AGEB
AG Energiebilanzen e.V.

# Energy Consumption

in Germany in 2024

# Primary Energy Consumption in Germany Dropped Slightly in 2024

## Contents



**Last Update: May 12, 2025**
Edited by: Hans Georg Buttermann (h.g.buttermann@ag-energiebilanzen.de)
(The article on renewable energy is based on the work of AGEE-Stat; last update: May 12, 2025)

**Arbeitsgemeinschaft Energiebilanzen e.V. –
Working Group on Energy Balances (Energy Balances Group)**
Reinhardtstraße 32, 10117 Berlin, Germany

h.g.buttermann@ag-energiebilanzen.de
f.schenke@ag-energiebilanzen.de
u.maassen@ag-energiebilanzen.de

www.ag-energiebilanzen.de

# Total Primary Energy Consumption

In 2024, the primary energy consumption in Germany (according to preliminary estimates) amounted to a total of 10,529 petajoules (PJ) or 359.2 million tons of coal equivalents (Mtce); compared to the previous year, this equals a decrease of 1.2 % (please see Table 1).[1)]

In 2024, the level of energy consumption as well as its composition (energy mix) continued to be characterized by the consequences of the war in Ukraine and/or the associated noticeably higher energy prices as well as declines in growth and sectoral changes in the German economy. In addition, energy consumption is also influenced by political and regulatory requirements at a national and a European level. Significant for the medium-term to long-term development are, for example, the gradual phase-out from nuclear energy by the end of 2022 (more specifically within the scope of the officially approved stretch-out operations until April 15, 2023), the initiated phase-out from coal-fired power generation as well as the continued promotion and support undertaken to expand renewable energy. Relevant at a European level are, for example, the reduction of the maximum quantity of emissions during the fourth trading period between 2021 and 2030 (linear reduction factor 2.2 % per annum instead of 1.74 % per annum as had been the case during the third trading period) within the EU-ETS, the objectives pursued for climate protection in the non-ETS sector,[2)] the requirements for improving energy efficiency (for example, the EU Energy Efficiency Directive (EED), Directive 2012/27/EU), binding targets for the progressive expansion of renewable energy (EU Renewable Energy Directive, Directive (EU) 2018/2001) as well as the Proposal for a Directive of the European Parliament and of the Council Amending Directive (EU) 2018/2001 (Document COM/2021/557).

Table 1

AGEB
AG Energiebilanzen e.V.

**Primary Energy Consumption in Germany in 2023 and 2024** [1)]

| Energy Carrier | 2023 | 2024 | 2023 | 2024 | Changes in 2024 Compared to 2023 | | | Proportions in % | |
|---|---|---|---|---|---|---|---|---|---|
| | Petajoules (PJ) | | Million Tons of Coal Equivalents (Mtce) | | PJ | Mtce | % | 2023 | 2024 |
| Mineral Oil | 3,876 | 3,808 | 132.3 | 129.9 | -68 | -2.3 | -1.7 | 36.4 | 36.2 |
| Natural Gas | 2,621 | 2,728 | 89.4 | 93.1 | 107 | 3.6 | 4.1 | 24.6 | 25.9 |
| Hard Coal | 860 | 772 | 29.3 | 26.3 | -89 | -3.0 | -10.3 | 8.1 | 7.3 |
| Lignite | 895 | 810 | 30.5 | 27.6 | -85 | -2.9 | -9.5 | 8.4 | 7.7 |
| Nuclear Energy | 79 | 0 | 2.7 | 0.0 | -79 | -2.7 | -100.0 | 0.7 | 0.0 |
| Renewable Energy | 2,079 | 2,110 | 70.9 | 72.0 | 31 | 1.0 | 1.5 | 19.5 | 20.0 |
| Electricity Exchange Balance | 33 | 95 | 1.1 | 3.2 | 61 | 2.1 | ... | 0.3 | 0.9 |
| Other | 208 | 207 | 7.1 | 7.1 | -1 | 0.0 | -0.7 | 2.0 | 2.0 |
| **Total** | **10,651** | **10,529** | **363.4** | **359.2** | **-123** | **-4.2** | **-1.2** | **100.0** | **100.0** |

*1) All data are preliminary; discrepancies in the totals are due to rounding off*

*Sources: Working Group on Energy Balances (AGEB); Working Group on Renewable Energies-Statistics (AGEE-Stat)*

*1) Large sections of this report (information on energy consumption according to sectors and energy carriers, unless stated otherwise) are based on the data indicated in Germany's final Energy Balance for 2023 (data status: January 31, 2025) as well as Germany's estimated Energy Balance for 2024 (data status: May 12, 2025) which actually represents an update of the early estimate of Germany's Energy Balance for 2024 (data status: February 15, 2025). A detailed description of the formal methods and estimation approaches used for early estimates of Germany's Energy Balance can be found in the studies* Pilotprojekt zur Frühschätzung der Energiebilanz 2020 und Vergleich zu späteren definierten Datenständen *(Federal Environmental Agency (UBA) Project No. 152983) and* Weiterentwicklung des Modells zur Frühschätzung der Energiebilanz *(Federal Environmental Agency (UBA) Project No. 177616). The studies were published as part of the* UBA-Texte *series and can be downloaded here: https://www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/texte_18-2023_pilotprojekt_zur_fruehschaetzung_der_energiebilanz_2020.pdf (download date: 2025-03-11; currently only available in German); https://www.umweltbundesamt.de/sites/default/files/medien/11850/publikationen/167_2024_texte_0.pdf (download date: 2025-03-11; currently only available in German).*

In 2024 as well, Germany's most important energy carrier continued to be mineral oil with a share of 36.2 %. It was followed by natural gas which increased its share to 25.9 % when compared to the previous year (2023: 24.6 %). Renewables ended up in third place with a share of 20 %; in 2023, their contribution had still been 19.5 %. Compared to 2023, the primary energy consumption of hard coal and lignite dropped by 10.3 % and 9.5 % respectively so that lignite covered approximately 7.7 % and hard coal 7.3 % of the demand for primary energy in 2024. The primary energy consumption of nuclear energy dropped to zero in 2024. (Due to the amendment of the German Atomic Energy Act (AtG), the decommissioning of the last three nuclear power plant units Isar 2, Neckarwestheim 2, and Emsland, which had initially been scheduled for December 31, 2022, was postponed by three and a half months until April 15, 2023.) As a result of this development, nuclear energy had still covered approximately 0.7 % of the demand for primary energy in 2023; as of 2024, this energy carrier (at least from domestic production) no longer contributed to covering the demand for primary energy in Germany.

In 2024, 26.3 billion kWh (95 PJ) more electricity flowed from foreign countries into Germany than flowed from Germany into neighboring countries. For the second time in a row, this made Germany a net importer of electric power for the first time again since 2002. Consequently, the balance in the electricity exchange had a consumption-enhancing effect (by plus 0.9 percentage points; previous year 2023: Plus 0.3 percentage points) on primary energy consumption in 2024. In 2022, the electricity exchange balance still had a consumption-reducing effect amounting to minus 0.8 percentage points.

*2) In this context, $CO_2$ pricing was introduced in Germany's heating and transportation sectors as of January 2021 within the scope of the Climate Protection Program 2030 (German Fuel Emissions Trading Act (BEHG – Act on National Certificates Trading for Fuel Emissions). Since then, both private and commercial consumers (non-ETS) have had to pay a $CO_2$ surcharge amounting to € 25 per ton of carbon dioxide content for such energy carriers as fuels, fuel oil, or natural gas. The $CO_2$ price within this national emissions trading system was to be gradually increased to € 55/t by 2025. The increase in the $CO_2$ price by € 5 per ton, which had originally been planned for January 1, 2023, was postponed for one year to January 1, 2024, in order not to place an additional burden on private households and the industrial economy against the backdrop of the sharp rise in energy prices (Ukraine conflict). On January 1, 2024, the $CO_2$ price per ton of carbon dioxide emitted went up once again to the amount of € 45/t as had initially been intended pursuant to the German Fuel Emissions Trading Act (BEHG – Act on National Certificates Trading for Fuel Emissions). On January 1, 2025, the price was increased to 55 euros. As of 2027, the price for $CO_2$ emissions in the transportation and building sectors is to be linked to the market mechanisms of a European emissions trading system.*

## General Conditions for the Development in Consumption in 2024

The development of primary energy consumption depends on numerous influencing factors. These factors include, in addition to changes in the general political and regulatory framework, primarily the macroeconomic and sectoral development (structural change), demographic factors, energy prices as well as temperature fluctuations.

*Temperature and Weather Influence*

The temperature conditions play, to a large extent, a vital role in non-industrial energy consumption because most of the energy consumed in these sectors is designated for the heating of privately and commercially used rooms. The temperature influence is usually measured in degree day figures; this index reflects – in simple terms – the cumulative temperature differences of those days on which the average temperature falls below a certain level (heating threshold temperature; here: 15 degrees Celsius).[3)]

In 2024, the number of degree days was once again noticeably below the level of the long-term average (arithmetic average between 1990 and 2023 taken from 16 measurement stations). The low number of days with heating threshold temperatures of less than 15° C generally points towards a higher average temperature level in the reporting year and an associated reduction of the observed demand for energy (in particular, for the heating of residential premises) as a result of milder weather.[4)]

When compared to the previous year, the number of degree days decreased as well by 58 to 2,983 because it was warmer in 2024 than it had been in 2023. In 2024, the degree day figures were about 1.9 % below those of the previous year (higher temperatures) so that the energy consumption observed in 2024, when compared to 2023, ought to have decreased also due to the influence of the weather and/or the milder temperatures.

When considering the development of the degree day figures during the individual months, it becomes apparent that the year 2024, particularly between the months of February and May, was significantly milder than the previous year. In contrast, and as measured by the degree day figures, the temperatures in January and between the months of September and December 2024 were lower than those of 2023. Consequently, the months between October and December which are relevant for the heating period were, taken as a whole, cooler in 2024 than had been the case during the respective months of the previous year (degree day figures minus 9.3 %). In total and as measured by the degree day figures, the month of January which is relevant for the heating period was also 14.6 % colder in 2024 than the same month of the previous year.

When compared to the long-term average (between 1990 and 2023), the year 2024 (excluding the summer months between June and August) was consistently warmer. In particular, the months of February, March, May, and June 2024 exhibited unusually mild temperatures (please see Figure 1).

