

Agora
Energiewende



Energiewende **in Germany:** **The status quo in 2022**

*Review of key developments and outlook
for 2023*

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Results at a glance

1

The return of coal cancels out energy-saving effects and causes emissions in 2022 to stagnate at the previous year's level of 761 million tons of CO₂ equivalents.

2

Sunny and windy weather increases renewables share of gross electricity consumption from 41.0 percent in 2021 to 46.0 percent in 2022.

3

In 2022, massive price increases dominate the energy markets and are a major driver of inflation. The mitigation of high prices and the replacement of fossil energies shape government action.

4

The energy crisis and the increasingly severe consequences of the climate crisis unleash a strong societal demand for the energy transition and its technologies.

Results at a glance

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The return of coal cancels out energy-saving effects and causes emissions in 2022 to stagnate at the previous year's level of 761 million tons of CO₂ equivalents.

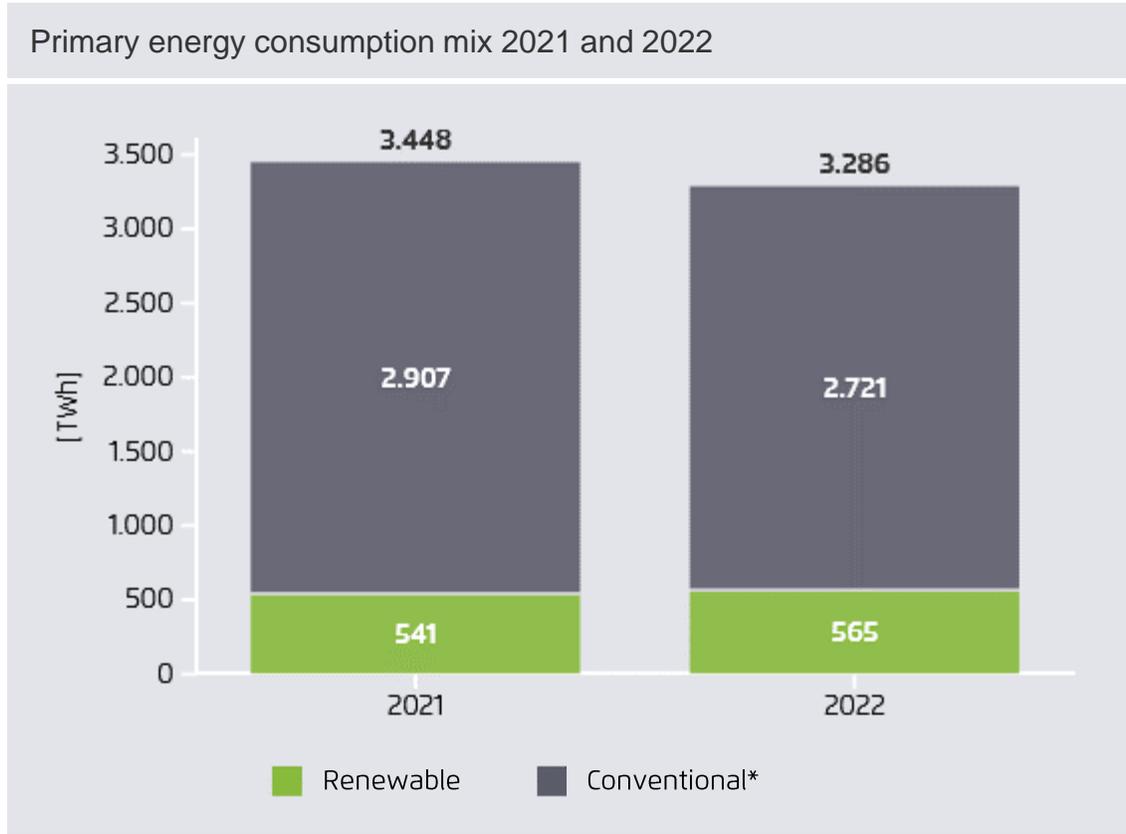
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While some painful energy-saving measures and production cuts reduce primary energy consumption by 4.7 percent, the war-related *fuel switch* away from natural gas and toward coal and oil increases emissions. The transport and building sectors again miss their sector targets. In total, Germany therefore misses its 2022 reduction target of 756 million tons of CO₂ equivalents.

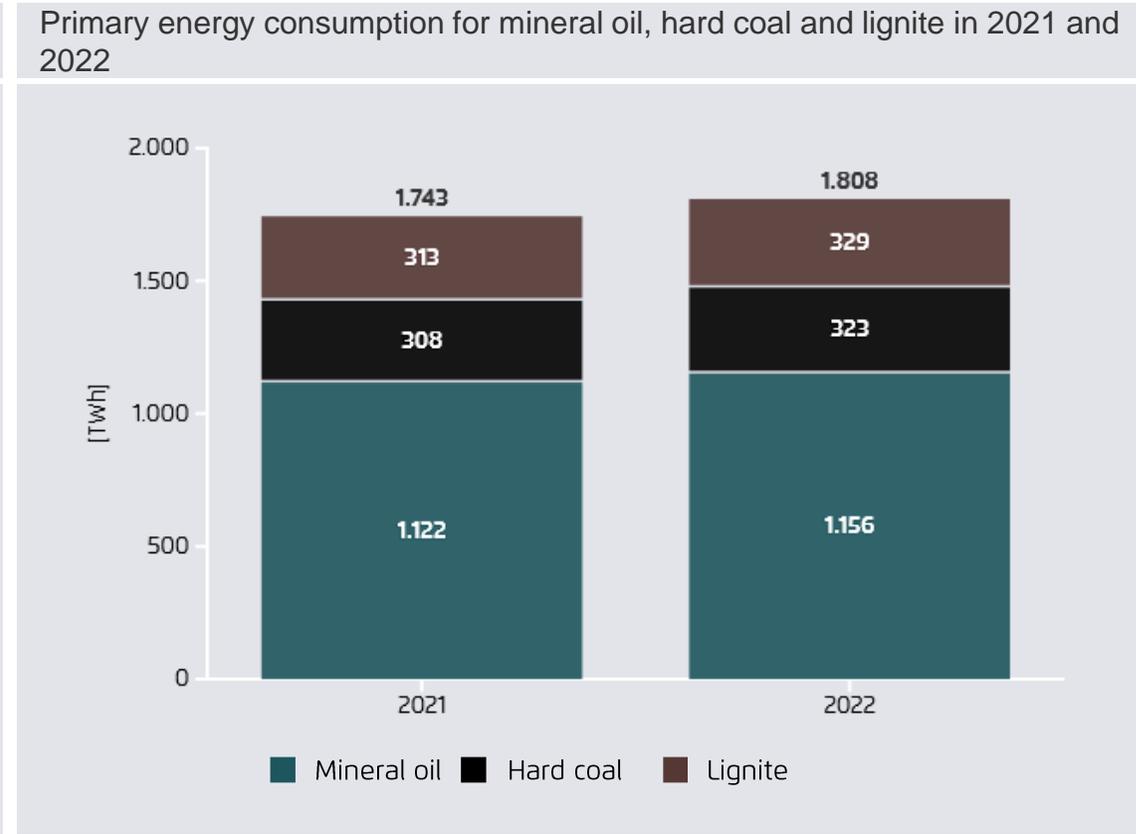
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Twofold surprise in 2022: Primary energy consumption fell by 4.7 percent; at the same time, emissions increased due to a fuel switch from natural gas to coal and oil.



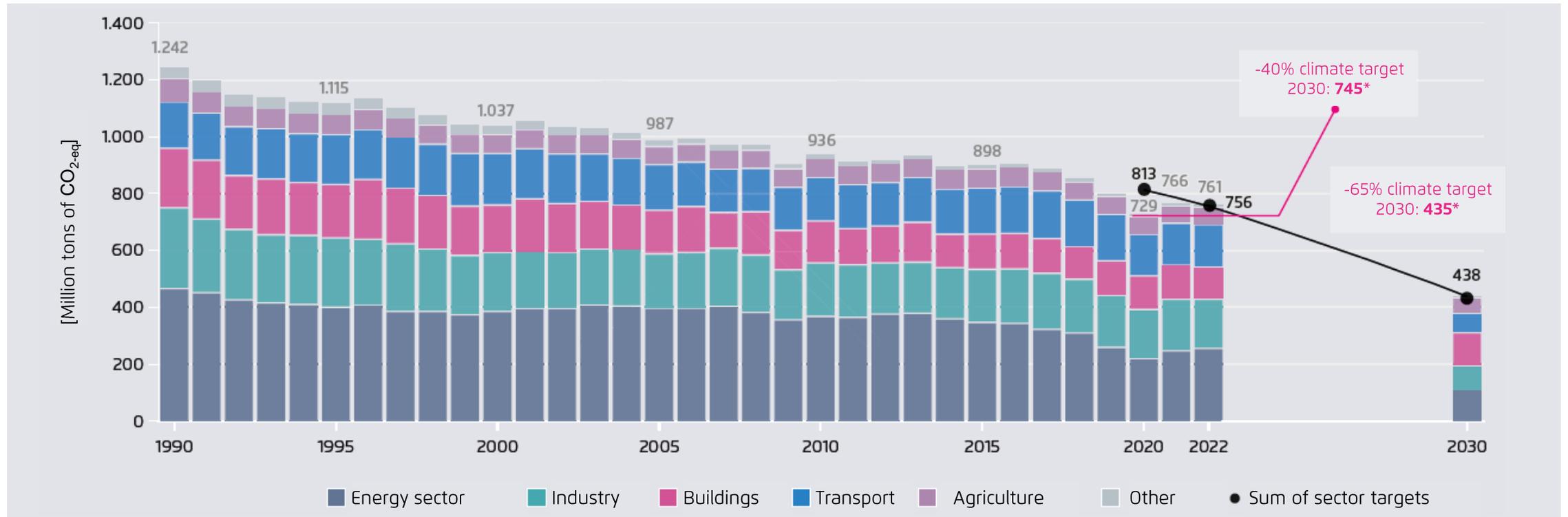
AGEB (2022a) *including net electricity imports - 2022: preliminary data



AGEB (2022a) - 2022: Preliminary data

The return of coal cancelled out energy-saving effects, causing emissions in 2022 to stagnate at the previous year's level of 761 million tons of CO₂ equivalents.

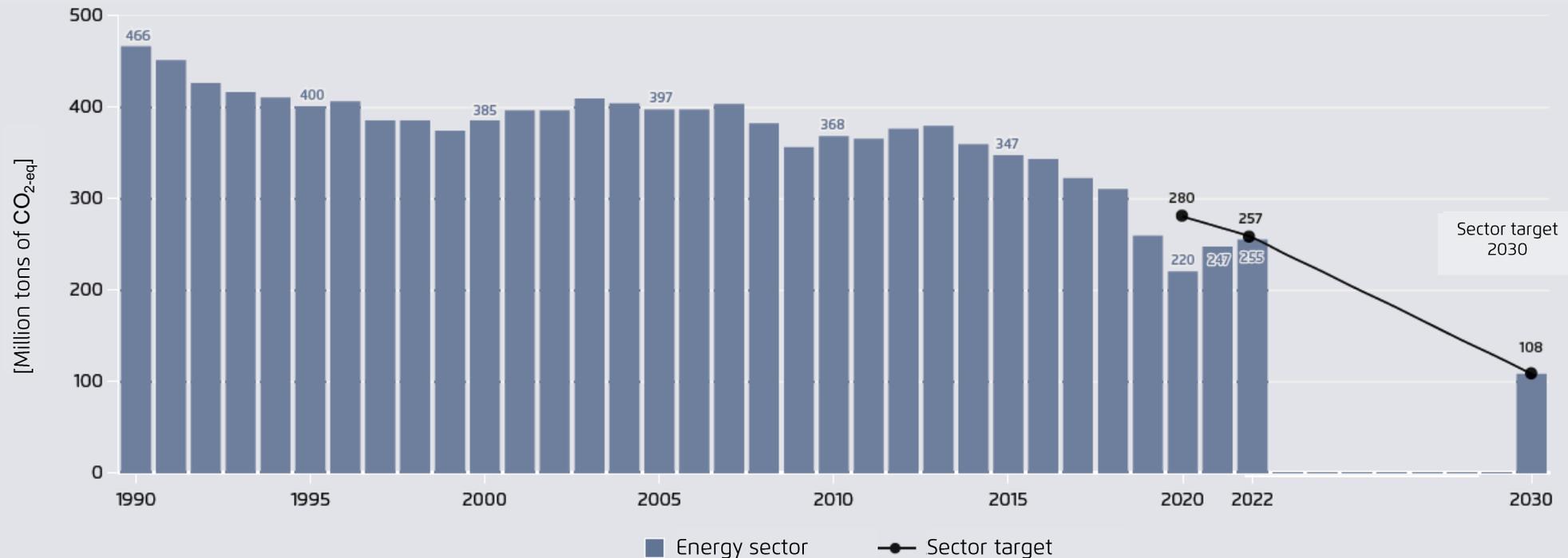
Development of greenhouse gas emissions in Germany by sector 1990 to 2021, estimate for 2022 and reduction targets 2020 to 2030



UBA (2022a); 2022: Agora Energiewende estimate based on AGEBA (2022a); sector targets according to Climate Protection Act Buildings 2021: Agora Energiewende calculation deviating from UBA (2022).

Although the **electricity sector** narrowly met the sector target with 255 Mt CO₂-eq, it increased: a plus of 8 Mt CO₂-eq compared with 2021 marks the second increase in a row.

Development of greenhouse gas emissions in the energy sector 1990 to 2021, estimate for 2022 and sector targets 2020 to 2030



UBA (2022a) 2022: Agora Energiewende estimate based on AGEBA (2022) and Destatis (2022).
Sector targets under Climate Protection Act or 2020, 2022 and 2030; interpolation between years.

