviewed in 2026, 2029 and 2032; 2022/2023 examine dates for the decommissioning of power plants scheduled to begin in 2030 (renewables build out, dispatchable supply)
 - impact on electricity prices will also be reviewed regularly. Depending on the results of these reviews, the government plans to grant relief to residential and commercial electricity consumers.

ENERGIE DER ZUKUNFT

Kommission zum Monitoring-Prozess

Prof. Dr. Andreas Löschel (Vorsitzender)

Prof.in Dr. Veronika Grimm

Dr. Felix Matthes

Prof.in Dr. Anke Weidlich

SCHWARZES GOLD

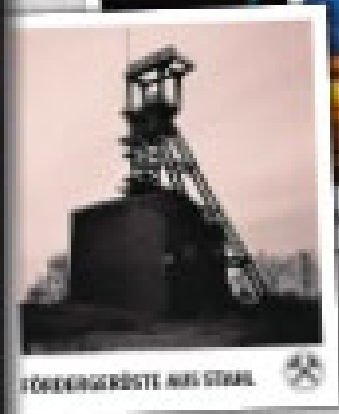
Die Geschichte des Steinkohlenbergbaus und die Zukunftsgestaltung in den Bergbauregionen



Der große Sammelspaß für die ganze Familie. Entdecken Sie die Geschichte des Steinkohlenbergbaus und Perspektiven für die Zukunft in 240 Sammelbildern.

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GLÜCK AUF ZUKUNFT!
PANIN
 WAZ EDITION KLAF



FÖRDERGERÜSTE AUS STAHL



HENRICH-HILDEBRAND-ROHE

SCHWARZES GOLD



GLÜCK AUF ZUKUNFT!
 Die Geschichte des Steinkohlenbergbaus und die Zukunftsgestaltung in den Bergbauregionen

Thanks.
Danke.

Monitoring the Energy Transition



Prof. Dr. Andreas Löschel (吕安迪)

<https://www.bmwi.de/Redaktion/EN/Artikel/Energy/monitoring-implementation-of-the-energy-reforms.html>

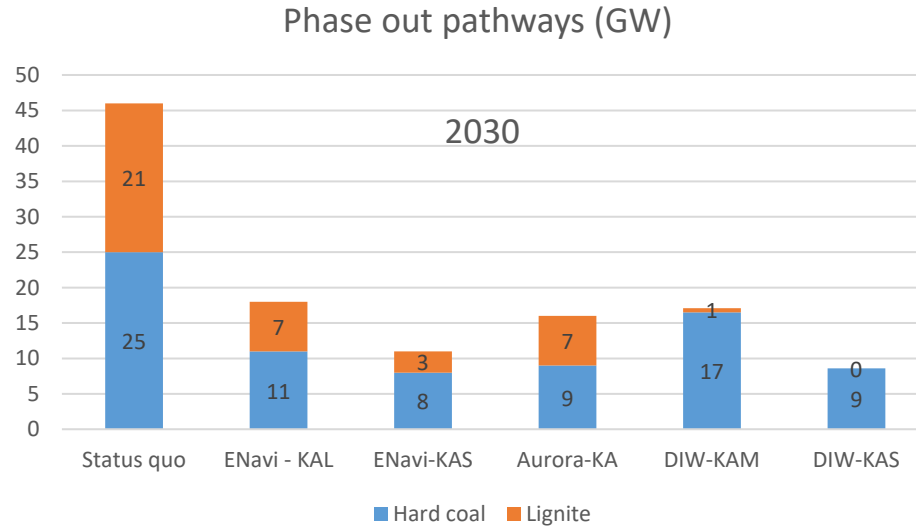
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Framework for Energy Sector Target

- Commission for growth, structural change and regional development appointed by the German government
- various studies on the impact of climate targets on coal-fired power generation and power generation (e.g. Agora 2016, Aurora 2018, BDI 2018, BUND 2018, DENA 2018, DIW 2018, Enavi 2018, Öko-Institut 2017/2018)
- achievement of the sectoral objective depends on different framework conditions:
 - renewables expansion: stronger expansion of renewable energies capacities +
 - CO₂-prices: higher national or ETS-prices +
 - fuel prices: higher coal price/lower gas price +
 - power Consumption/Efficiency: Higher Power Consumption -
 - European integration (goals, instruments), interactions, balance - / +
 - determine the development of coal capacities without further intervention given economically driven closure and modernisation decisions and provide a framework for the investigation of various coal phase-out scenarios

Different Coal Phase Out Paths



- Studies on coal exit with different paths:
 - ENavi-KAL (-6 GW): exit 2050 and sector target 2030 achieved
 - ENavi-KAS (-13 GW): ambitious phase-out 2035 (Agora Energiewende, 2016)
 - Aurora-KA (-11 GW): exit 2040 and close 2 GW per year by age
 - DIW-KAM (-10 GW): 3 GW by 2020, mainly brown coal, hard coal after 2030
 - DIW-KAS (-18 GW): 7 GW by 2020, hard coal and lignite by 2030
- in all scenarios, target achievement in 2030
(for Aurora-KA only with 65% renewable energy expansion)