The impact of short-term temperature effects on the development of primary energy consumption is typically eliminated in that temperatures are assumed as indicated in the long-term average[5)] and that inventory-adjusted data are taken into account for mineral oil consumption.[6)] When taking these assumptions as a basis, then primary energy consumption would not have decreased by 1.2 % as was observed in 2024; instead, it would have stagnated more or less at the previous year's level

*3) Degree day figures (in accordance with DIN VDI 3807) are specifically defined as the sum of the differences between a fixed indoor temperature (here: 20° C) and the daily average temperature of those days on which the air temperature falls below the heating threshold temperature (here: 15° C).*

*4) When compared to the long-term average (average number of degree day figures between 1990 and 2023), the year 2024 was warmer. At an annual average (as measured by the degree days), the temperatures were 15.1 % higher than the values of the long-term average. If one were to shift one's considerations solely towards this long-term perspective, then primary energy consumption in 2024 would have been noticeably above the observed level provided that the weather conditions during this year had equaled those of the long-term average.*

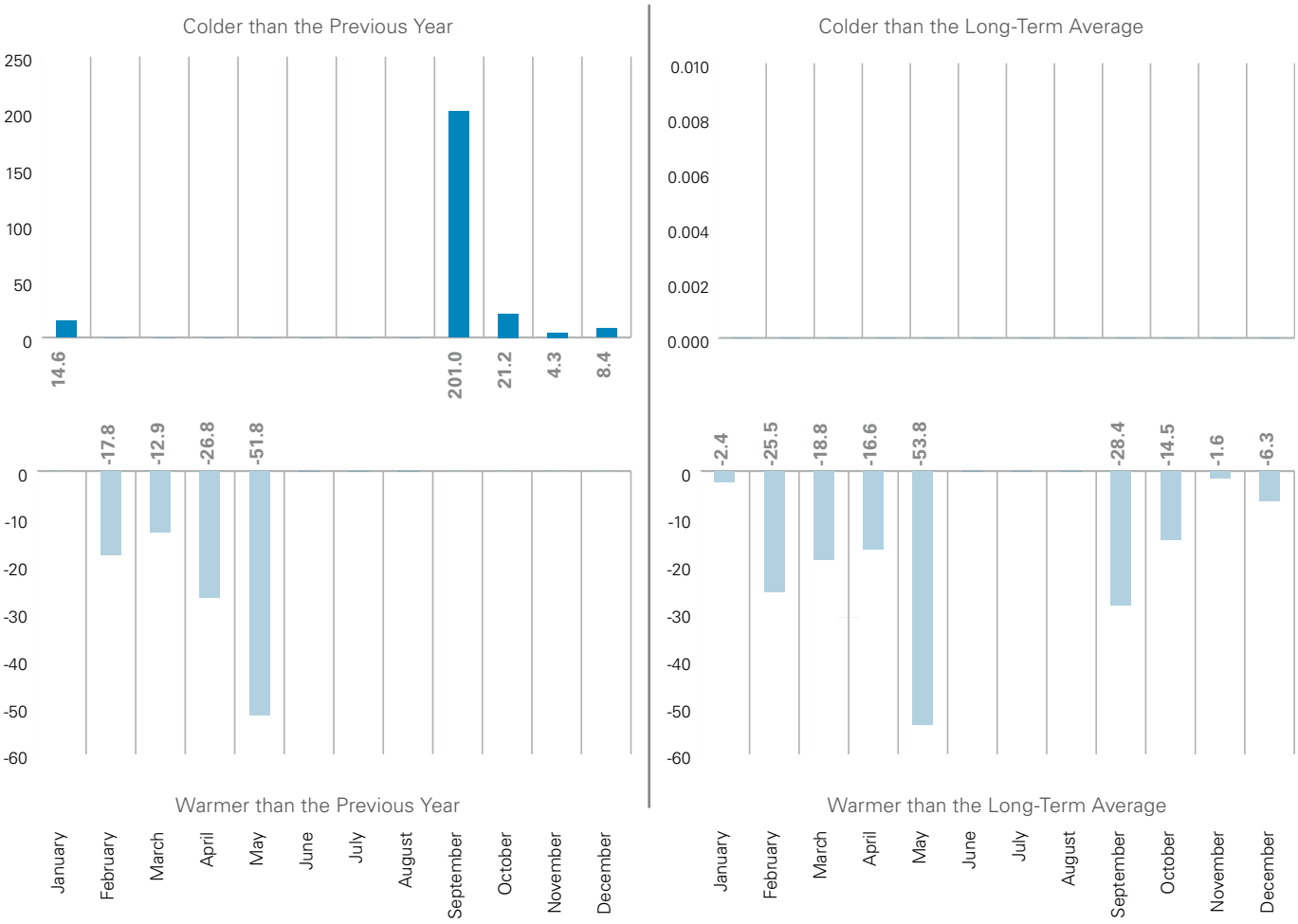
*5) For assessing the long-term developments of energy consumption (as of 1990), the temperature adjustments in this report are generally conducted by taking the long-term average (between 1990 and 2023) into account (please see Table 15, Diagrams 15 and 16). For short-term comparisons, the weather conditions prevailing during any other comparative period (for example, the previous year) could also be considered as an alternative. It is obvious that both the level of the temperature-adjusted absolute energy consumption and the rate of change compared to the previous year depend on the reference period chosen for the respective adjustment procedure.*

Figure 1

AGEB
AG Energiebilanzen e.V.

## Monthly Degree Day Figures in Germany (16 Measurement Stations)

Changes in 2024 compared to the previous year and to the long-term average (1990-2023) in %
Due to their limited informative value, the months of June and August are not included.




*Source: Germany's National Meteorological Service (DWD)*

(rate of change in the weather and inventory adjusted primary energy consumption in 2023/2024: -0.1 %). Depending on their specific use for space heating purposes, the adjustment effect has a different impact on the individual energy carriers (please see Figure 2).

When it comes to the influence of the weather, it is generally accepted that temperature-adjusted changes in energy consumption in comparably warmer years are stronger than changes in the original values; accordingly, in colder years the increases in temperature-adjusted values are generally lower than those in the original values. This becomes also apparent from the different spreads of the energy carriers depicted in Figure 2.

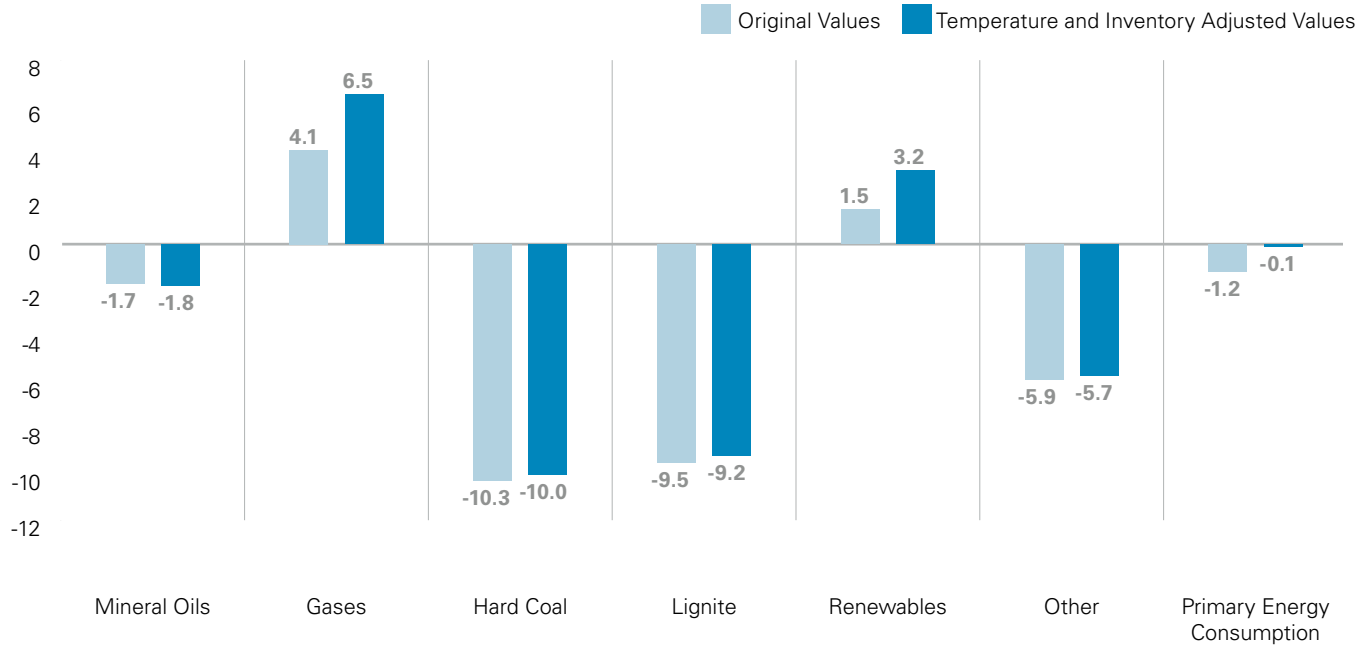
6) *The information on mineral oil consumption provided in the Energy Balance (particularly on light fuel oil) includes, in part, only sales figures. Hence, the actual consumption of this energy carrier may deviate from the indicated sales volumes by the respective changes in stockpiling. Yet official statistics actually record these inventory changes only for the energy sector and the manufacturing industry which means that the requisite figures can only be incorporated into the consumption calculations of these two sectors. No original statistical data are available on the changes in fuel oil stocks for private households and for the trade, commerce, and service sector. In order to close the described gap, the Arbeitsgemeinschaft Energiebilanzen (AG Energiebilanzen) – Working Group on Energy Balances (Energy Balances Group) has been using for quite some time now an econometrically based method which is designed to empirically determine the inventory changes for these sectors, and which permits complete and comprehensive consumption calculations also for mineral oils. For more details on this procedure, please see* Umsetzung eines Verfahrens zur regelmäßigen und aktuellen Ermittlung des Energieverbrauchs in nicht von der amtlichen Statistik erfassten Bereichen *(2016), a survey conducted by the AG Energiebilanzen on behalf of the German Federal Ministry for Economic Affairs and Energy (BMWi), pp. 82ff. (Internet: https://www.bmwi.de/Redaktion/DE/Downloads/Studien/umsetzung-verfahren-ermittlung-energieverbrauch-nicht-amtliche-statistik-langfassung.pdf?__blob=publicationFile&v=7 (download date: 2023-02-21; currently only available in German)).*

Figure 2

AGEB
AG Energiebilanzen e.V.