Crisis-related decline in energy consumption caused **industrial emissions to fall by 8 to 173 Mt of CO₂-eq**. Despite a partial switch to coal and oil, the sector target was thus achieved.

Development of greenhouse gas emissions in industry 1990 to 2021, estimate for 2022 and annual sector targets 2020 to 2030.



UBA (2022a) 2022: Agora Energiewende estimate based on AGEB (2022a) and Destatis (2022a).

Third consecutive missed target for **buildings**: despite 16 percent gas savings compared to 2021, emissions were 5 million t CO_{2-eq} above the sector target of 113 million t CO_{2-eq}*

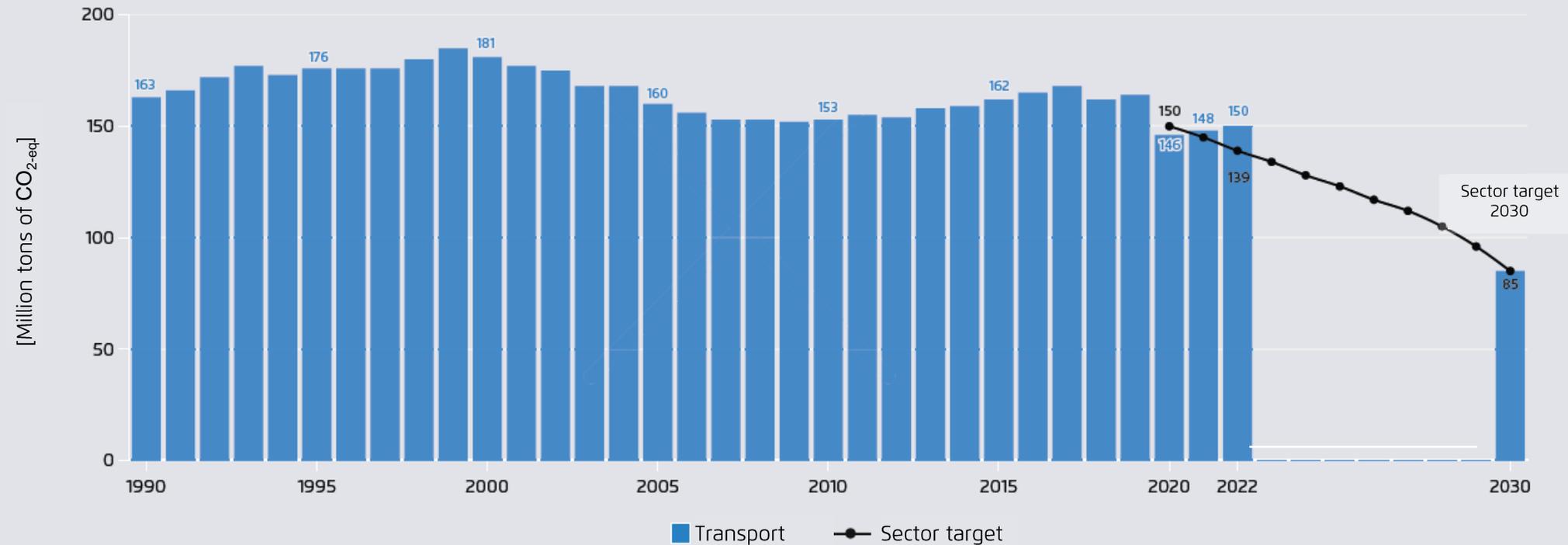
Development of greenhouse gas emissions in the buildings sector 1990 to 2021, estimate for 2022 and annual sector targets 2020 to 2030.



UBA (2022a) 2022: Agora Energiewende estimate based on AGEb (2022a), AGEb (2022c), CDC (2022).
2021: Estimate by Agora Energiewende deviating from UBA (2022a).

Rising emissions and thus second consecutive missed target in **transport**: in 2022, emissions of 150 Mt CO_{2-eq} were even more clearly above the target of 139 Mt CO_{2-eq} than in 2021.

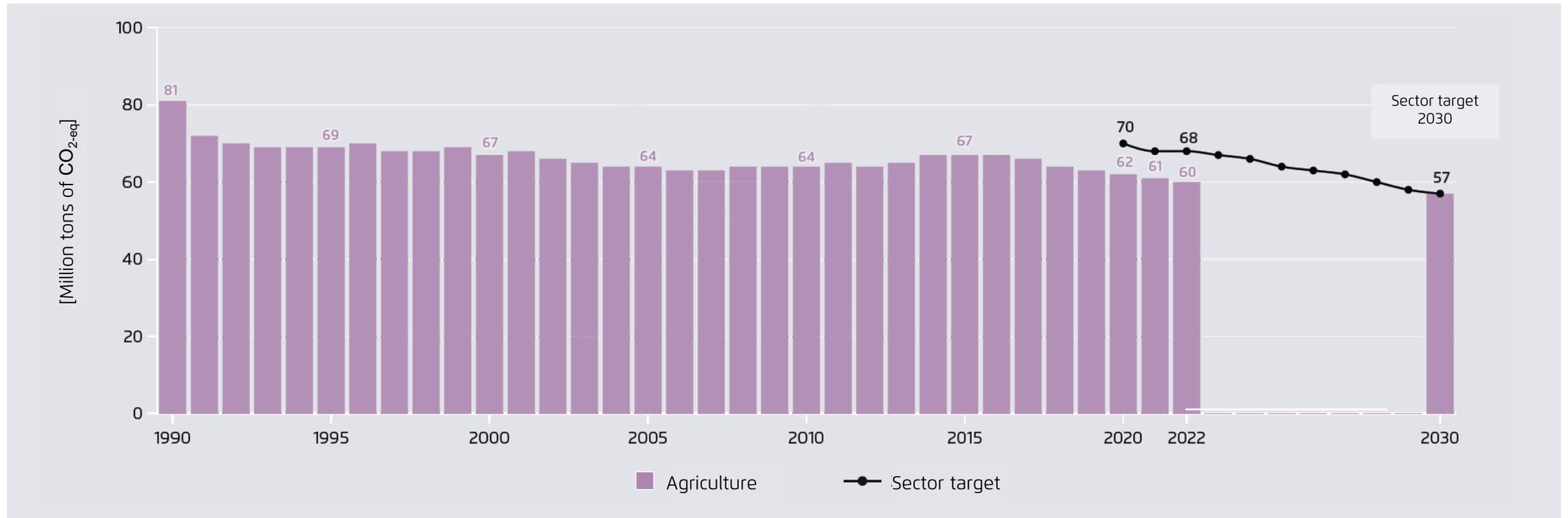
Development of greenhouse gas emissions in transport 1990 to 2021, estimate for 2022 and annual sector targets 2020 to 2030.



UBA (2022a) 2022: Agora Energiewende estimate based on AGEB (2022a), AGEB (2022d), destatis(2022b).

At 60 million t CO₂-eq, the agricultural target of 67.8 million t CO₂-eq was significantly undershot. This is mainly due to statistical corrections in nitrous oxide emissions.

Evolution of greenhouse gas emissions in agriculture 1990 to 2021, estimate for 2022, and annual sector targets 2020 to 2030.



UBA (2022a) 2022: Agora Energiewende estimate based on AGEB (2022a).

Results at a glance

1

Thanks to sunny and windy weather, the share of renewable energies in gross electricity consumption grows from 41.0 percent in 2021 to 46.0 percent in 2022. This

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record is not a success of climate policy: the expansion crisis in onshore wind energy continues, with only two gigawatts being added. In total, nine out of ten wind and solar tenders were undersubscribed in 2022, so that the expansion is also

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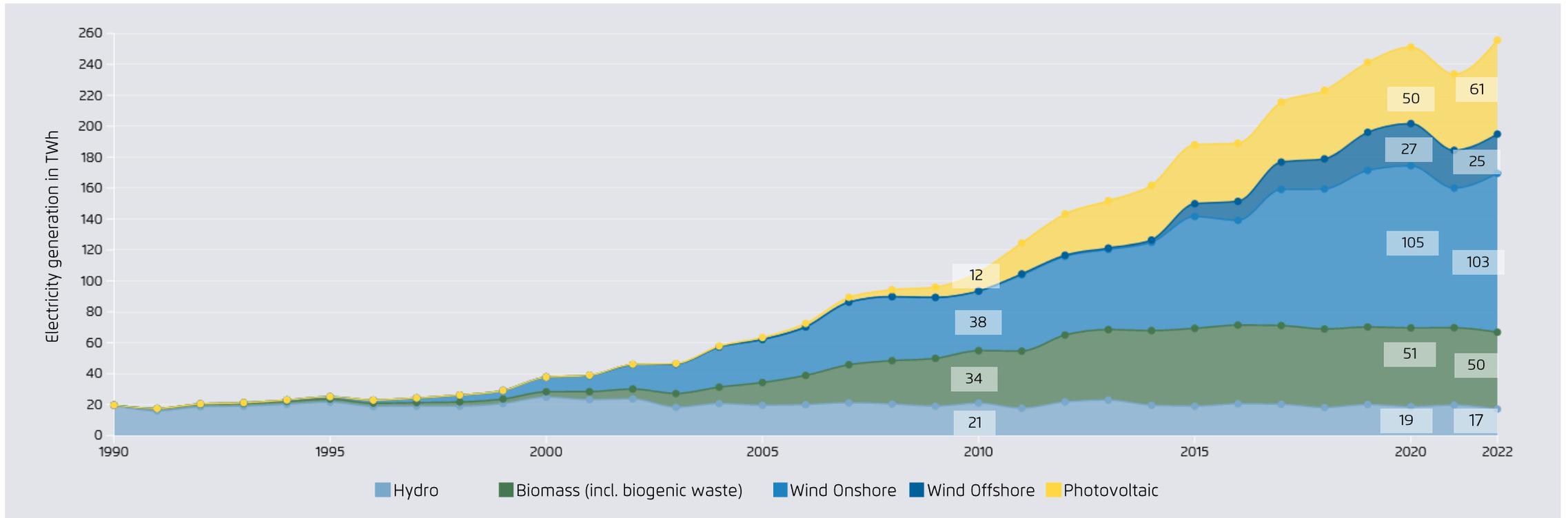
threatening to fall short of requirements in the coming years.

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The acceleration measures agreed in 2022 are not sufficient to achieve the target of 80 percent renewables in gross electricity consumption by 2030.

The increase in renewable electricity generation is not a climate policy success, because it was mainly due to sunny weather and a lot of wind at the beginning of 2022.

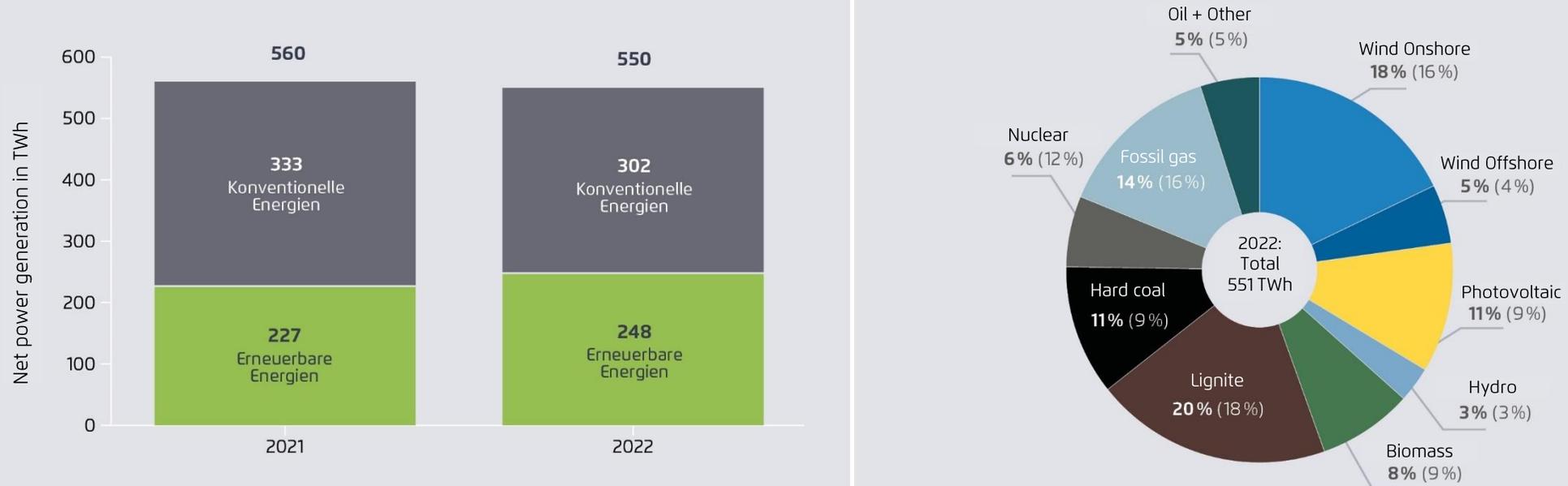
Gross electricity generation from renewables 1990 to 2022



(AGEB 2022b) 2022: preliminary data

Net electricity generation fell in 2022 from 559 TWh in 2021 to 551 TWh. Renewables achieved a generation record of 248 TWh.

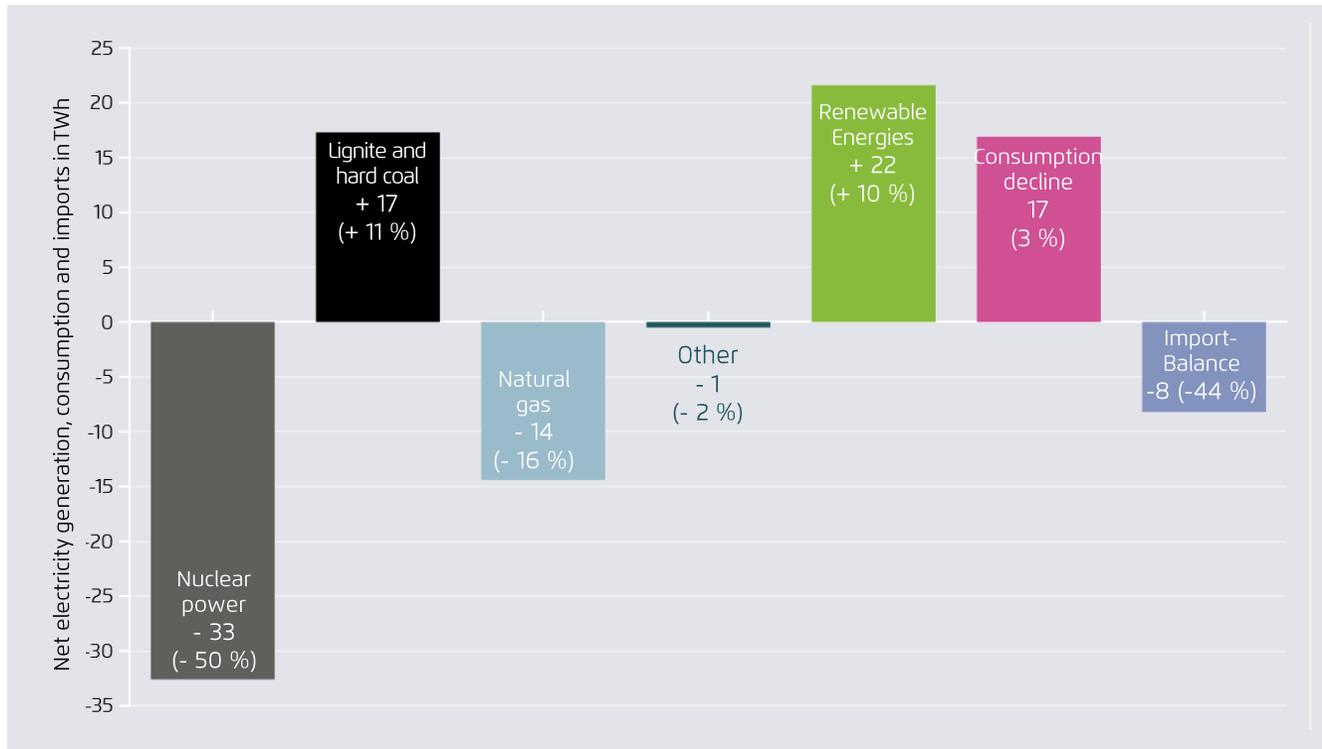
Electricity mix in 2021 and 2022 (net electricity generation)



AGEB (2022) Biomass including biogenic household waste

High fuel prices, renewables, and declining consumption with only a slight increase in exports decreased conventional power generation by 9 percent in 2022.

Change in net electricity generation, consumption, and imports in 2022 compared to 2021

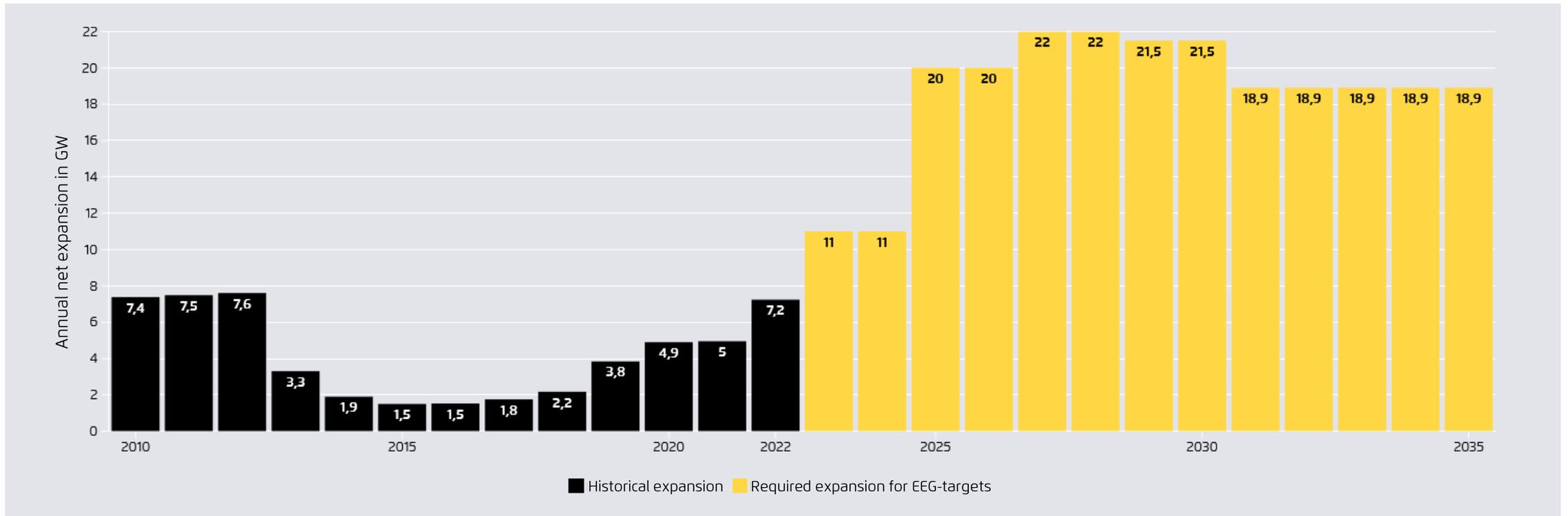


Calculation by Agora Energiewende based on AGEB (2022b) - preliminary data

- Wind power remained the largest renewable electricity supplier with 126 TWh, but expansion was again far too low at 2.4 GW.
- Solar power reached a total of 60 TWh, 23 percent more than in 2021, thanks to sunny weather and 7.2 GW of new capacity.
- 17 TWh (+ 11 percent) more electricity from lignite and hard coal-fired power plants pushed gas-fired generation out of the market due to high natural gas prices.
- Electricity generation from natural gas fell by 14 TWh; this corresponds to a decrease of 16 percent.
- Nuclear power plants supplied 33 TWh of electricity, around 50 percent less than in 2021, following the scheduled shutdown of 4 gigawatts of installed capacity.

Solar expansion recovered steadily from the expansion crisis. However, to get on EEG's target path, around a threefold increase in 2022 additions to 20 gigawatts by 2025 is required.

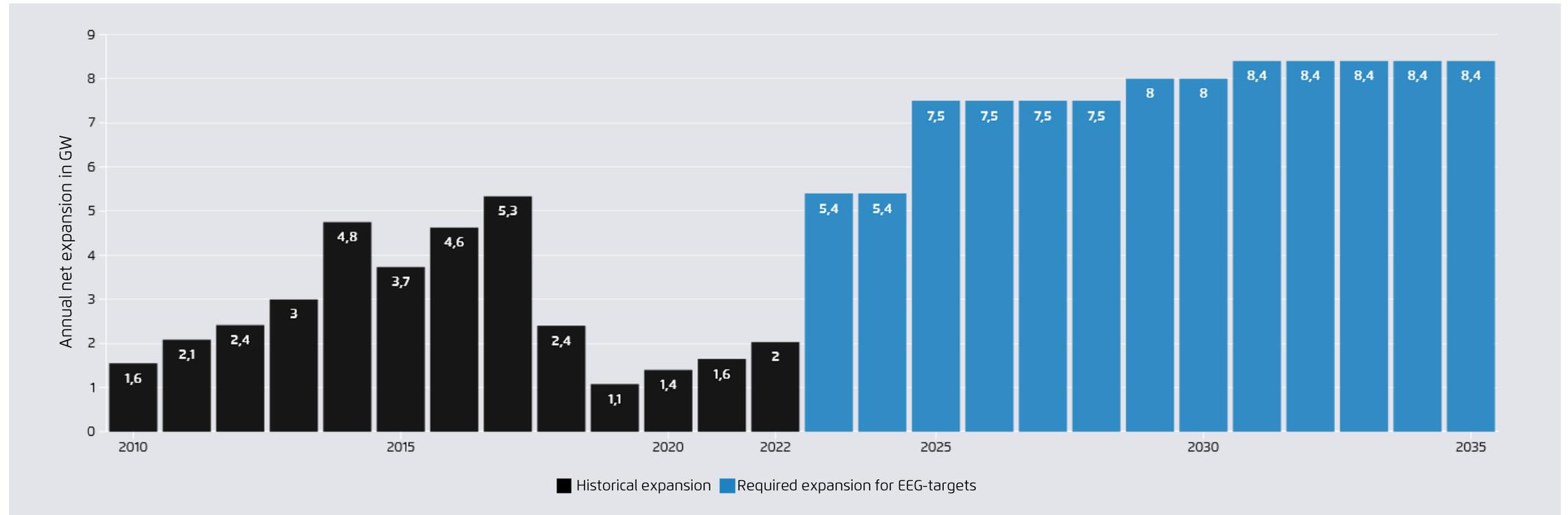
Historical and future required photovoltaic expansion for EEG targets



Agora Energiewende (2023) - The EEG 2023 sets expansion targets for 2024, 2026, 2028, 2030, 2035 and 2040. The chart shows the corresponding average expansion required per year.

Wind power additions increased slightly in 2022 - but an end to the wind addition crisis is still not in sight.

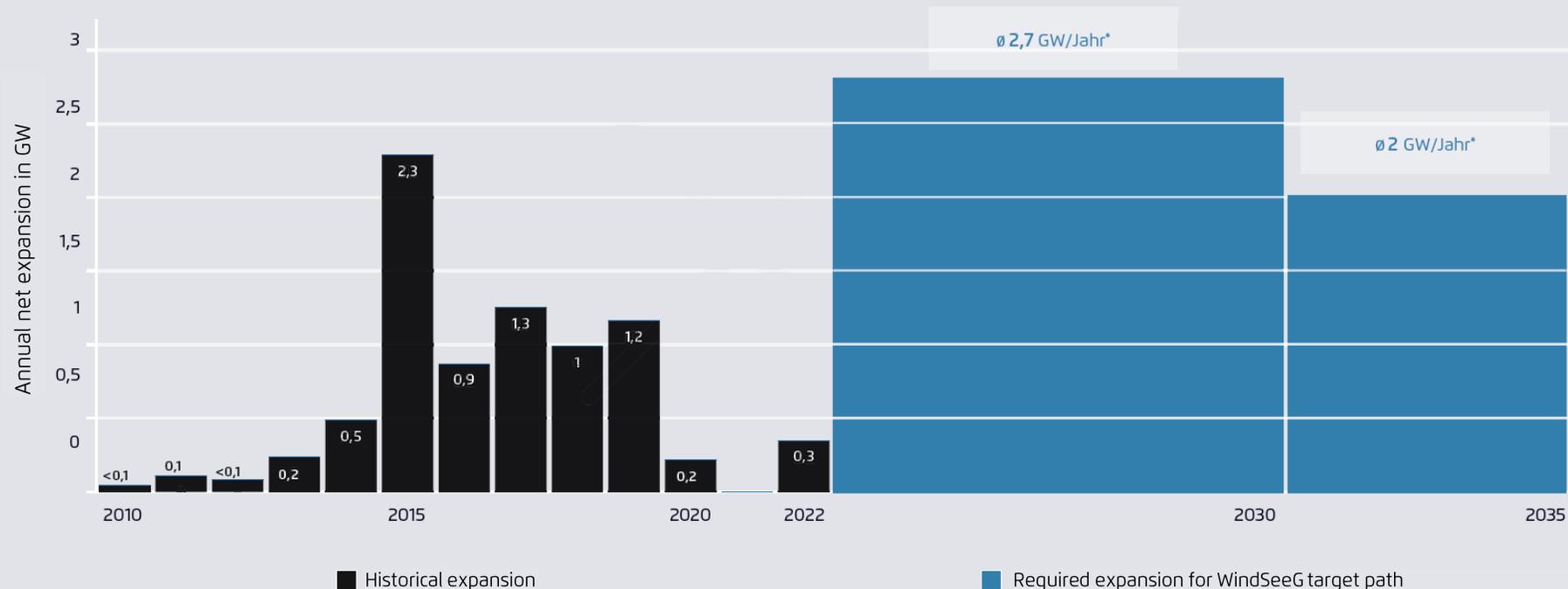
Historic and future wind-onland expansion needed for EEG targets



Agora Energiewende (2023) - The EEG 2023 sets expansion targets for 2024, 2026, 2028, 2030, 2035 and 2040. The chart shows the corresponding average expansion required per year.

With an addition in the GW decimal places, offshore wind remained in the expansion crisis in 2022. Annual additions until 2030 must increase almost tenfold from 2023 onwards.