**Primary Energy Consumption in Germany According to Energy Sources**

Changes between 2024 and 2023 in %




*Sources: Working Group on Energy Balances (AGEB); Germany's National Meteorological Service (DWD)*

When it comes to mineral oil, the (stock level adjusted) trend was additionally influenced by the fact that in light of the energy prices which dropped again when compared to 2023, primarily private (but also commercial) consumers stocked up on fuel oil and continued to refill their tanks in 2024.

Considering mineral oils as a whole, the opposing effects (stockpiling reduces the actual consumption of fuel oils whereas excluding the influence of the weather increased it in 2024) result in the fact that the primary energy consumption adjusted by inventory and temperature effects (as well as the observed mineral oil consumption) declined by about 1.8 %. Consequently, the inventory effects compensated and/or balanced almost completely the impact of the weather adjustment, which increases consumption when taken in isolation, on the observed development of consumption in 2024 if and when the weather adjustment, as done here, is carried out on the basis of the long-term average of the degree day figures between 1990 and 2023.

When it comes to gases, however, it is solely the weather effect which plays a role within the scope of the adjustment. Against this backdrop and after having excluded the temperature influence, gas consumption increased somewhat stronger than it had initially been presumed by the observed trend (namely, by about 6.5 % instead of 4.1 % as is presumed by the original values). When it comes to coals and renewables, temperature effects only play a marginal role because these energy carriers are primarily used for the generation of electric power and/or the production of iron and steel.

*Macroeconomic and Sectoral Factors*

An export-oriented economy which also imports a substantial share of its demand for energy carriers and raw materials as is characteristic for Germany depends to a large extent on global economic trends. According to estimates of the International Monetary Fund (IMF), the global economy ought to have increased by 3.2 % in 2024.[7)]

*7) Please see International Monetary Fund (2025), World Economic Outlook Update, January 2025.*

For comparison: In 2023, the global economy had exhibited a plus of 3.3 %. For the eurozone, the IMF projections anticipate a moderate increase in growth to 0.8 % in 2024 (in 2023, it had still been 0.4 %).

The German economy was not able to benefit from the outlined moderate development of the global growth perspectives.

The price-adjusted gross domestic product (GDP) in Germany shrank by about 0.2 % in 2024; it, thus, decreased for the second year in a row (2023: -0.3 %). Both economic and structural burdens obstructed and impeded an improved macroeconomic development in 2024.

Compared to the previous year, the price-adjusted consumption expenditure increased slightly; namely, by 1.0 % (2023: -0.3 %), whereby only weak impulses[8] came from private consumption expenditure (2024: +0.3 %) while, in contrast, the growth impulses from public consumption expenditure were significantly stronger (2024: +2.6 %). Compared to the previous year, gross fixed capital formation[9] went down by 2.8 % in 2024 (after it had already decreased by 1.2 % in the previous year). The negative development of gross fixed capital formation was primarily due to continuously dwindling equipment investments (machinery, equipment, and vehicles) which shrank by 5.5 % when compared to the previous year whereas building investments (residential construction and non-residential construction and/or building construction and civil engineering projects), adjusted by price effects, decreased by 3.5 % in 2024 when compared to the previous year.

All told, the total domestic utilization increased by 0.2 % in 2024. For comparison: In the previous year (2022/2023), a negative contribution to growth amounting to nearly -0.4 % had still emanated from the total domestic utilization.

With a minus of 0.8 %, exports of goods and services also declined in 2024 after they had already shrunk in the previous year (2023: -0.3 %). At the same time, the value of price-adjusted imports went up by 0.2 % in 2024 (previous year: -0.6 %) so that all told, a negative growth contribution (-0.4 %) came from the foreign trade balance (net visible and invisible exports). The German export surplus fell to the lowest (price-adjusted) value since 2009 in 2024. Compared to the previous year, it decreased by 8.1 % to about 161 billion euros (previous year 2023: 175 billion euros).[10]

In line with the general macroeconomic conditions, the economic development varied considerably in the individual economic branches. While some sectors, such as vehicle construction, were able to benefit from the increasing equipment investments, the economic performance in such other branches as, for example, the construction industry continued to decrease as a result of material shortages and supply bottlenecks, the lack of skilled professionals as well as high construction costs (increasing interest rates and inflation).

In the producing industry as well, the diverging trends of the individual macroeconomic aggregates also contributed to the fact that the sectors developed very differently in 2024.

The production trend of those economic branches which either directly sell a significant proportion of their production abroad or act as prepaid suppliers for export-dependent sectors was decelerated by the slump in exports. Economic branches which depend on the overall situation in the construction sector recorded setbacks in growth and/or reduced their production because price-adjusted construction investments (residential and non-residential buildings) continued to decrease in 2024 when compared to the previous year 2023. Energy-intensive sectors saw themselves confronted with a reduction of their international competitiveness due to the still relatively high energy price level in Germany and the resultant production cutbacks.

*8) Despite increasing incomes, private households held back on their purchases/consumption expenditures in 2024, which is presumably also due to increased economic uncertainties.*

*9) Investments into equipment, mechanical plants, and buildings (residential and non-residential buildings, including building construction and civil engineering) as well as changes in stocks.*

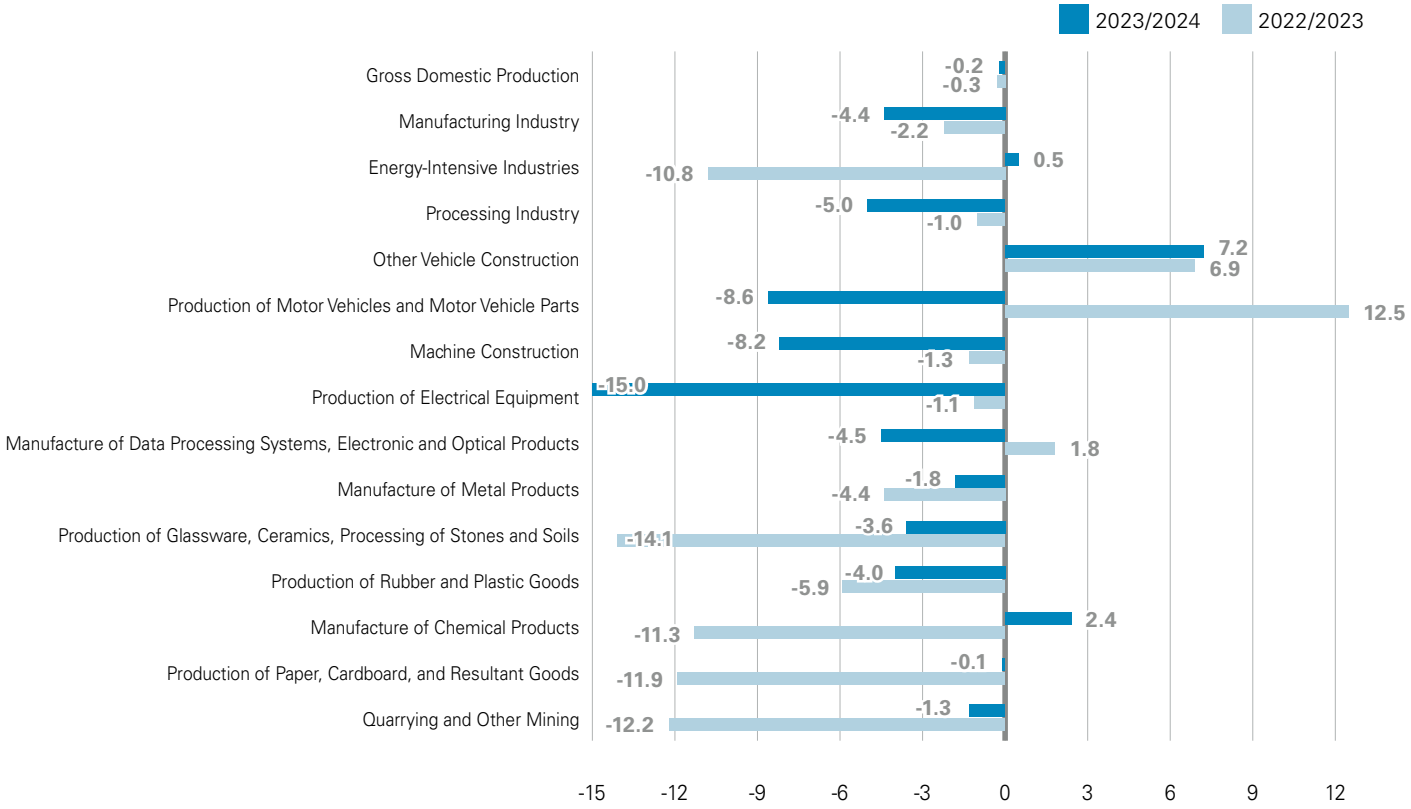
*10) Destatis, National Accounts 2024. Price-adjusted volume indications and contributions to growth; price-adjusted, chain-linked volume indications (reference year 2020).*

Figure 3

AGEB
AG Energiebilanzen e.V.

**Production Index in Germany's Manufacturing Industry between 2023 and 2024**

Changes compared to the previous year in %




*Source: Federal Statistical Office (Destatis)*

All told, the output in the producing industry decreased by about 4.4 % in 2024 (2023: -2.2 %). In the manufacturing industry, production (also measured by the production index) shrank by 5 % in 2024 (after it had already decreased by 1 % in the year before) because the international competitiveness of many economic branches was reduced even further and/or continued to remain under pressure due to persistently high energy prices. Energy-intensive economic branches were particularly affected by the increasing energy prices; even though their production as a whole increased only slightly by approximately 0.5 % in 2024 when compared to 2023, it continued to hover at a very low level since it had already shrunk by 10.8 % in 2023/2022.

Against this backdrop, Figure 3 provides an overview of the annual rates of change in the production indices for eleven key economic branches of the manufacturing industry (aggregated at the two-digit level of the economic branch classification WZ) between 2023 and 2024:

- In 2024, only two sectors of the eleven economic branches were able to achieve increases in production when compared to the previous year. These branches include "other vehicle construction" (+7.2 %) and "manufacture of chemical products" (+2.4 %) which, however, had been forced to accept production losses amounting to 11.3 % in the preceding year.