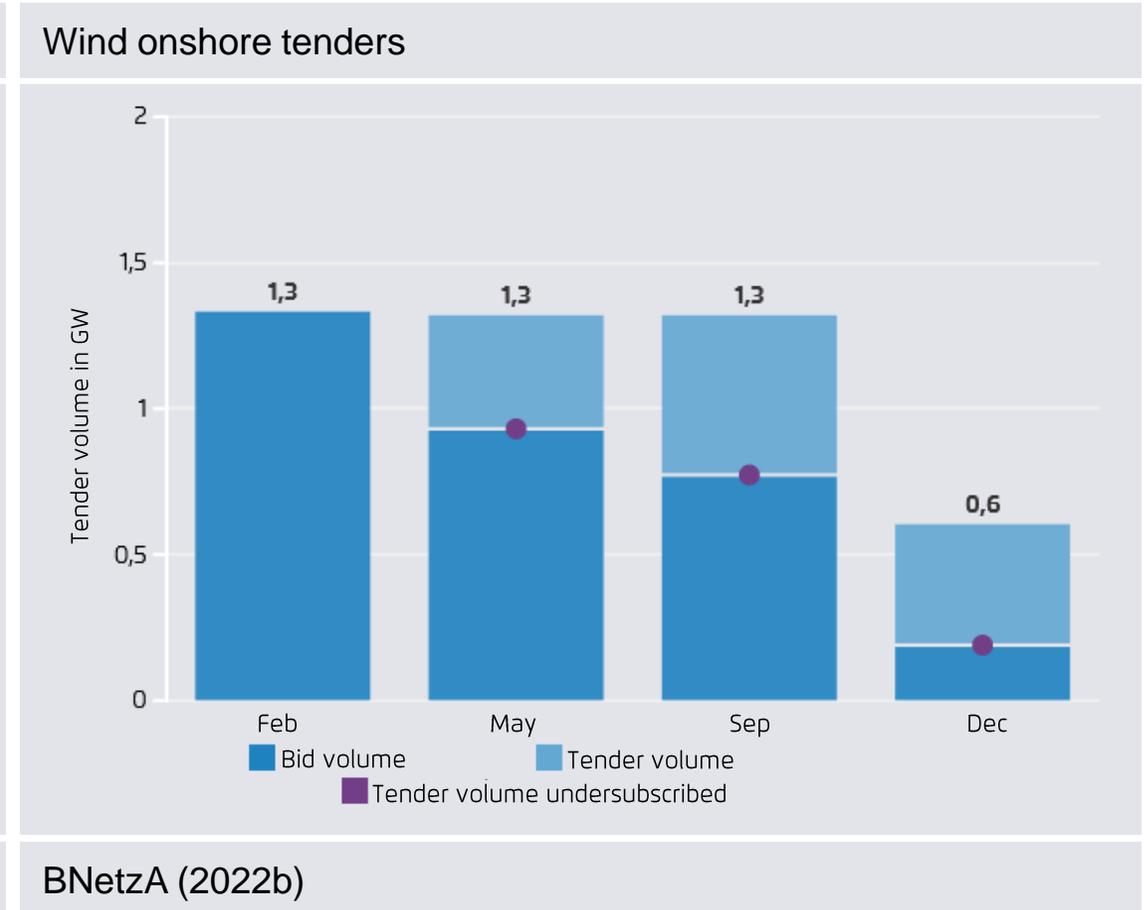
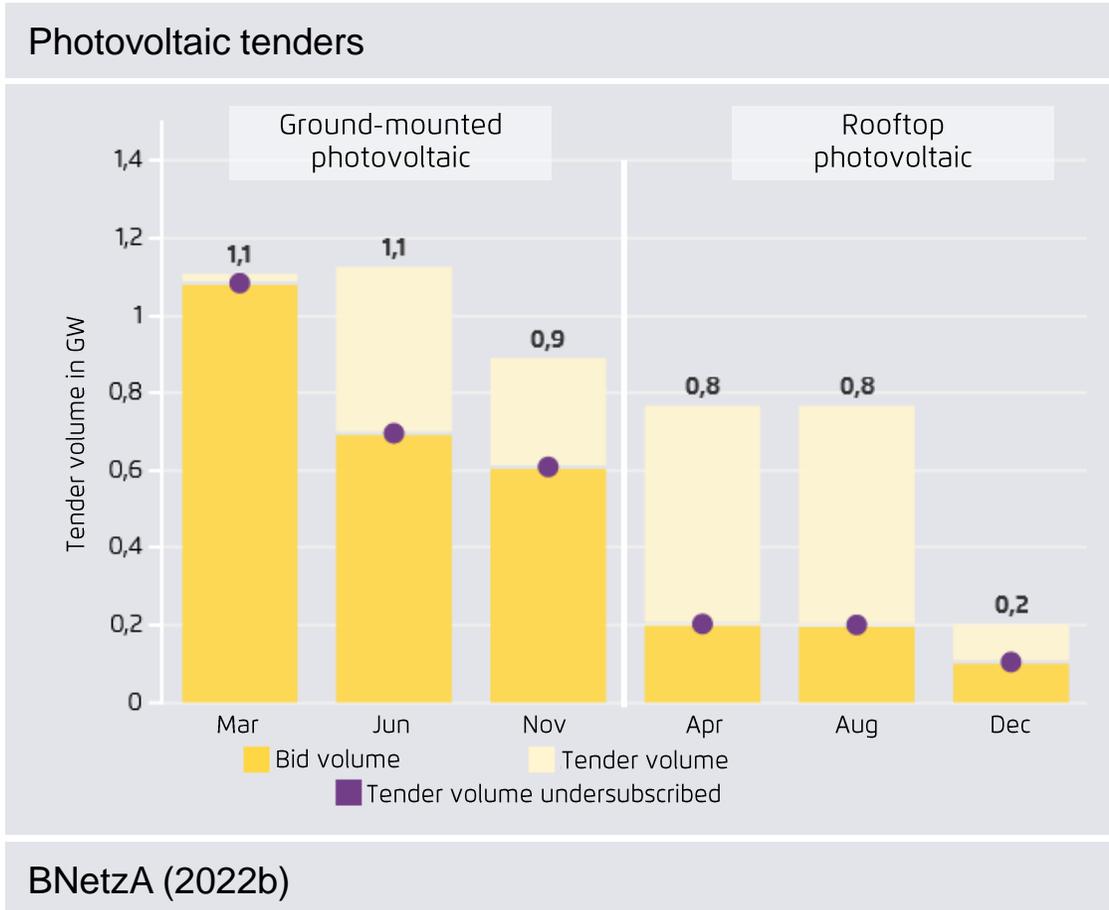
Historical and future wind offshore expansion required to meet WindSeeG expansion targets.



Climate-neutral electricity system 2035, Agora Energiewende (2022) - WindSeeG sets expansion targets for 2030, 2035 and 2045.

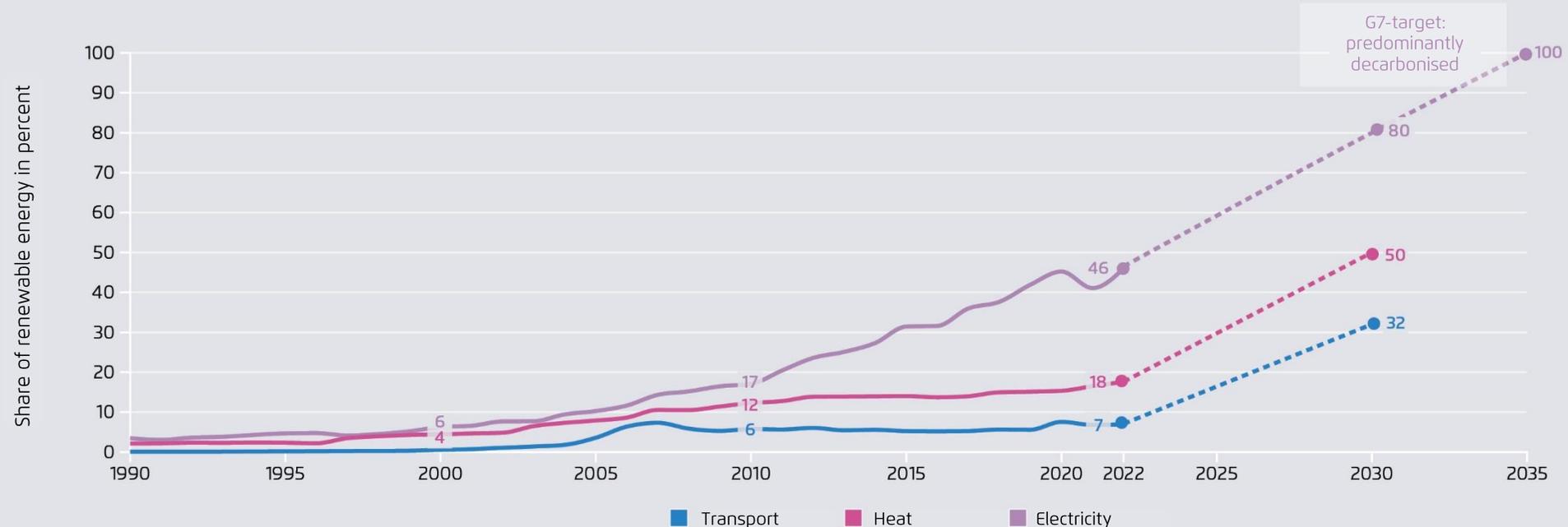
*Annual expansion strongly time-delayed due to long project duration of wind-on-sea plants and grid connections.

Nine out of ten wind and solar tenders were undersubscribed in 2022. Without drastic measures, the expansion will remain too low in the coming years.



Renewable targets in the electricity sector were reset in 2022: at least 80% renewables in 2030 (previously 65%) and carbon-neutral electricity in 2035 - but RES expansion remained too low.

Share of renewables in final energy consumption 1990 to 2022 and sector targets for 2030 and 2035



Agora Energiewende (2023) based on AGEBA (2022a/b), AGEE Stat (2022) - 2022: preliminary data, 2030 and 2035: targets of the German government.

Results at a glance

1

In 2022, massive price increases dominate the energy markets and are a major driver of inflation. Government action is dominated by the need to cushion high prices and replace fossil fuels. At times, exchange gas prices are more than ten times higher than in the previous year.

2

Central climate policy measures such as the immediate climate protection program announced in the coalition agreement are falling by the wayside. This backlog must be made up by 2023 if the 2030 climate target of minus 65 percent emissions compared with 1990 is to be met.

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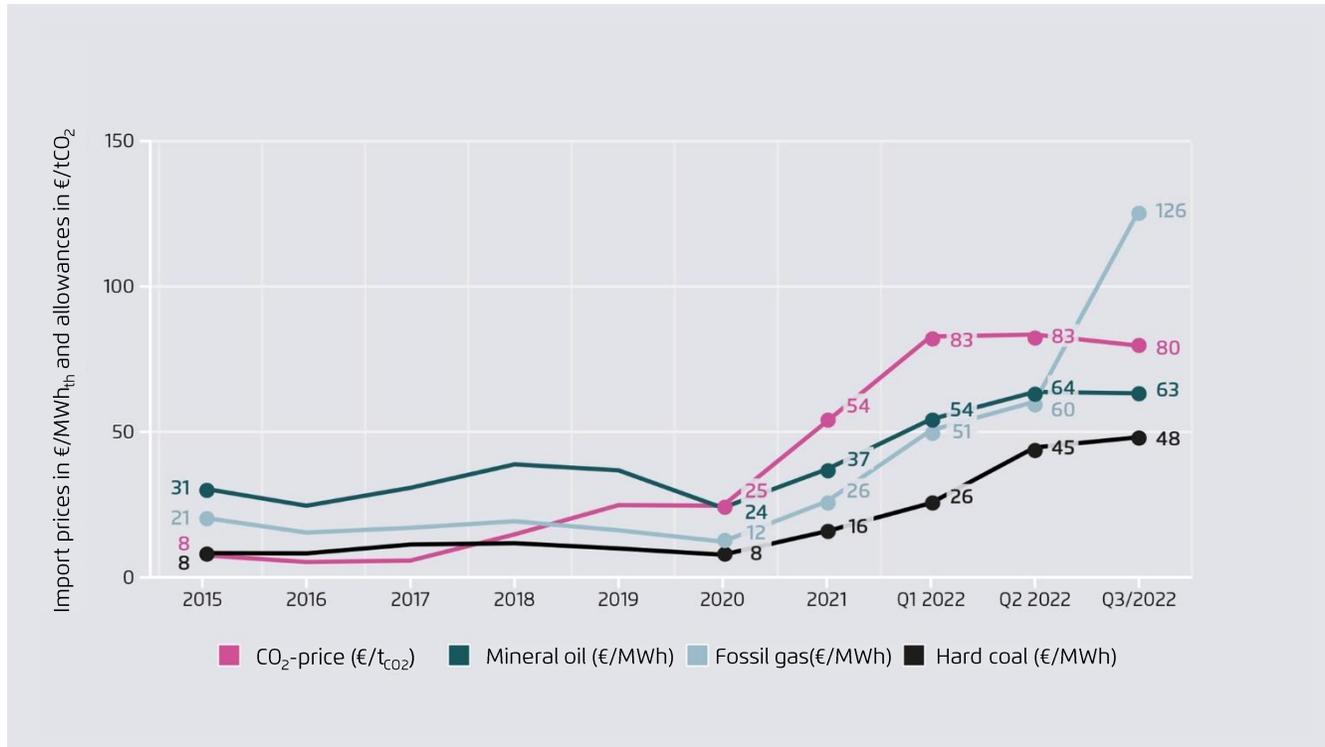
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Development of energy prices



The rapid rise in the price of fossil gas by €100/MWh characterized the year 2022, with the prices of coal and oil subsequently being pulled along to record highs.