- All other sectors, in particular the economic branches of the capital goods manufacturing industry such as, for example, "production of electrical equipment" (-15 %), "production of motor vehicles and motor vehicle parts" (-8.6 %),[11] or

*11) All told, about 2.8 million passenger cars were newly registered in Germany in 2024, which was 1 % less than in the previous year (all told, about 4.1 million passenger cars rolled off the assembly lines in 2024; approximately as many as in the year before). According to the different types of propulsion systems, the registration of new passenger cars increased by 1.4 % for vehicles with gasoline engines and by 12.7 % for vehicles with hybrid drives whereas the registration of new passenger cars with battery-powered electric drives (BEV) declined by more than 27 % when compared to the previous year. The registration figures (BEV) for 2024 reflect the abrupt discontinuation of the environmental bonus on December 17, 2023, which had resulted in an anticipatory effect for the purchase of new e-vehicles in 2023. The number of newly registered passenger cars with diesel engines also decreased in 2024; namely, by almost 0.7 % when compared to the previous year.*

"machine construction" (-8.2 %), recorded declines in production which were significantly above average when compared to the manufacturing industry after their production output (except for "production of motor vehicles and motor vehicle parts") had shrunk noticeably already in the previous year.

- With the exception of "manufacture of chemical products," the energy-intensive and/or electricity-intensive economic branches did not emanate any positive growth impulses in 2024. Production in the sector "production of glassware, ceramics, processing of stones and soils" shrank by 3.6 %, "manufacture of metal products" by 1.8 %, and "production of paper, cardboard, and resultant goods" by 0.1 % after these three economic branches had already recorded major production slumps in the past year.

As a result of the described decline in production in the manufacturing industry as a whole, a consumption-reducing impulse can generally be expected once again for the use of energy in the reporting year 2024. The described effect tends to be strengthened by the disproportionally high production decrease in all energy-intensive sectors of the manufacturing industry.

It should be remembered at this point that the persistently high energy prices in all economic branches create additional incentives for the utilization of efficiency potentials that have not been used so far. High energy costs in combination with the expectation that a rapid and/or complete return to the former (low) price level is virtually impossible ought to further enhance the attractiveness and/or profitability of investments into energy-saving technologies (and methods designed to substitute energy, for example, with secondary raw materials). That is why despite the partly tense economic situation, improvements in energy productivity can be expected which go above and beyond the structural change in industry.

*Demographic Factors*

According to initial estimates of the Federal Statistical Office, about 83.6 million people (inhabitants) lived in Germany at the end of the year 2024. Thus, the population grew by almost 100,000 people when compared to the end of the year 2023. In 2024 as well, the net immigration (i. e. the difference between inward and outward migration) was the sole cause for the population growth. As had been the case in all years since German Reunification, the difference between births and deaths turned out to be negative also in 2024 because once again, more people died than were born.[12) 13)]

Under these premises (updated statistical figures are not yet available), the number of households is likely to have slightly increased further as well. According to the Federal Statistical Office, more than 41.3 million private households existed in Germany in 2023, of which about 41.1 % were single-person households (which translates into approximately 17 million).

The increase in the number of households is not only due to the demographic development, but at the same time also due to the persistent trend of living in smaller households. Currently, an average of approximately 2.05 persons lives in one household.

That is why taken in isolation, the demographic development as well as changes in the household sizes are likely to have had a continuous consumption-enhancing effect on the development of energy consumption in 2024.

*Energy Prices*

Energy prices play an important role when it comes to consumption behavior, efficiency improvements, and substitutions (between energy and capital as well as materials and/or resources). Generally speaking, the higher the prices for individual energy carriers are, the sooner efficiency improvements and substitutions occur.

*12) For more details, please see Destatis, Press Release No. 30 dated January 23, 2025:* Bevölkerung im Jahr 2024 um 100.000 Menschen gewachsen. *Internet: https://www.destatis.de/DE/Presse/Pressemitteilungen/2025/01/PD25_030_124.html (download date: 2025-03-03; currently only available in German).*

*13) Within the scope of the following analyses and calculations, not the population at the end of the year will be considered, but instead the average population based on the 2011 Census and the results of the population projections as also applied within the scope of the National Accounts. For more details on the first annual results of the domestic product calculations for 2024, please see Destatis:* Inlandsproduktberechnung 2024 – Erste Jahresergebnisse – Fachserie 18 Reihe 1.1. *Internet: https://www.destatis.de/DE/Themen/Wirtschaft/Volkswirtschaftliche-Gesamtrechnungen-Inlandsprodukt/Publikationen/Downloads-Inlandsprodukt/inlandsprodukt-erste-ergebnisse-xlsx-2180110.xlsx?__blob=publicationFile&v=18 (download date: 2025-03-03; currently only available in German).*

Table 2

AGEB
AG Energiebilanzen e.V.

## Prices of Selected Energy Sources

2023 and 2024; changes compared to the same period of the previous year in %

| | 2023 | 2024 | | | | |
|---|---|---|---|---|---|---|
| | | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter | Average |
| | **Import Prices** | | | | | |
| Mineral Oil | -19.9 | -0.2 | 9.8 | -5.5 | -12.4 | -2.4 |
| Natural Gas | -50.9 | -41.7 | -11.5 | -3.6 | -1.2 | -17.3 |
| Hard Coal | -42.0 | -25.9 | -14.1 | -6.4 | -16.2 | -16.6 |
| | **Consumer Prices** | | | | | |
| Fuel Oil, Light | -22.2 | -2.4 | 7.9 | -7.3 | -12.0 | -3.8 |
| Natural Gas | 14.7 | -7.6 | -4.9 | -2.8 | 1.8 | -3.5 |
| Electricity | 12.6 | -7.6 | -7.2 | -6.5 | -4.2 | -6.4 |

*Source: Federal Statistical Office (Destatis)*

As a direct consequence of the Russian invasion of Ukraine (February 2022), volatile energy prices with partially drastic price peaks and the associated effects on the economic development and the global demand for energy had exerted a substantial impact on the condition of the global energy markets in 2021/2022. With regard to the partially drastic increases in energy prices, a countermovement started in 2023. At an annual average, the import prices for crude oil, natural gas, and hard coal decreased significantly again. This trend continued at the level of the import prices in 2024; albeit to a lesser extent. At an annual average and compared to the previous year, the import price for crude oil declined by 2.4 % in 2024. Much more pronounced were the price reductions on the import market for hard coal (-16.6 %) and natural gas (-17.3 %) (please see Table 2).

Yet in 2024 as well, the import prices for all three energy carriers continued to be above the import price level that had been observed in the year 2021, i. e. prior to the crisis.

In addition, the development of the exchange rate slightly reinforced the decline in energy prices on the global market for consumers in Germany. At an annual average, the exchange rate of the Euro against the US Dollar (by using the indirect quotation) increased by 0.1 % in 2024. This appreciation of the Euro against the US Dollar made imports of goods and services from the Dollar zone even cheaper than before.

Notwithstanding the above, the prices for domestic consumers deviate to some extent noticeably from the development of import prices because consumer prices, in addition to governmental taxes as well as statutory charges and levies,[14] also include such components as transport and distribution costs as well as other distribution expenses. In addition, due to the contractual ties that exist and depending on the specific energy carrier and customer group considered, import prices and/or procurement costs usually have no direct impact on the final consumer prices.

In 2024, consumer prices for such grid-bound energy carriers as natural gas and electric power (across all customer groups) decreased by 3.5 % and 6.4 % respectively when compared to the previous year. Consumer prices for light fuel oil declined by 3.8 % over the same period of time (2024/2023).

The consumer price trend for specific customer groups and/or end users will be highlighted in more detail in the respective sections of this report which refer to the individual energy carriers.

*14) For example, the increase in the national $CO_2$ price by € 5/t, which had initially been scheduled for January 1, 2023, in compliance with the German Fuel Emissions Trading Act (BEHG – Act on National Certificates Trading for Fuel Emissions), was postponed by one year so that the fixed price for $CO_2$ remained unchanged at € 30/t in 2023. It was only in January 2024 when the price was increased to € 45/t, which leads to the fact that, for example, the price for natural gas on the heating market for private consumers will go up from 0.54 ct/kWh (2022 and 2023) to 0.82 ct/kWh (2024). As per January 1, 2025, the $CO_2$ price for gasoline, fuel oil, and gas increased to € 55 per ton (which equals 15.7 ct/l for gasoline, 17.6 ct/l for diesel/fuel oil, and 1 ct/kWh for natural gas).*

## Dependence on Energy Imports

When it comes to an economy's resilience to energy crises, the availability, production, and utilization of domestic energy resources play a role that should not be underestimated. Stable domestic production volumes generally reduce the dependence on imports and lower the risk of disturbances or disruptions in the overall supply as well as the commodity price risk for businesses and consumers.

On a global scale, Germany is considered to be a country with rather poor resources, renouncing the use as well as also increasingly abandoning the production of indigenous coal reserves while at the same time systematically expanding the use of renewable energy sources which are considered part of the domestic energy production. Against this backdrop, a glance at Germany's foreign trade balance for energy carriers is of particular interest. Germany is a major net importer of virtually all fossil fuels (i. e. hard coals, mineral oil, and natural gas). Nor did this situation fundamentally change in 2024; Germany's dependence on imports remained at a level that was about as high as it had been in the previous year even though the procurement and/or supply structures of energy imports (natural gas, hard coal, petroleum) changed dramatically because Germany turned away from Russia as the hitherto most important energy supplier.

In 2023, domestic primary energy consumption had been covered by imports amounting to almost 97 % for mineral oils and about 95 % for natural gas (final data of the Energy Balance for Germany). 100 % of the hard coals had come from foreign sources. In contrast, 100 % of the lignite had continued to be available from indigenous sources, and renewables had also come almost entirely from domestic production. Thus, more than 68 % of Germany's entire energy supply had been dependent upon energy imports in 2023.

According to initial preliminary calculations, the dependence of Germany's domestic energy supply from energy imports stayed barely unchanged in 2024; the contribution of domestic energy production to Germany's primary energy consumption remained stable at approximately 32 %.

What changed fundamentally were the import prices for energy carriers. All told, the further reduction of import prices when compared to 2023, together with the dwindling domestic primary energy consumption

Table 3

AGEB
AG Energiebilanzen e.V.