Import prices for natural gas, hard coal and mineral oils and CO₂ emission allowance prices 2015 to 2022

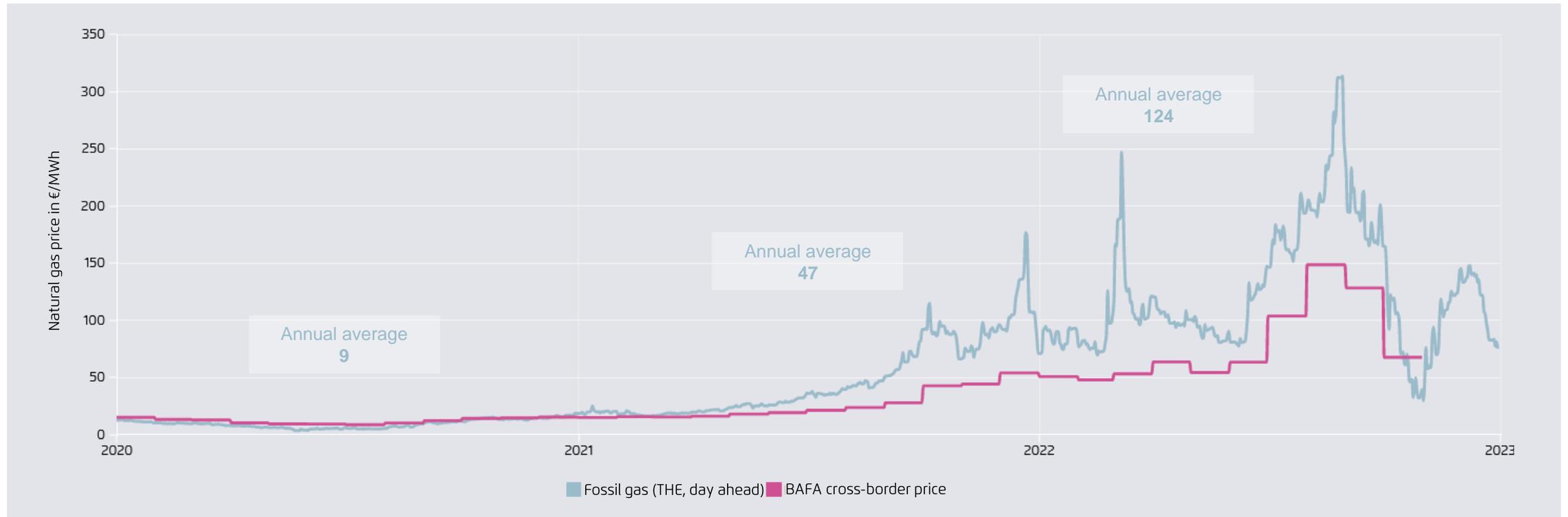


- The upward price trend began in the fall of 2021, when Russia cut back on wholesale offers.
- The outbreak of war on February 24 and the declining supplies via the Nord Stream-1 pipeline in the summer further heated prices.
- In the third quarter, the energy crisis drove up prices for natural gas to 126 euros per megawatt hour and for hard coal to 329 euros per ton (equivalent to a price of 48 euros per megawatt hour).
- Compared with the 2021 annual average, 2022 prices increased by an average of 204 percent for natural gas, 149 percent for hard coal, and 63 percent for petroleum.

BAFA (2018); BAFA (2022a/b), Bloomberg (2022), and VdKI (2021).

Natural gas trade was characterized by scarcity and high uncertainties. With full storage facilities and mild weather conditions, the price fell temporarily below the prior-year level.

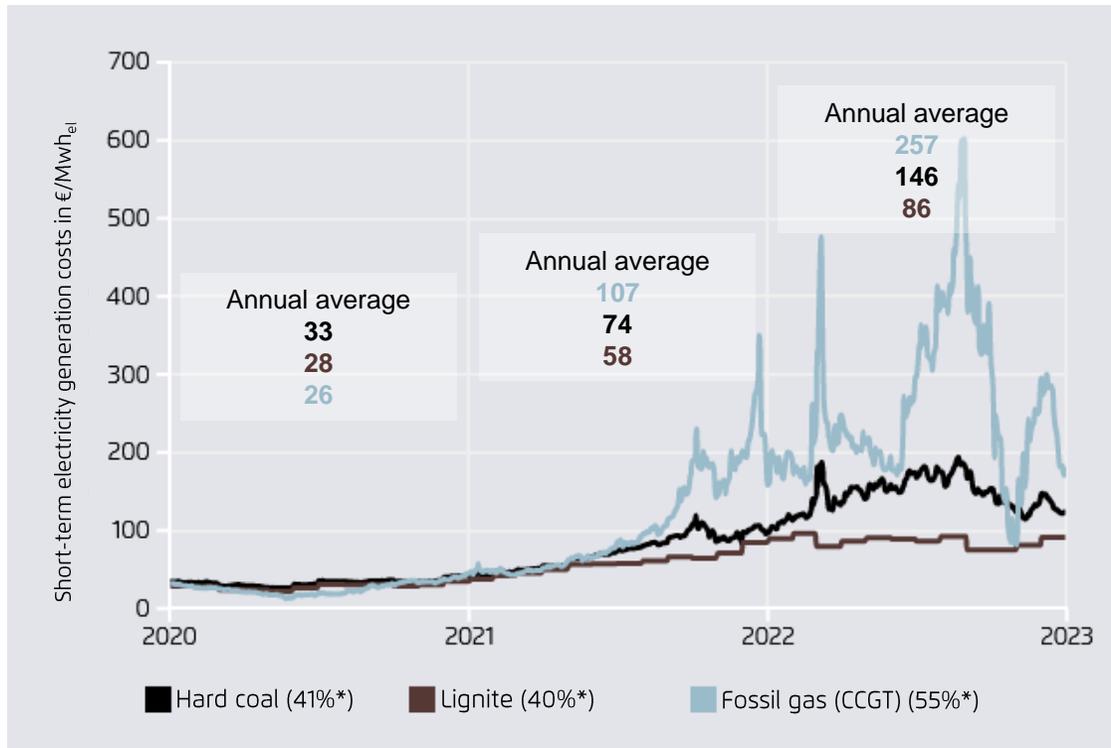
Cross-border price (monthly) vs. short-term price for natural gas (THE, day ahead, daily) for 2020-2022.



BAFA (2022a) and Bloomberg (2022)

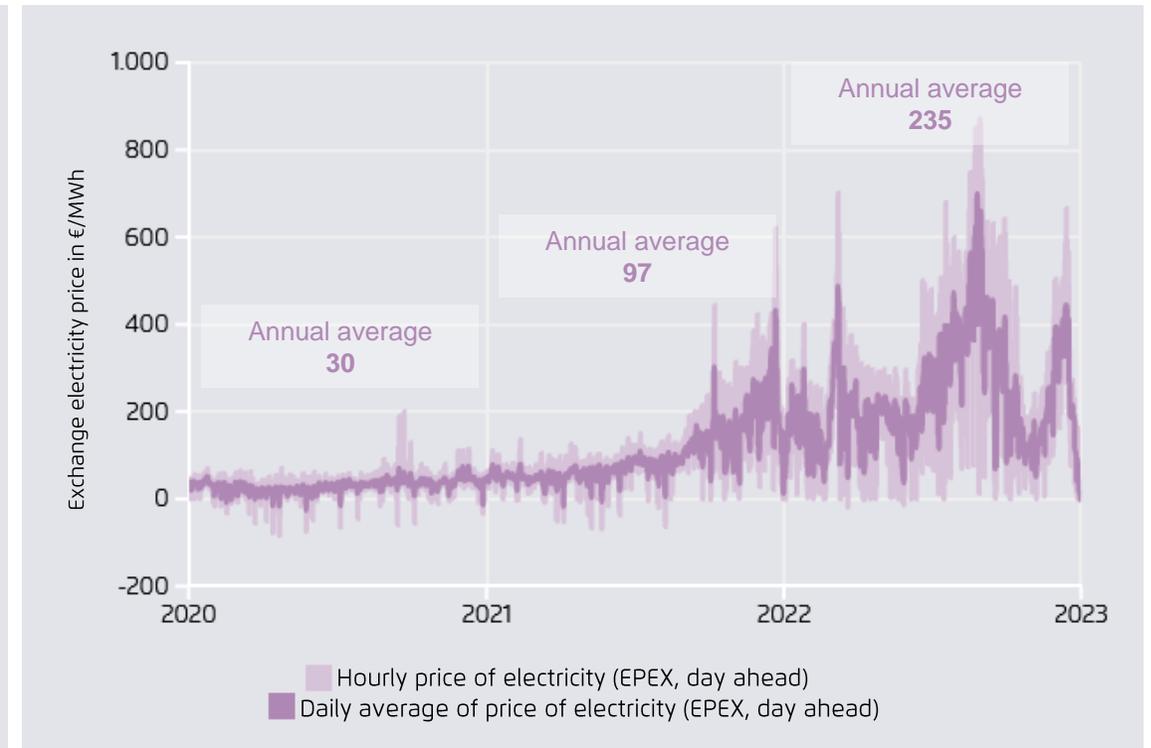
The prices of natural gas and coal drove electricity prices to more than double on an annual average basis in 2022.

Short-term power generation costs for hard coal, lignite, natural gas 2020-2022 (daily).



Bloomberg (2022) *efficiency
CCGT = combined cycle gas turbine power plant.

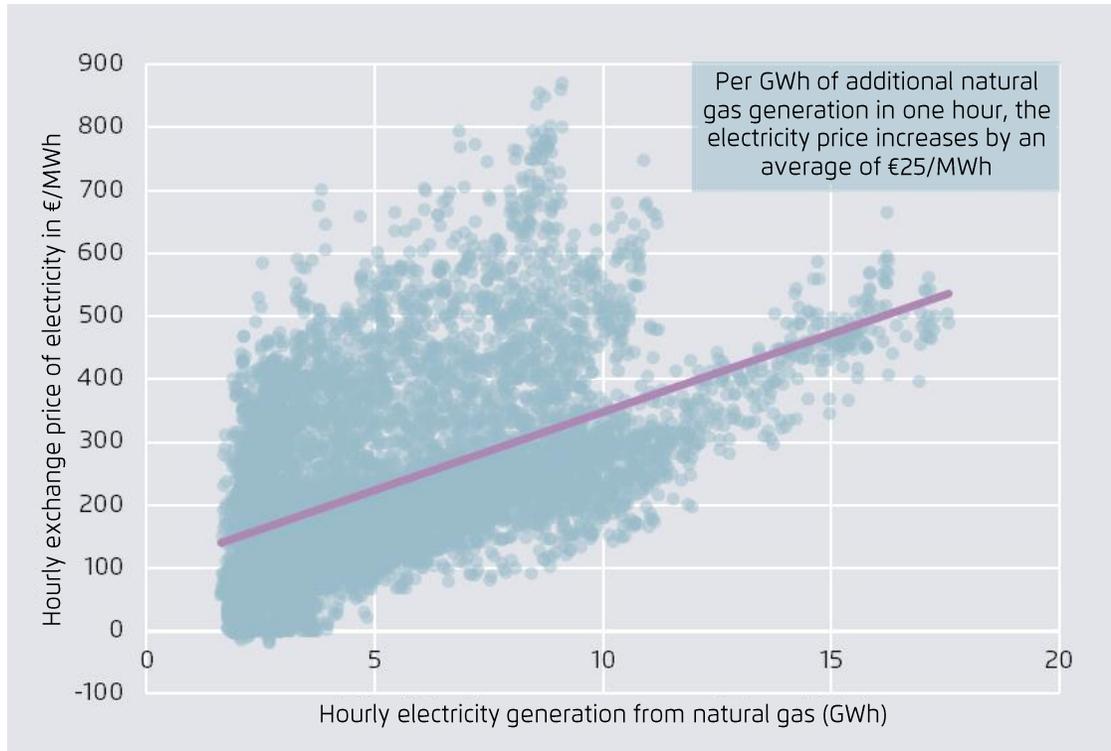
Price development for electricity (EPEX, *day-ahead*) hourly and daily average 2020 to 2022



ENTSO-E (2022a)

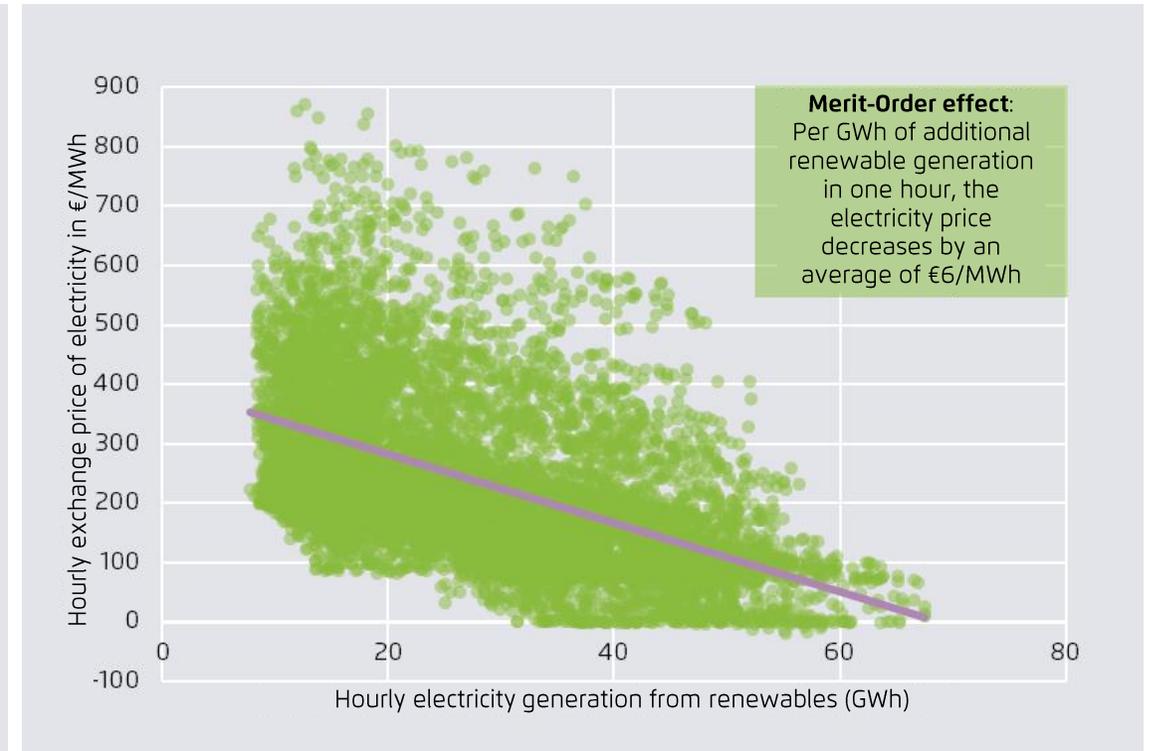
The main factor behind the rise in electricity prices was record natural gas prices. The decline in consumption and renewables dampened the rise in electricity prices.

Influence of generation from natural gas on the German exchange electricity price in 2022 (EPEX, *day-ahead*, hourly)



Agorameter (2022)

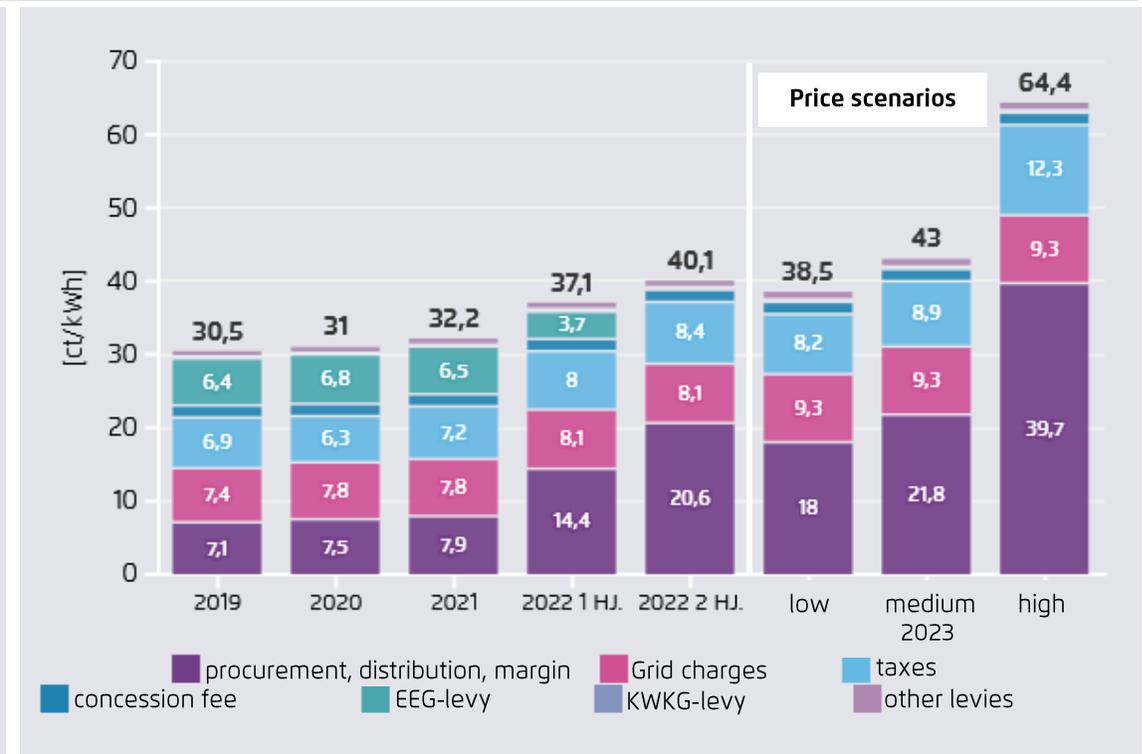
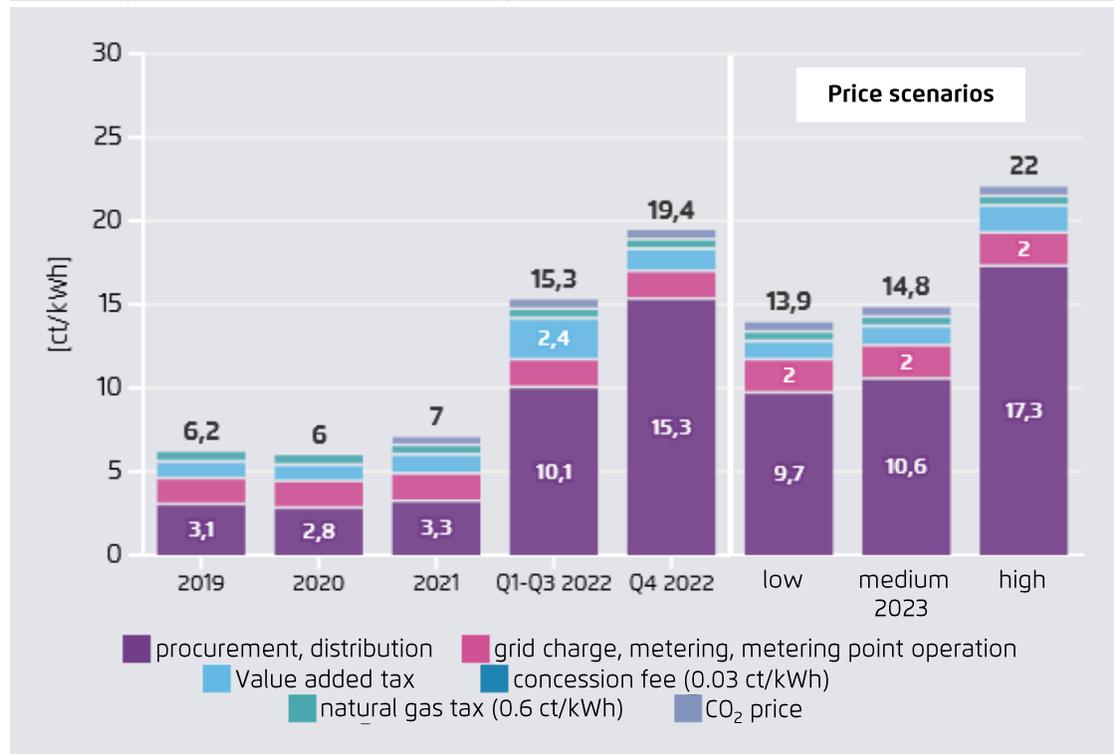
Influence of generation from renewables on the German exchange electricity price in 2022 (EPEX, *day-ahead*, hourly)



Agorameter (2022)

End consumers of natural gas and electricity are affected by the price increase with a time lag, but (theoretically) to different degrees depending on their procurement strategy.

Household prices for natural gas (left) and electricity (right) 2019 to 2022 and price scenarios for 5-, 3- and 1-year average procurement strategies on the stock exchange futures market for 2023

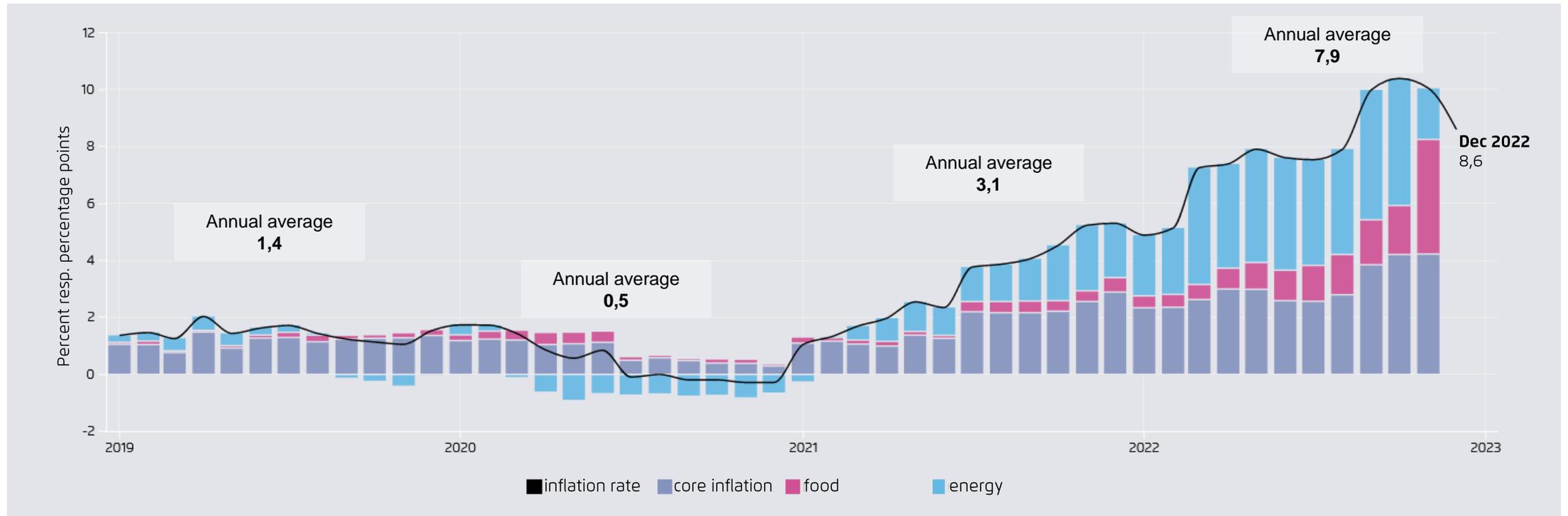


BDEW (2022a) and Bloomberg (2022), Agora Energiewende based on Bloomberg (2022).

BDEW (2022b) and Bloomberg (2022), Agora Energiewende based on Bloomberg (2022).

Fossil inflation 2022: High energy prices drove inflation to 7.9 percent and triggered government price and profit interventions as well as relief measures of over €300 billion.

Consumer Price Index (percent) in Germany 2019 to 2022 and contributions of core inflation, food and energy in percentage points



Destatis (2022c) - Growth spreads: Own calculations. Up to and including December 2022.

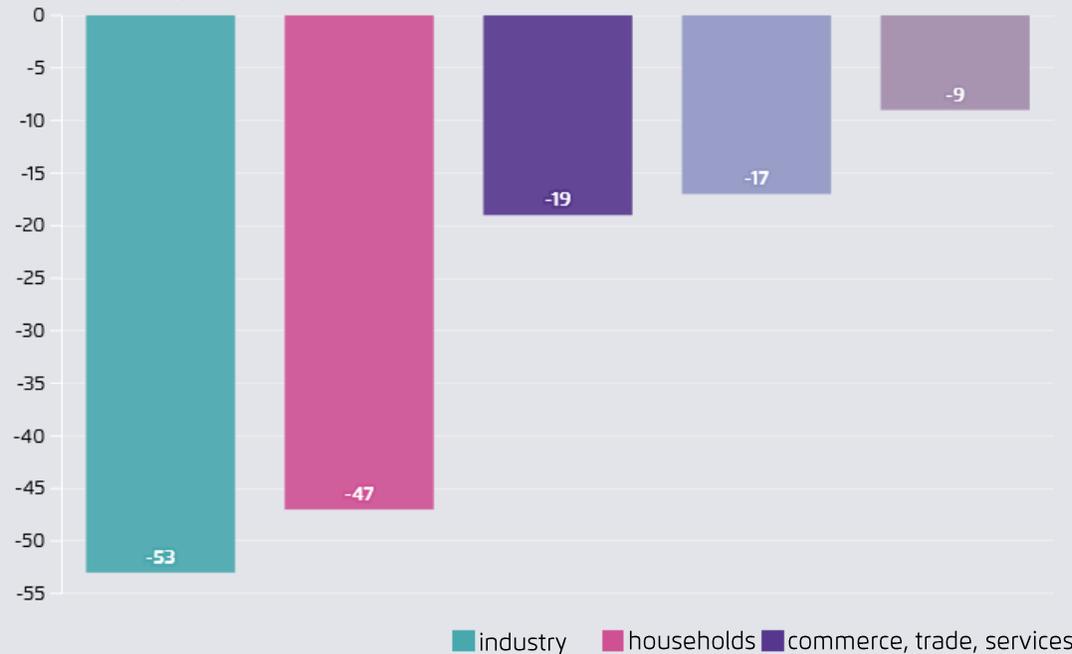
**Demand sectors
Industry, buildings
and transport**



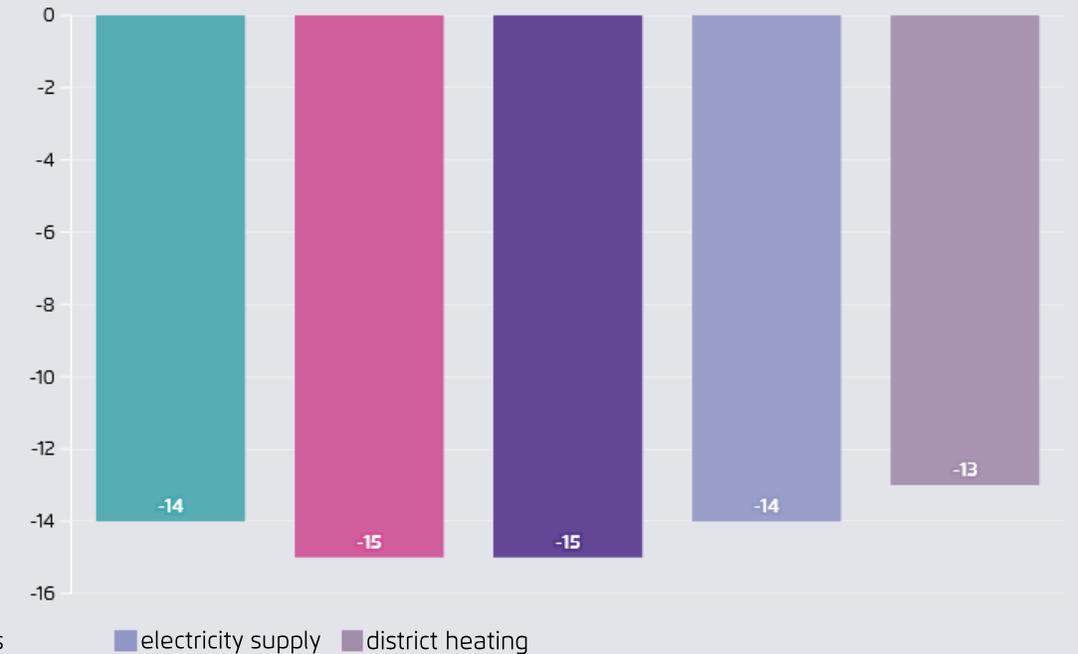
Gas savings shaped energy consumption in the demand sectors in 2022: due to the crisis, natural gas consumption fell by 14.8 percent.