**Balance of Foreign Trade with Energy Carriers in Germany between 2020 and 2024**

| | 2020 | 2021 | 2022 | 2023 | 2024 | Changes in 2024 Compared to 2023 | |
|---|---|---|---|---|---|---|---|
| | | | | | | Billion Euros | % |
| Coal, Coke, and Briquettes | 2.3 | 4.7 | 12.8 | 6.9 | 4.8 | -2.2 | -31.4 |
| Petroleum, Petroleum Products, and Related Goods | 26.9 | 36.6 | 62.2 | 48.8 | 44.4 | -4.4 | -9.1 |
| Gas [1] | 12.3 | 27.8 | 60.5 | 25.7 | 19.9 | -5.8 | -22.4 |
| **Total Fossil Fuels** | **41.4** | **69.0** | **135.4** | **81.4** | **69.0** | **-12.4** | **-15.2** |
| Electric Power | -0.9 | -2.3 | -5.3 | 0.7 | 2.0 | 1.3 | 183.3 |
| **Total** | **40.6** | **66.8** | **130.1** | **82.1** | **71.1** | **-11.1** | **-13.5** |

*1) Including transit volumes, gas (SITC 34): Natural gas in gaseous or liquefied state, propane and butane liquefied*

*Source: Federal Statistical Office (Destatis)*

and the associated decline in energy imports, caused the import calculation for coal, oil, and gas to decrease from about 81.4 billion euros in 2023 by 12.4 billion euros to 69 billion euros in 2024, which equals a total reduction of more than 15.2 %. The value of (net) oil imports decreased by more than 9 %, the value of natural gas imports even by 22.4 %. The value-based import balance for coals dropped by more than 31 %.

In 2024, as already in the previous year, more electricity flowed from foreign countries into Germany than conversely from Germany into neighboring countries; this made Germany a net importer of electric power once again. The result was a (value-based) import surplus amounting to 2 billion euros for electric power in 2024. For comparison: In the previous year, Germany had imported electricity from neighboring countries which on balance amounted to 0.7 billion euros whereas in 2022, Germany had exported electricity to neighboring countries which on balance amounted to 5.3 billion euros (please see Table 3).

## Primary Energy Production in Germany

Except for renewables, domestic energy production decreased for all other energy carriers in 2024 which resulted in an overall decline of approximately 1.1 % to 3,377 PJ or 115.3 Mtce (please see Table 4).

The domestic production of fossil fuels attained a level of 1,235 PJ in 2024; compared to the year 2023 (1,330 PJ), this equals a decline of 95 PJ which translates into 7.1 %. The decline in domestic energy production was primarily due to the dwindling contribution of lignite whose production dropped by 91 PJ in 2024 when compared to 2023 (which equals a minus of 9.9 %).

Compared to 2023, the production of natural gas in 2024 declined by about 2 PJ and, thus, by nearly 1.5 %;[15] the production of petroleum is likely to have decreased by 0.6 % (0.4 PJ) over the same period of time.

A positive contribution towards domestic energy production in 2024 came from renewable energy sources; even though there were a reduced supply of wind and a smaller number of sunshine hours when compared to the previous year, they managed to expand their production due to the construction of new plants by 57 PJ which translates into 2.7 %.

The overall result shows that renewables represented the most important indigenous energy source with an approximate proportion of 63.4 % in 2024. About 24.4 % of the domestic energy production were provided by lignite in 2024; thus, lignite reduced its contribution margin by 2.4 percentage points when compared to the previous year. However, both energy carriers (renewables and lignite) continued to rank far ahead of the domestic production of natural gas and petroleum.

When taking primary energy consumption into account, the proportion of domestic production amounted to 32.1 % in 2024; it, thus, remained unchanged when compared to the previous year (please see Table 4). The constancy in this share can be attributed to the fact that primary energy consumption (according to the available estimates) decreased to virtually the same extent as domestic energy production (-1.1 %); namely, by 1.2 %.

Table 4

AGEB
AG Energiebilanzen e.V.

**Primary Energy Production in Germany in 2023 and 2024**

| | Production | | | | Changes in 2024 Compared to 2023 | | Proportions | |
|---|---|---|---|---|---|---|---|---|
| | 2023 | 2024 | 2023 | 2024 | | | 2023 | 2024 |
| | Petajoules (PJ) | | Million Tons of Coal Equivalents (Mtce) | | PJ | % | % | |
| Mineral Oil | 70 | 69 | 2.4 | 2.4 | 0 | -0.6 | 2.0 | 2.0 |
| Natural Gas | 135 | 133 | 4.6 | 4.5 | -2 | -1.5 | 4.0 | 3.9 |
| Hard Coal | 0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0.0 |
| Lignite | 916 | 826 | 31.3 | 28.2 | -91 | -9.9 | 26.8 | 24.4 |
| Renewable Energy | 2,085 | 2,142 | 71.1 | 73.1 | 57 | 2.7 | 61.1 | 63.4 |
| Other Energy Carriers | 209 | 207 | 7.1 | 7.1 | -1 | -0.7 | 6.1 | 6.1 |
| **Total** | **3,414** | **3,377** | **116.5** | **115.3** | **-37** | **-1.1** | **100.0** | **100.0** |
| For Information Purposes: Proportion of Primary Energy Consumption | | | | | | | 32.1 | 32.1 |

*Some figures are estimates; discrepancies in the totals are due to rounding off*

*Sources: Working Group on Energy Balances (AGEB); German Association of Energy and Water Industries (BDEW); The German Coal Industry's Statistical Office; Federal Office for Economic Affairs and Export Control (BAFA); en2x-Fuels & Energy Business Association; Working Group on Renewable Energy Statistics (AGEE-Stat)*

*15) Over the past few years, the domestic production of petroleum and natural gas dropped because of the increasing depletion of old fields and deposits. To that extent, this trend continued during the reporting year 2024. However, it also needs to be pointed out in this context that the production of natural gas and petroleum not only depends on geophysical-technical factors, but also on economic constraints. Increasing oil and gas prices usually generate a particular impulse to reinforce the exploration efforts. Also worth mentioning here is that in times of high energy prices, the recommissioning of old fields and the use of new production technologies can perhaps be economically viable as well.*

# Mineral Oil

According to preliminary calculations made by the AG Energiebilanzen, the primary energy consumption of mineral oil in Germany amounted to 3,808 PJ (129.9 Mtce) in 2024, which was 1.7 % below the previous year's level.

The development of domestic sales of mineral oil products recorded an increase of 0.5 % in 2024. Taken together, consumption of the most important mineral oil products developed very differently from one another (please see Table 5): Compared to the previous year, the consumption of diesel fuels

Table 5

AGEB
AG Energiebilanzen e.V.

**Consumption and Volume of Mineral Oil in Germany in 2023 and 2024**

| | 2023 | | 2024 [1] | | Change [2] |
|---|---|---|---|---|---|
| | PJ | in Million Tons | PJ | in Million Tons | in % |
| **Total Consumption** | **3,876** | **90.3** | **3,808** | **88.6** | **-1.7** |
| Self-Consumption and Losses [3] | 205 | 4.6 | 176 | 3.7 | -13.9 |
| Statistical Differences | 5 | 0.0 | 64 | 1.5 | |
| Domestic Consumption | 3,677 | 85.7 | 3,696 | 86.4 | 0.5 |
| Proportion of: Gasoline | 803 | 18.4 | 840 | 19.3 | 4.6 |
| Diesel Fuel | 1,311 | 30.7 | 1,280 | 30.1 | -2.4 |
| Aviation Fuels | 402 | 9.4 | 386 | 9.0 | -3.8 |
| Fuel Oil, Light | 527 | 12.4 | 509 | 12.0 | -3.4 |
| Fuel Oil, Heavy | 50 | 1.2 | 48 | 1.2 | -5.4 |
| Naphtha | 202 | 4.6 | 239 | 5.4 | 18.6 |
| Liquid Gas | 141 | 3.1 | 151 | 3.4 | 7.4 |
| Refinery Gas | 53 | 1.2 | 51 | 1.1 | -2.7 |
| Petroleum Coke | 16 | 0.5 | 17 | 0.5 | 4.1 |
| Other Products | 172 | 4.2 | 174 | 4.3 | 1.4 |
| **Total Volume** | | | | | |
| Domestic Production | 70 | 1.6 | 69 | 1.6 | -0.6 |
| Refinery Production | 3,777 | 88.6 | 4,163 | 97.8 | 10.2 |
| Generated from: Input of Crude Oil | 3,376 | 79.1 | 3,676 | 86.0 | 8.9 |
| Input of Products | 417 | 9.5 | 470 | 11.8 | 12.7 |
| Foreign Trade Products (Balance) | 505 | 11.4 | 209 | 4.4 | |
| Imports | 1,543 | 36.0 | 1,438 | 33.6 | -6.8 |
| Exports | 1,039 | 24.7 | 1,229 | 29.2 | 18.3 |
| Compensation [Balance (Bunker, Differences)] | -406 | -9.7 | -564 | -13.6 | |
| Refining Capacity | | 105.7 | | 105.7 | 0.0 |
| Utilization of Refining Capacity in % | | 74.8 | | 81.4 | |
| **Primary Energy Consumption of Mineral Oil** | **3,876** | **90.3** | **3,808** | **88.6** | **-1.7** |

*1) Preliminary data for 2024; some figures are estimates*
*2) Change in % based on the data in petajoules (PJ)*
*3) Energy consumption in the petroleum processing conversion sector, crude oil flare and pipeline losses, and the balance of petroleum product conversion inputs and outputs in the petroleum processing and other energy producing sectors*

*Sources: Working Group on Energy Balances (AGEB); Federal Office for Economic Affairs and Export Control (BAFA)*

Table 6

AGEB
AG Energiebilanzen e.V.