Changes in natural gas sales in 2022 compared to 2021: across all sectors, natural gas consumption decreased by 136 terawatt hours

Absolute change in TWh



Relative change in TWh



BDEW (2021) and BDEW (2022c) - 2022: preliminary data

Industry

Savings and efficiency measures as well as production losses due to high energy prices reduced gas consumption in industry.

Production index of the energy-intensive industry and manufacturing sector



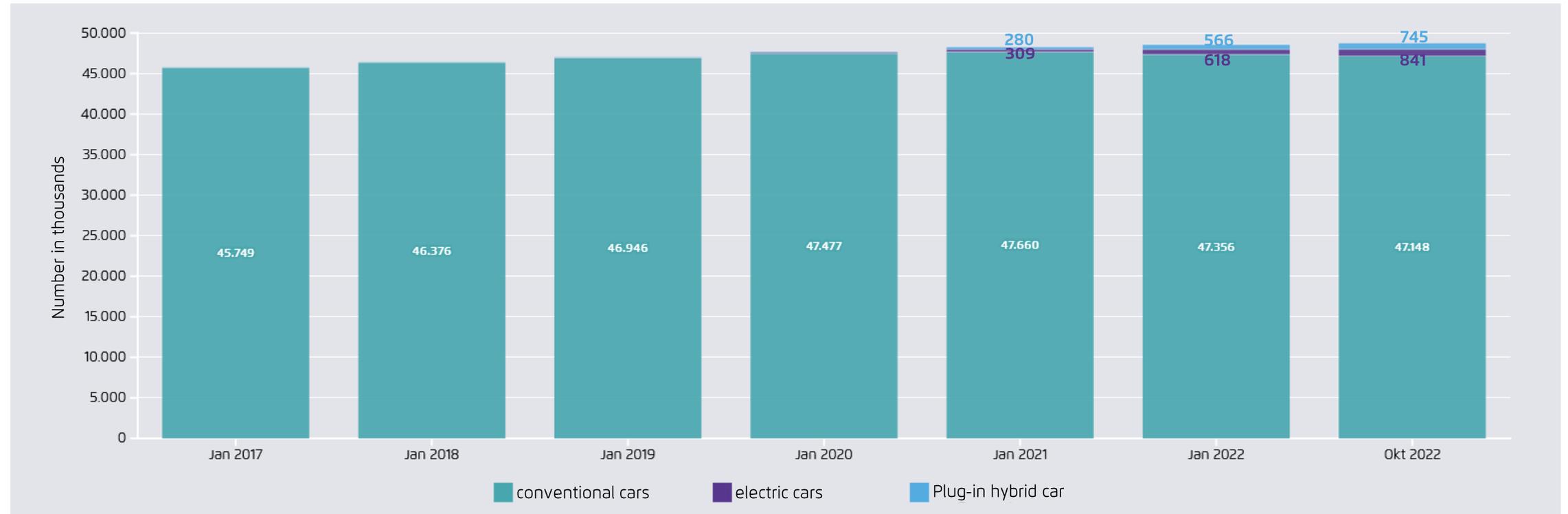
BDEW (2020), BDEW (2021) and BDEW (2022c) - 2022: preliminary data

- The decline in natural gas consumption in industry is due to cost-cutting and efficiency measures as well as production losses caused by high energy prices.
- There were declines in production particularly in energy-intensive industries such as the chemical industry, metal production and the paper industry.
- Gas sales to industry decreased by 53 TWh in 2022 (-14% compared to 2021) and were even 28 TWh lower than in the 2020 corona year.
- Some of this decline in demand may prove permanent.

Transport

Rising CO₂ emissions showed no overall progress in the transport sector. E-vehicles became more popular in new registrations in 2022, but remain marginal in the stock.

Number of electric and plug-in hybrid vehicles in the portfolio

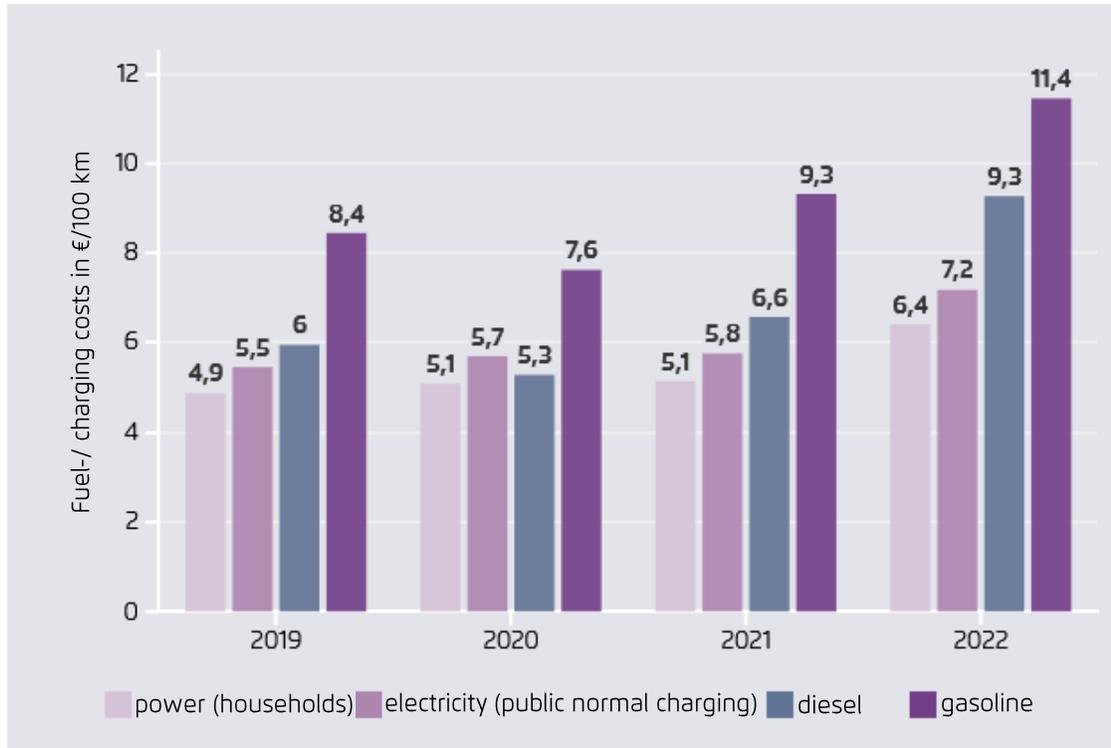


Agora Verkehrswende (2023) based on Kraftfahrtbundesamt (2022)

Transport & Buildings

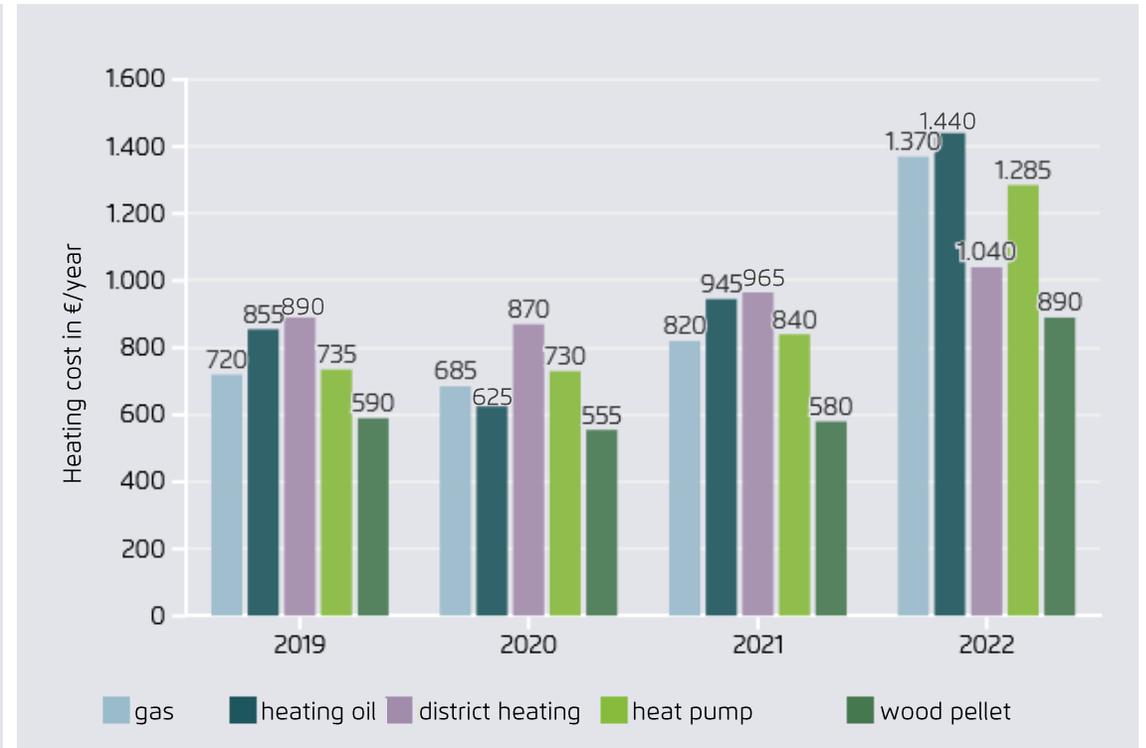
In 2022, e-vehicles and heat pumps could deliver their efficiency benefits in terms of energy costs. Even with relief and price brakes for fossil gas, the climate-neutral alternative must remain affordable.

Cost of traction power, gasoline and diesel per 100 kilometers 2019 to 2022



Agora Verkehrswende (2019), BAFA (2020), BDEW (2022b) and en2x (2022)

Heating costs for an average apartment in an apartment building (70 m²)



Heizspiegel.de (2022)

Results at a glance

1

The energy crisis and the increasingly severe consequences of the climate crisis unleash a strong societal demand for the energy transition and its technologies:

2

Heat pumps in households and industry are in demand as never before, the number of photovoltaic balcony modules is quadrupling, and Germans are saving on heating.

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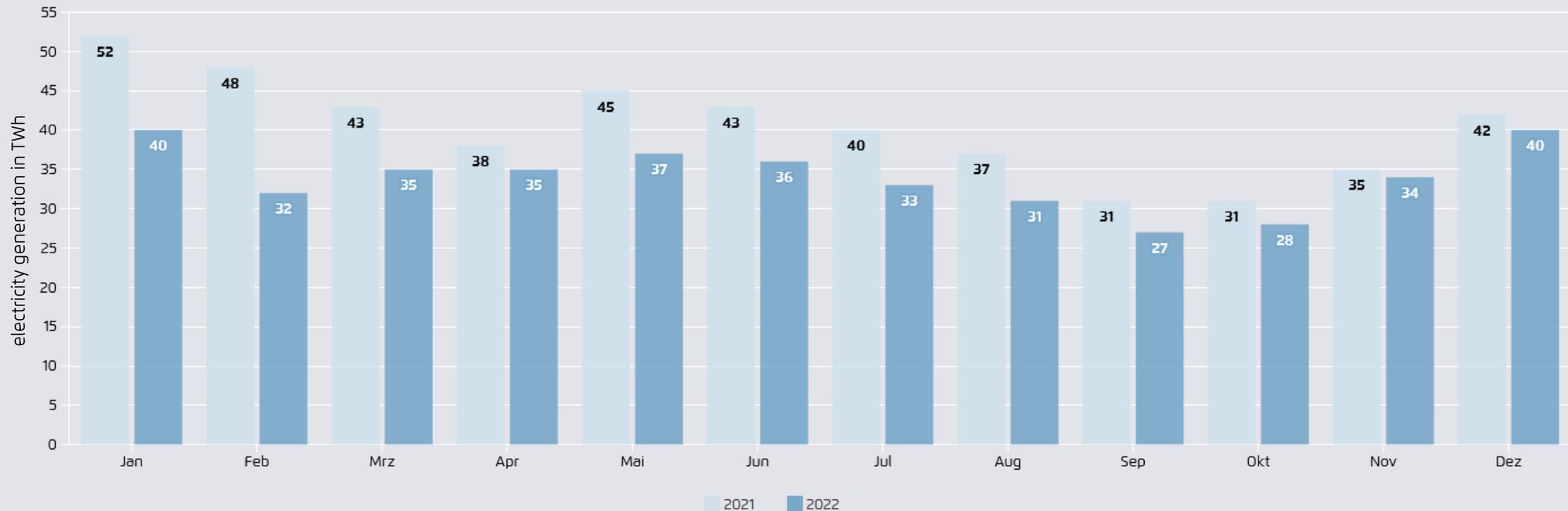
More and more municipalities are demanding freedom to make mobility more climate-friendly. The German government should support this demand in 2023 with ambitious measures and

4

remove existing hurdles.

The consequences of climate change had noticeable effects: The sun shone longer in 2022 than ever before, the annual Ø temperature reached record highs*, persistent drought in Europe.