## Mineral Oil Balance[1] for Germany in 2023 and 2024

in PJ

| | | 2023 | 2024 [2] | Change |
|---|---|---|---|---|
| | | Petajoules (PJ) | | in % |
| Domestic Production | | 70 | 69 | -0.6 |
| + | Imports | 4,839 | 5,022 | 3.8 |
| **=** | **Volume** | **4,909** | **5,091** | **3.7** |
| +/– | Change in Stocks (Reduction: +, Replenishment: -) | -60 | 0 | -100.2 |
| – | Exports | 1,093 | 1,283 | 17.3 |
| **=** | **Primary Energy Consumption** | **3,876** | **3,808** | **-1.7** |
| – | Use in Power Plants [3] | 40 | 41 | 1.9 |
| – | Use in Combined Heat and Power Plants (Heat) | 9 | 7 | -14.2 |
| – | Other Conversion Input [4] | 4,086 | 4,470 | 9.4 |
| + | Conversion Output | 4,090 | 4,507 | 10.2 |
| – | Consumption during Production and Conversion as well as Non-Energetic Consumption | 828 | 902 | 9.0 |
| + | Statistical Differences / Flare Losses (Balance) | 1 | -61 | |
| **=** | **Final Energy Consumption** | **3,002** | **2,956** | **-1.5** |
| | Industry [5] | 95 | 94 | -0.8 |
| | Including | | | |
| | Basic Chemistry | 46 | 48 | 4.0 |
| | Traffic | 2,302 | 2,274 | -1.2 |
| | Households | 427 | 410 | -3.9 |
| | Trade, Commerce, and Services | 179 | 178 | -0.7 |

*1) Mineral oil = crude oil, fuels, heating oil, petroleum coke, liquefied petroleum gas, refinery gas, and other petroleum products*
*2) Preliminary data for 2024; some figures are estimates*
*3) Used for electricity generation in general utility power plants, industrial and combined heat and power plants, and grid feeders*
*4) Mineral oil processing, other energy producers and coking plants*
*5) Including the use of mineral oil products for heat generation in industrial cogeneration plants*

*Sources: Working Group on Energy Balances (AGEB); Official Mineral Oil Statistics*

decreased by 2.4 % to 1,280 PJ (30.1 million tons). Nonetheless, sales of diesel fuels continued to be significantly above the level of gasoline sales (840 PJ which translates into 19.3 million tons) whose demand increased by 4.6 % in 2024 when compared to the previous year. The consumption of aviation fuels decreased by 3.8 % during the reporting year 2024. Thus, sales in this segment amounted to about 386 PJ, which translates into 9 million tons, in 2024. All told, the demand for fuels (2024: About 2,506 PJ which equals 58 million tons), which accounted for an approximate share of 66 % in Germany's total domestic sales, was approximately 0.4 percentage points or 10 PJ lower in 2024 than it had been in 2023.

With a decrease of 3.4 %, which equals 11 PJ (0.4 million tons), sales of light fuel oil experienced a downward trend. This trend was most likely due to the milder weather (for more details, please see Section *Temperature and Weather Influence* hereinabove),

continuing savings in fuel oil due to the substitution of oil-fired heating systems, continuing efficiency improvements as well as attitude and behavior related savings on part of the consumers.

Refinery production increased by 10.2 % to a level of 97.8 million tons in 2024. Towards this end, refinery production from crude oil, which accounted for a share of 88.3 % (2024), went up by almost 9 % when compared to 2023 whereas the processing of products increased by 12.7 %. In light of the increased production, the refining capacity of 105.7 million tons, which compared to the previous year remained unchanged once again, was actually utilized at 81.4 % in 2024; in 2023, the degree of utilization had amounted to about 74.8 %.

Foreign trade in mineral oil products (without crude oil) changed significantly in 2024. On balance, imports predominated in 2024; with 1,438 PJ (33.6 million tons), they topped the exports which amounted to 1,229 PJ (29.2 million tons). Quantitative exports of mineral oil products increased by more than 18 % whereas imports decreased by 6.8 % when compared to 2023 (please see Table 5).

In 2024, the final energy sectors consumed about 2,956 PJ of mineral oil products which was approximately 1.5 % less than in the year 2023. Fuel consumption (gasoline and diesel fuels, aviation fuels as well as small amounts of liquid gas) accounts for the largest final energy sector by far. In 2024, a total of 2,390 PJ of fuels were used, for example, for the propulsion of vehicles, ships, and airplanes which was 1.3 % (31.8 PJ) less than in 2023. When interpreting the overall development in the fuel market outlined herein, it needs to be kept in mind that fuels are not used solely in the transportation sector, but also in industry, private households, and the trade, commerce, and service sector. In the transportation sector, i. e. for meeting mobility needs, about 2,274 PJ of fuels were consumed in 2024 which was 1.2 % less than in the year before. Private households consumed about 410 PJ of mineral oil products (primarily fuel oil, light, as well as small amounts of liquid gas and gasoline fuels)[16] for the heating of residential premises and the preparation of hot water in 2024. Due to the milder weather conditions, consumption/sales in this consumption segment decreased by 3.9 % when compared to the previous year. The final energy consumption of mineral oil products in the sectors trade, commerce, and services as well as industry is rather of subordinate relevance. In 2024, the trade, commerce, and service sector used about 178 PJ in the form of diesel fuel (for example, for the operation of machinery and farm tractors in the agricultural and construction sectors) as well as fuel oil and liquid gas primarily for the heating of business premises and commercial sites. Industry consumed about 94 PJ of mineral oil products (fuel oil, light and heavy, diesel fuel, refinery gas as well as other mineral oil products) in 2024. Within industry, basic chemistry is an area of high demand (please see Table 6). In the chemical industry, mineral oil products are not only used for the production of process heat, but to a considerable extent also as a raw material. If one were to attribute these quantities (2024: 681 PJ), which are recorded in Germany's Energy Balance as "non-energetic consumption," to the chemical industry, then industry's mineral oil consumption as a whole would amount to 775 PJ which would make it rank second behind consumption in the transportation sector.

Due to its limited domestic petroleum resources, Germany is primarily dependent on crude oil imports; according to data released by the Federal Statistical Office, the total import volume amounted to 78.4 million tons in 2024; this exceeded the previous year's level by 7.5 % which translates into 5.4 million tons.[17] Compared to the previous years, the procurement regions for deliveries of crude oil to Germany had already shifted significantly in 2023. The main cause of these structural shifts had been the resolutions adopted by the EU on the imposition of an embargo on oil from Russia.[18]

16) *The volumes of gasoline fuels recorded in the household sector of the Energy Balance for Germany are not used for the propulsion of passenger cars, but primarily for the operation of such engine-powered garden tools as, for example, gas-driven lawn mowers or the like.*

17) *According to the Official Mineral Oil Statistics, whose data also form the basis of Germany's Energy Balance, crude oil imports attained a level of 83.9 million tons in 2024. Thus, imports of crude oil increased by about 6.7 million tons, which translates into 8.7 %, when compared to the previous year. However, the data indicated in the Official Mineral Oil Statistics do not provide any breakdown of crude oil imports according to individual procurement regions and/or countries so that at this point (please see also Table 7), reference was made to the pertinent data published by the Federal Statistical Office.*

18) *The first step of the EU sanctions, which became effective on December 5, 2022, stipulated a stop of crude oil imports via maritime transport (oil tankers). The second step of the embargo put a ban on imports of crude oil via the Druzhba pipeline as of January 1, 2023, and the third step finally prohibited imports of diesel and other mineral products (as of February 5, 2023). At the same time, a price cap for crude oil amounting to 60 US dollars per barrel was agreed upon; this price cap is designed to force Russia into selling crude oil to clients in non-EU countries at prices that do not exceed this cap.*

Table 7

AGEB
AG Energiebilanzen e.V.

**Germany's Crude Oil Imports in 2023 and 2024 According to Countries of Origin**

| Important Supplier Countries/Production Regions | 2023 | 2024 | Changes 2023/2024 | 2023 | 2024 |
|---|---|---|---|---|---|
| | in Million Tons | | in % | Proportions in % | |
| Russia | 0.1 | 0.0 | -81.6 | 0.2 | 0.0 |
| United Kingdom | 7.9 | 8.2 | 3.6 | 10.9 | 10.5 |
| Norway | 13.5 | 15.3 | 13.1 | 18.5 | 19.5 |
| Kazakhstan | 8.5 | 10.6 | 24.2 | 11.7 | 13.5 |
| USA | 13.4 | 14.3 | 6.6 | 18.3 | 18.2 |
| Nigeria | 2.8 | 2.5 | -13.8 | 3.9 | 3.1 |
| Other Countries | 26.7 | 27.6 | 3.6 | 36.6 | 35.2 |
| **Total** | **73.0** | **78.4** | **7.5** | **100.0** | **100.0** |
| OPEC | 20.5 | 17.6 | -14.5 | 28.2 | 22.4 |
| North Sea [1] (Excld. FRG) | 21.6 | 23.8 | 10.4 | 29.6 | 30.4 |
| Former CIS | 9.8 | 12.4 | 25.7 | 13.5 | 15.8 |
| Other | 21.0 | 24.6 | 17.5 | 28.8 | 31.4 |
| **Total** | **73.0** | **78.4** | **7.5** | **100.0** | **100.0** |

*1) Including other EU countries*

*Discrepancies in the totals are due to rounding off. Data for 2023 preliminary, partially estimated.*

*Source: Federal Statistical Office (Destatis)*

Against this backdrop, imports of crude oil from the states of the Russian Federation dwindled fundamentally in the expanded German import market. Already in 2023, crude oil imports from Russia had gone down by almost 100 % when compared to the previous year (which, however, still equaled a supply share of 0.1 % in the crude oil import market). Then in 2024, Russian crude oil deliveries to Germany virtually came to a complete standstill. For comparison: In 2021, Germany had still imported 27.7 million tons, which translates into a share of 34.4 %, of its total import volume from Russian deposits. The decline in Russian oil supplies was compensated by increased procurement volumes from other supplier countries; above all, the USA, Norway, and other countries.[19)]