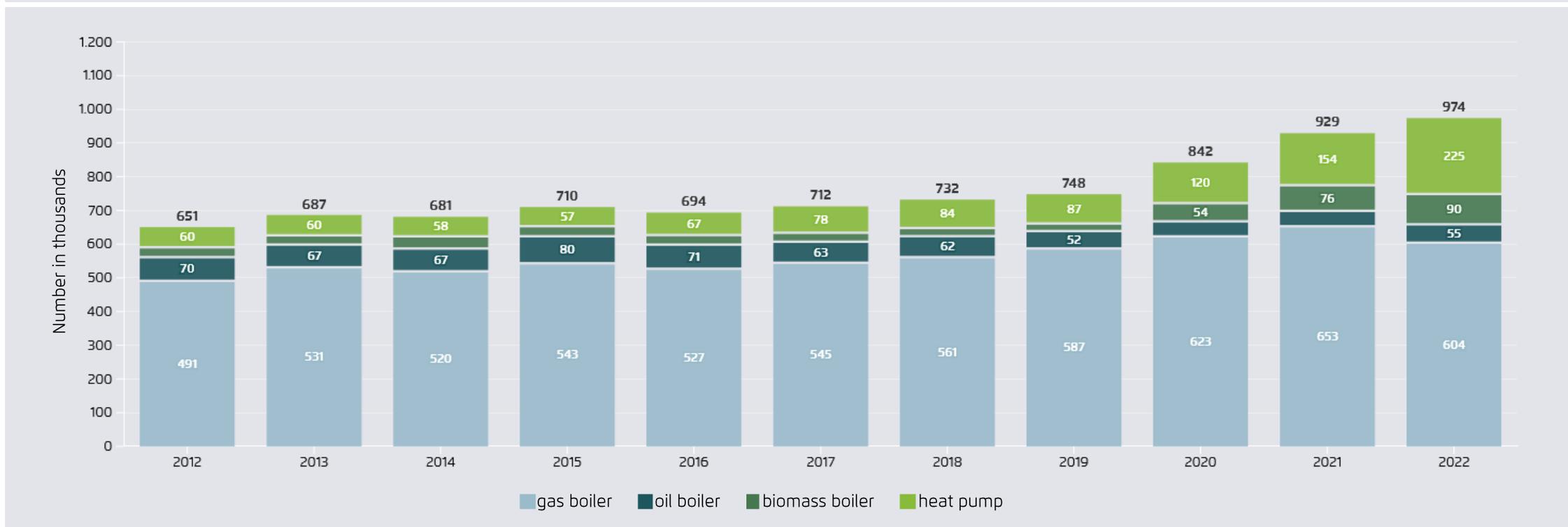
Monthly net electricity generation from hydropower in Europe in 2021 and 2022



ENTSO-E (2022b) *DWD (2022), as of 30.12.2022

In the energy and climate crisis year 2022, demand for energy transition and its technologies such as e-vehicles and heat pumps climbed - but fossil technologies still dominate.

Sales structure heat generators 2012 to 2022: heat pumps gain in popularity (sales 2022: +40 %, gas heaters -8 %)



BDH (2022) - 2022: Estimate based on BDH (2022).

Developments in energy policy in 2022 and outlook for 2023



Crisis management shaped political action in 2022. Particular focus: fossil diversification and financial relief.

Fossil diversification

- Purchase of liquefied natural gas (LNG) on short-term markets and legally required filling of gas storage facilities (EnWG, GasSpFüllstV)
- Legislative push for construction of mobile and fixed LNG terminals (LNGG, May 2022).
- Continued operation and reactivation of coal-fired power plants (EKBBG, revision KVBG)

Financial relief

- Three relief packages with individual measures, including abolition of EEG levy, energy lump sum payments, tax cut on energy (95 billion euros)
- "Defense umbrella" (200 billion euros) to finance, among other things, gas and electricity price brakes on the proposal of a gas commission. Effective as direct payments: Savings incentives remain included

Savings measures

- Two regulations for energy-saving measures effective in the short and medium term
- Public relations campaign and expansion of data processing and provision by the Federal Network Agency

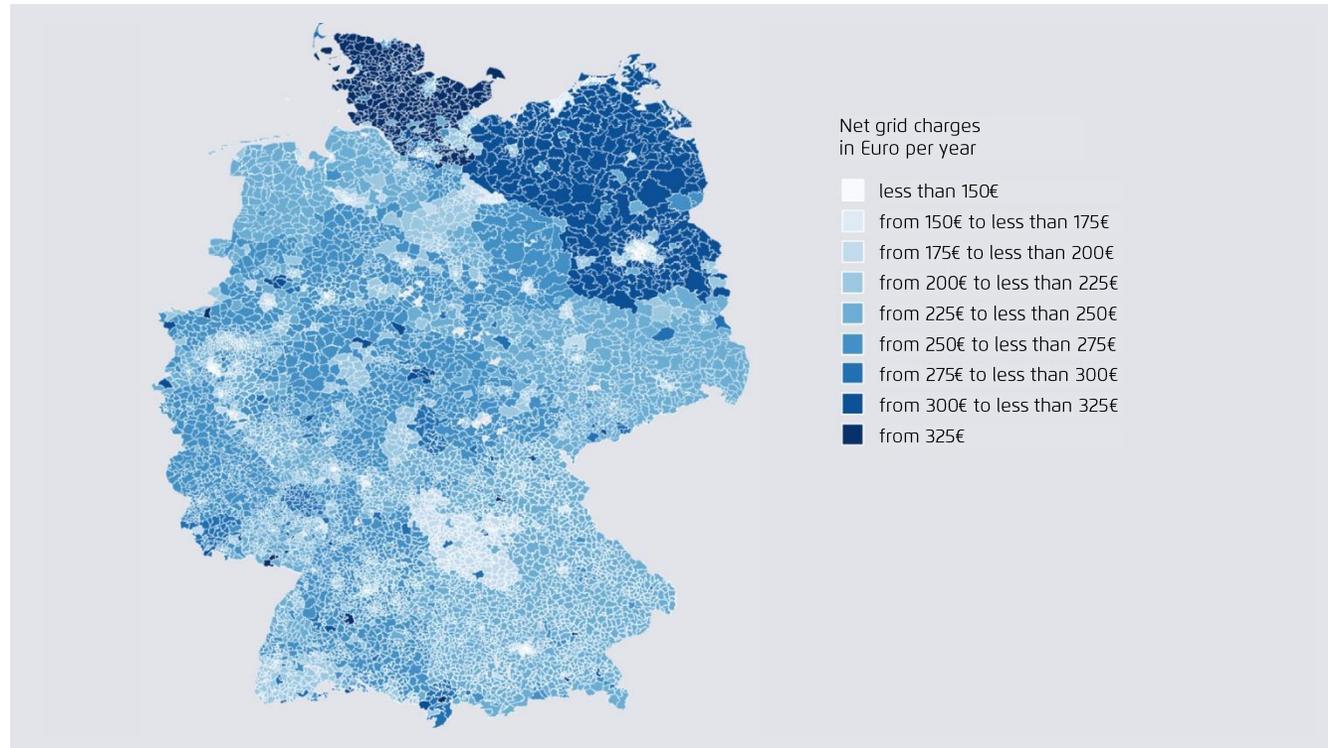
The plans from the coalition agreement and the BMWK “Eröffnungsbilanz“ were not fully implemented. Above all, the lack of the announced immediate action program leaves a gap.

Coalition agreement (November 2021)	BMWK “Eröffnungsbilanz“ (January 2022)
<ul style="list-style-type: none"> → "Immediate climate protection program with all necessary laws and projects by the end of 2022." ● 	<ul style="list-style-type: none"> → EEG amendment for 80 percent renewable electricity with 750 TWh consumption ●
<ul style="list-style-type: none"> → Target: 80 percent renewable electricity in 2030 with increasing consumption (680-750 TWh) ● 	<ul style="list-style-type: none"> → Solar expansion acceleration package ●
<ul style="list-style-type: none"> → Fixed expansion targets for solar and offshore wind ● 	<ul style="list-style-type: none"> → Wind onshore Act that ensures land availability (two percent), reconciliation with species protection, and expedited procedures ●
<ul style="list-style-type: none"> → Coal phase-out "ideally" by 2030 ● 	<ul style="list-style-type: none"> → Climate protection contracts (CCfDs) with industry ●
<ul style="list-style-type: none"> → Financing of EEG levy via federal budget, support for rising CO₂ price ● 	<ul style="list-style-type: none"> → Area-wide municipal heat planning, decarbonization and expansion of heating networks ●
<ul style="list-style-type: none"> → Industrial strategy and measures for industrial decarbonization (CCfDs). ● 	<ul style="list-style-type: none"> → Revision of the building energy law ●
<ul style="list-style-type: none"> → Target: 50 percent climate-neutral heat by 2030 ● 	<ul style="list-style-type: none"> → Update hydrogen strategy (target doubling) ●
<ul style="list-style-type: none"> → Target: from 2025, new heating systems must be operated with at least 65 percent renewable energies ● 	
<ul style="list-style-type: none"> → Increasing the targets for hydrogen production ● 	

Implementation: ● missing ● no resolution in line with objectives ● advanced or implemented

Structural reforms and the comprehensive removal of obstacles and hurdles to the energy transition fell behind.

Distribution of net grid charges (€/year) for residential customers in Germany in 2022

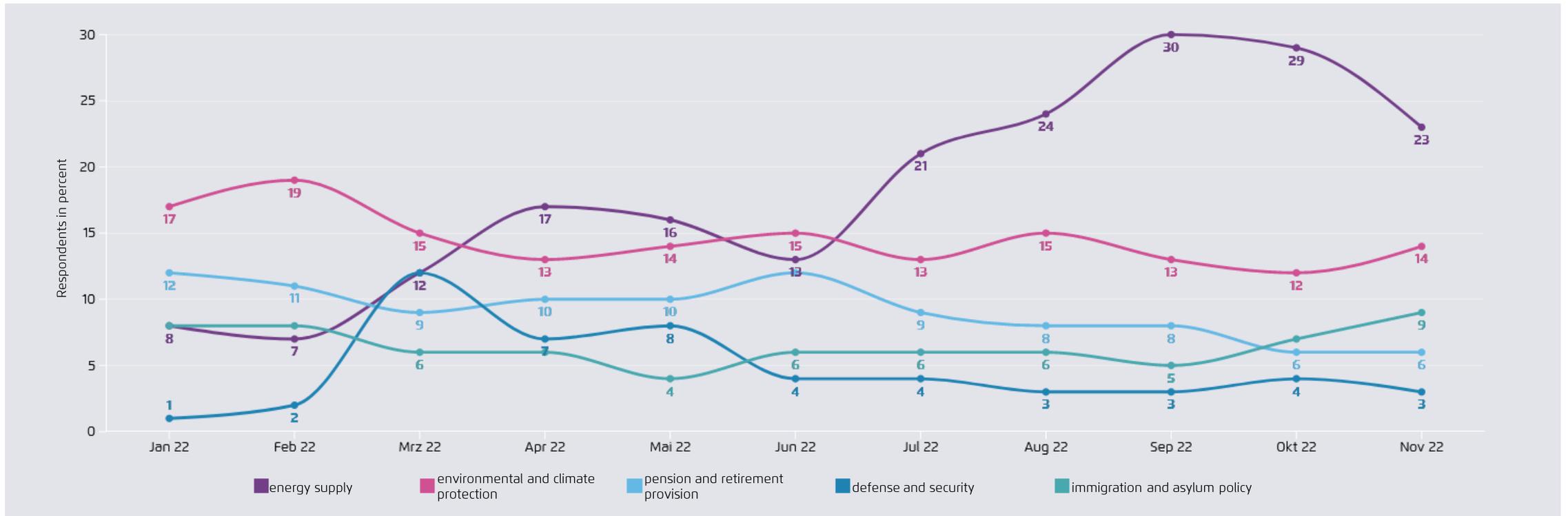


- Highest charges in Schleswig-Holstein, Mecklenburg-Western Pomerania and Brandenburg.
- Lowest charges in Bavaria and North Rhine-Westphalia.
- Reasons: Area-specific rolling of network costs.
- Consumers pay locally for the investments in distribution networks, which today are mainly made through investments in wind and solar energy.
- The long-needed reform of grid fees, which date back to the last century, is still not on the political agenda, even though the current grid fees are making the energy transition unnecessarily expensive.

Agora Energiewende based on GET AG cockpit (2022) - data for a household with 2,500 kWh annual consumption, without power metering in the standard load profile (SLP)

In 2022, climate and environmental protection were among the two most important issues for people in Germany.

Annual progression of the five most important topics



YouGov (2022), Question: In your opinion, which of the following is the most important issue that politicians in Germany should be concerned about?

2023 holds the opportunity to structurally overcome the fossil fuel crisis with broad societal support and put the transformation to climate neutrality on track. (1/2)

Energy priorities:

- Acceleration of renewable expansion with focus on land provision, species protection and manufacturing of renewable plants (time-limited “Außenbereichsprivilegierung“, go-to-areas)
- Electricity market design for system-supporting price signals incl. realignment of charges and levies
- Comprehensive digitization of the distribution networks
- Provision of dispatchable power plant capacity, as quickly as possible fueled with renewable hydrogen

Priorities Industry:

- Strategies for green lead markets, carbon management and circular economy
- Implementation of climate protection contracts
- Provision of funding and regulatory requirements to stimulate green lead markets

2023 holds the opportunity to structurally overcome the fossil energy crisis with broad societal support and put the transformation to climate neutrality on track. (2/2)

Priorities buildings and heat networks:

- Turnaround in the boiler room: implementation of the 65 percent target for new heating systems
- Expansion and decarbonization of heat networks (regulation, municipal heat planning)
- Aligning the framework for energy-efficient refurbishment with industrial and social policies

Priorities Traffic:

- Advance electrification in transport quickly
- Eliminate outdated subsidies and privileges for automobile traffic
- Establish reliably funded support programs for climate-friendly means of transport
- Create a legal framework that enables municipalities to shape the transport transition locally

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Thank you!

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