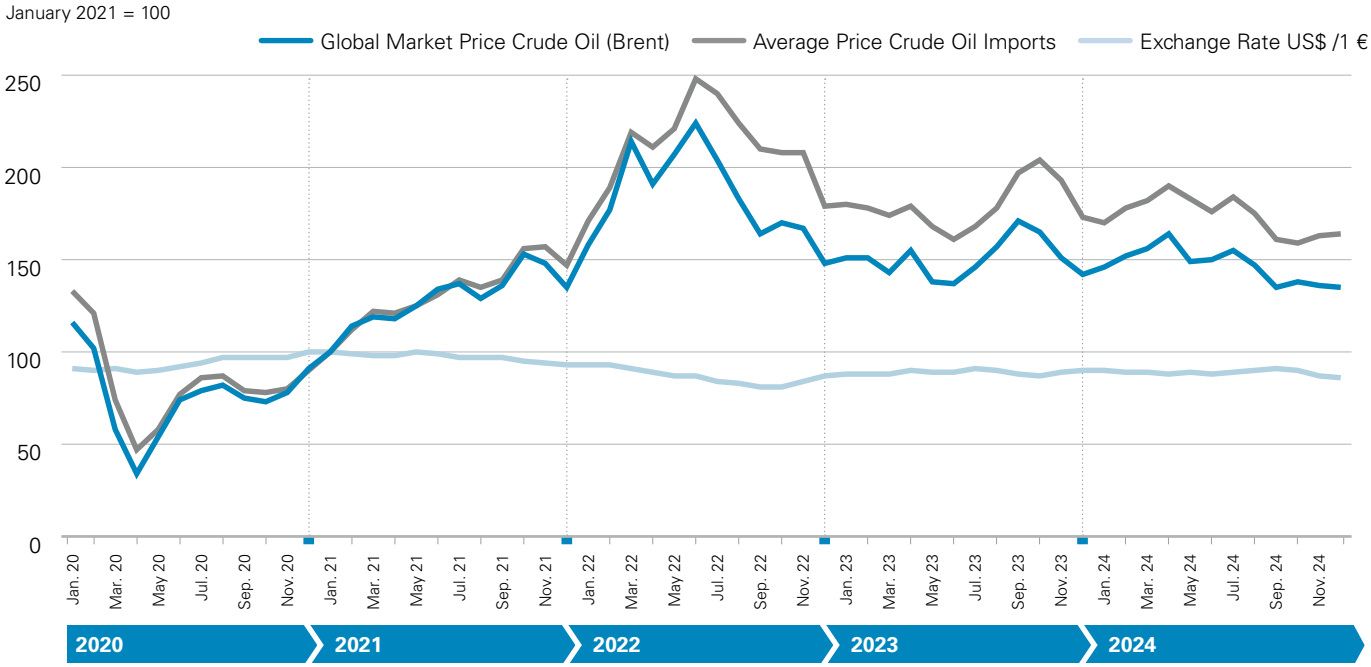
In 2024, the most important supplier countries for crude oil were (with regard to their market shares) Norway and the USA whose supply shares in total imports amounted to 19.5 % and 18.2 % respectively. Kazakhstan and the United Kingdom followed in third and fourth place with supply shares of 13.5 % and 10.5 % respectively whereby the United Kingdom increased its delivery volume by 3.6 % in 2024 when compared to the previous year despite the fact that the market share of deliveries from the United Kingdom actually decreased by 0.4 % due to the faster growing import market (please see Table 7).

Split into individual oil producing regions, the proportion of crude oil imports from the Russian Federation decreased whereas the countries of the former Soviet Union (CIS states) actually increased their share from 13.5 % (2023) to 15.8 % in 2024. In contrast, the OPEC states (2024: 22.4 %) recorded noticeable declines in their shares in the growing market. When compared to 2023, deliveries of crude oil from OPEC states decreased by 2.9 million tons which equals a minus of almost 14.5 %. The countries bordering the North Sea were able to increase their

*19) For more details on this topic, please see infoplus 02/2024:* Mineralölversorgung klappt auch ohne Russland. *Internet: https://ag-energiebilanzen.de/wp-content/uploads/2024/07/AGEB_InfoAusgabe-2-2024.pdf (download date: 2025-04-07; currently only available in German).*

Figure 4

**Global Market Prices for Crude Oil (Brent) [1], Border-Crossing Prices for German Crude Oil Imports [2], and Exchange Rates between 2020 and 2024**




*1) Original values in US dollars per barrel*
*2) Original values in euros per ton*

*Sources: Federal Ministry for Economic Affairs and Energy (BMWi); Deutsche Bundesbank (German Central Bank); en2x-Fuels & Energy Business Association*

supply share only slightly by 0.8 % and, thus, attained a market share of 30.4 % in 2024 (2023: 29.6 %).

In 2024 as well, international oil prices and the Euro/US Dollar exchange rate, which determine the price for German crude oil imports, exhibited a very volatile development; in other words, they experienced considerable short-term fluctuations (please see Figure 4).

While the prices for crude oil grade Brent UK, which is important for Europe, with an annual average of about 82 US dollars per barrel (US-$/bbl; 1 barrel = 159 liters) in 2023 had already been approximately 18 US dollars below the previous year's values, they continued to decrease to a level of 80 US dollars in 2024. Despite the above-mentioned decline, the price for Brent still exceeded the price level that had been attained in 2021 by approximately 10 US dollars which translates into 13.9 % above that level.

Over the course of the year 2024, the decline in prices outlined above showed a much more pronounced development in individual months. Based on its value in January (with about US-$ 80/bbl), the crude oil price (Brent UK) initially increased to an annual high of nearly US-$ 90/bbl until April 2024. Thereafter, a continuous decline (with fluctuations) in the crude oil price could be observed so that the price level finally reached an annual low of just below US-$ 74/bbl in December 2024.

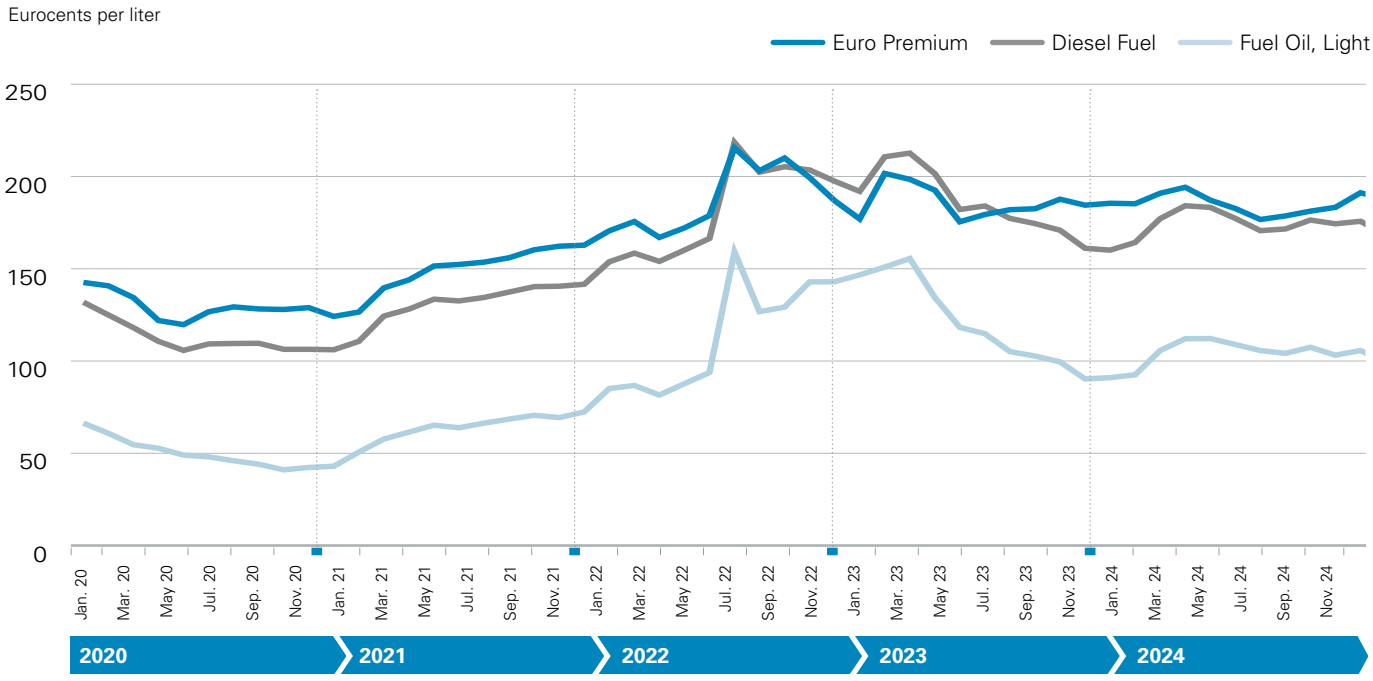
Compared to the pandemic-related low in May 2020 (about US-$ 18/bbl), the oil price based on dollars was four to five times higher during all months of the current reporting year.

German crude oil import prices (average price of crude oil imports, in €/t) developed to a large extent parallel to the global market prices. Differences are essentially influenced by fluctuations in the exchange rate of the Euro (to the US Dollar). Since January 2024, the exchange rate decreased from US-$ 1.09/€ (indirect quotation) to about US-$ 1.08/€ in June/July 2024. Subsequently, an appreciation to approximately US-$ 1.11/€ could be observed until September 2024

Figure 5

AGEB
AG Energiebilanzen e.V.

**Prices for Fuels and Light Fuel Oil in Germany between 2020 and 2024**




*Sources: en2x-Fuels & Energy Business Association; Federal Statistical Office (Destatis)*

before the exchange rate decreased again to US-$ 1.04/€ at the end of the year (December 2024).

A direct monthly comparison with the previous year shows the following, partially opposing trends: From January to March 2024, the exchange rate (indirect quotation) ranged somewhere between slightly more than 0.8 % and nearly 1.6 % above the level of the respective months of the previous year (appreciation). Between April and July 2024, the exchange rate ranged somewhere between 0.5 % and 2.2 % below the level of the respective months of the previous year (depreciation). The months of August, September, and October 2024, in turn, were characterized by an appreciation of the Euro to the US Dollar (ranging somewhere between 0.9 % and almost 4 %). Until the end of the year (December 2024), the Euro depreciated noticeably once again; with US-$ 1.05/€, it was quoted almost 3.9 % below the level of the respective month of the previous year.

At an annual average and when compared to the year 2023, the exchange rate in 2024 increased only by almost 0.1 % to more than US-$ 1.08/€ (appreciation of the Euro against the US Dollar).

Consequently, the (moderate) appreciation of the Euro at an annual average as described above tended to have additionally supported the decline in crude oil prices on the global market for German consumers over the course of the year; it was only during the months between April and July as well as between November and December 2024 that the depreciation resulted in a slight weakening and/or compensation of the price drop for consumers in Germany.

All told, German crude oil import prices (on an annual basis and calculated in Euro/bbl) decreased to a somewhat greater extent (-2.8 %) than the global market prices (in US-$/bbl) for crude oil (-2.7 %) between 2023 and 2024 whereby – as already outlined hereinabove – opposing trends could be observed in individual months of the year.

Converted into euros and tons, German crude oil import prices went down from an annual average of € 586/t in 2023 to about € 570/t in 2024. For comparison: In 2021, the import price for crude oil had amounted to € 436/t (and in the crisis year 2022 to € 690/t).

Prices for oil products in Germany followed primarily the changes in crude oil costs and in international product quotations; albeit at different rates (please see Figure 5).

Compared to the previous year, prices for fuels decreased. On an annual average in 2024, diesel fuel was approximately 7.2 cents cheaper than in the year before (-4.2 %) whereas prices for gasoline fuels at gas stations decreased by 5.5 ct/liter (-3 %) over the same period of time. At the fuel pumps, car drivers (as well as commercial freight transport) had to pay about € 1.79/liter for gasoline fuels (Euro-Super premium) and about € 1.66/liter for diesel fuels in 2024. From an overall perspective, fuel prices in the reporting year were, thus, significantly below the peak values that had been attained in 2022; nonetheless, the year 2024 still remained the third most expensive refueling year so far behind 2023 (which had been the second most expensive refueling year).

At an annual average, consumer prices for light fuel oil dropped by about 4 % in 2024. Thus, a liter of fuel oil cost in total and on average € 0.99/liter in the year 2024.

Considering the entire year under review, the prices for the mineral oil products mentioned above experienced a volatile trend; albeit the overall fluctuations in prices were less pronounced over the course of the reporting year 2024 than during the crisis year 2022.[20)]

In 2024, the price for premium gasoline at the fuel pumps fluctuated between a minimum of € 1.71/liter (September 2024) and a maximum of € 1.91/liter (April 2024); thus, ranging between -4.9 % and +6.6 % around the average value. When it comes to the price for diesel fuel, the spread around the average value proved to be slightly more pronounced with -6.2 % and +6.0 %, whereby the low was reached at a price level of € 1.56/liter in September 2024.

Over the course of the year 2024, the consumer price for light fuel oil followed more or less the curve of the price trend that was observed for diesel fuel; albeit at a lower level. With about 92 ct/liter, one liter of fuel oil (light) was cheapest in September 2024, and with € 1.07/liter most expensive in February (2024); this means that the prices fluctuated between -7.4 % and +8.1 % (related to the average value). For customers buying fuel oil, this development produced, in the worst case, price differences amounting to about 15 ct/liter, depending on whether the order was placed during the heating period (February 2024) or in September.

*20) When interpreting the development of fuel prices in 2022, it needs to be considered that a temporary reduction of the energy tax on gasoline and diesel fuel ("fuel price brake," "fuel discount") was in effect between June 1, 2022, and August 31, 2022.*

## Natural Gas

According to preliminary data, natural gas consumption in Germany increased by 4.1 % to about 758 billion kWh ($H_i$), which translates into 2,728 PJ ($H_i$), in 2024.[21] In light of the overall shrinking demand for energy, the increase in natural gas consumption caused the proportion of natural gas of the total primary energy consumption to increase as well. When compared to 2023, the latter increased by 1.3 percentage points to 25.9 % in 2024. In 2024 as well, the development of natural gas consumption described herein continued to be essentially characterized by a price level that was still comparatively high, continuous savings measures on part of the consumers and, finally, the economic slump.

Domestic production of natural gas continued to decline in 2024; with an estimated volume of approximately 37 billion kWh, it will, thus, fall 1.5 % below the previous year's level (2023: 37.6 billion kWh). In 2024, domestic production of natural gas covered about 4.9 % of Germany's natural gas consumption. About 95.6 % of the natural gas used or, on balance, stored in Germany were imported.

Since the reporting year 2018, the data reflecting the development of natural gas imports and exports have also included all transit volumes which pass through the Federal Republic of Germany's territory to its neighboring countries. That is why only the foreign trade balance (net imports) will be examined closer here. In 2024, the import volume of natural gas remaining in Germany (imports minus exports) decreased slightly to 692.5 billion kWh ($H_i$) after (on balance) 695.2 billion kWh ($H_i$) of natural gas had still been imported in the previous year. Thus, the net import volume decreased by about 0.4 % when compared to the previous year. Total imports (including transit volumes) dropped by almost 11 % to 795.6 billion kWh in 2024. Exports (also including transit volumes) declined as well; namely, by 47.7 % to 103.1 billion kWh.

With regard to the origin of the natural gas consumed in Germany, the following picture becomes apparent: With a stable market share of more than 45 %, Norway was by far the largest supplier of natural gas to Germany. Across the Dutch border as well, Germany continued to source considerable volumes of natural gas in 2024 (which, related to the total consumption, ranged between 4 % and 5 % in 2024); however, a substantial portion thereof consisted of transit volumes whose regional origin cannot be determined exactly. After the shutdown of the gas field in Groningen, the natural gas volumes which flowed directly from the Netherlands to Germany were reduced significantly. In 2024, more than 37 % of the natural gas consumed in Germany came from other non-identifiable countries, and 5 % (with a continuously declining tendency over the course of time) from domestic natural gas production (please see Figure 6).

In addition, the gas infrastructure was expanded by terminals built as entry points for liquefied natural gas (LNG). This permitted direct gas supplies to be procured from countries which are not connected to the German long-distance pipeline grid, so it was now possible to diversify gas supplies even further. The associated reduction of the dependence on specific supplier countries enhances the security and reliability of a safe and ample energy supply. In December 2024, three terminals were in regular operation in Wilhelmshaven, Brunsbüttel, and Mukran. Due to the urgency of the matter, all three terminals were created with the help of floating storage and regasification units (FSRU).[22] Such FSRU are converted LNG tankships which are capable of converting LNG and feeding it into the German long-distance grid.

The terminal with the highest utilization capacity and/or usage rate was the one in Wilhelmshaven through which 58 % of the total amount of 65 billion kWh ($H_i$) that had been received in 2024 were fed into the long-distance grid, followed by Brunsbüttel with almost one third of the supplies.

*21) The AG Energiebilanzen calculates natural gas consumption both in the Energy Balance for Germany and in all other publications based thereon according to the heating value (previously referred to as lower calorific value, Hi, i = inferior, Latin for "below"). The calorific value (previously referred to as upper calorific value, $H_s$, s = superior, Latin for "higher") of natural gas is approximately 10 % above the heating value.*

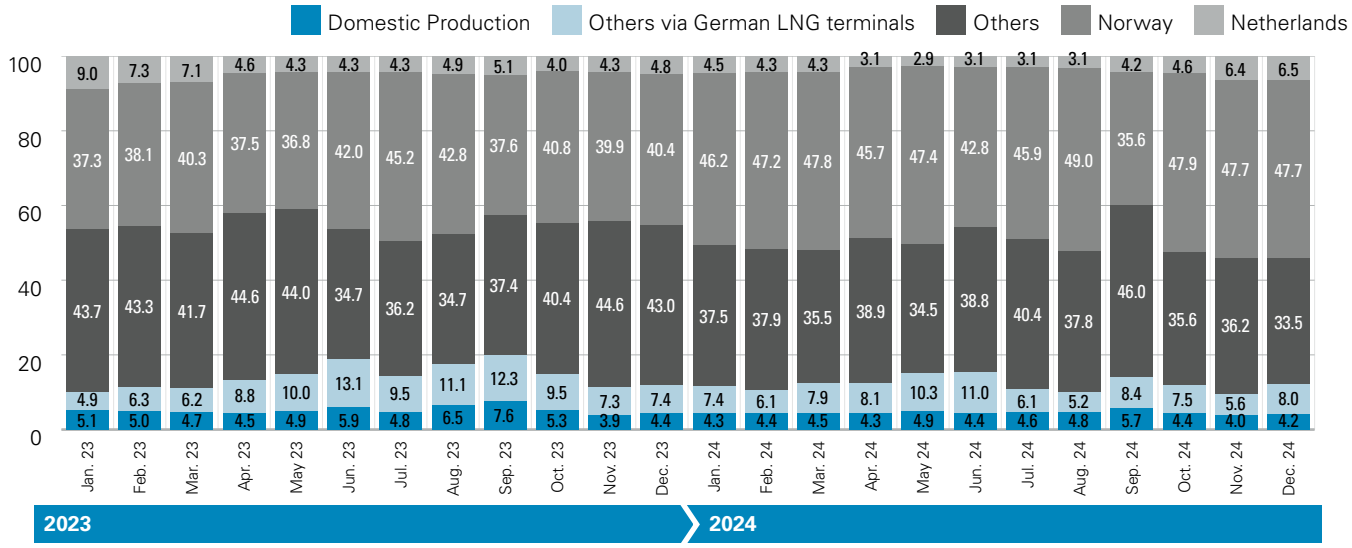
*22) LNG storage and regasification vessels are referred to as "floating storage and regasification units," abbreviated FSRU.*

Figure 6

AGEB
AG Energiebilanzen e.V.

## Origin of the Gas Consumed in Germany

January 2023 to December 2024, shares in total consumption in %




*Source: BDEW, ENTSOG, FNB, own calculations*

With a proportion of 91 % of the total LNG quantities delivered, the USA dominated the four LNG supplier countries in 2024. The three other regions of origin Norway, Angola, and Egypt exhibited supply shares between 2 % and 4 %. Gas Infrastructure Europe (GIE) informed that in addition to the already existing LNG terminals, more terminals are scheduled and/or being planned. For example, the existing terminal in Wilhelmshaven will be supplemented by another terminal (Wilhelmshaven 2), also in the form of an FSRU. Furthermore, the construction of additional onshore LNG terminals is being planned both in Wilhelmshaven and Stade.[23)]

According to preliminary data, only 37 billion kWh ($H_i$) of natural gas were produced on Germany's national territory in 2024. Compared to the previous year, this equals a decline in domestic production of nearly 1.5 %. Domestic production of natural gas has been continuously decreasing since the early 2000s. The gas produced in Germany is not exported.

At the beginning of 2024, the underground storage facilities connected to Germany's natural gas grid started with a filling level of 91 %. With the statutory requirement of filling levels for gas storage facilities, operators of such storage facilities in Germany are obligated to always safeguard and guarantee average minimum filling levels at specific points in time. With a filling level of 74 % on February 1, the targeted minimum filling level of 40 % was easily surpassed in the same way as the target levels were significantly exceeded as per October 1 and November 1. However, the mild weather during the months between February and April had a minor impact on German gas storage facilities which, in turn, facilitated their refill over the summer months. According to Gas Infrastructure Europe, the filling level of the German storage facilities amounted to 79.8 % by the end of the year (December 31, 2024).[24)]

On balance, about 28.1 billion kWh ($H_i$) of natural gas were withdrawn from storage facilities in 2024.

*23) Due to disputes regarding the completion of the requisite infrastructure on shore, the floating LNG terminal in Stade is currently neither technically completed nor ready for operation. At the moment, it is not possible to assess whether or when a delayed commissioning of the terminal will occur. For more details, please see NDR Internet: https://www.ndr.de/nachrichten/niedersachsen/lueneburg_heide_unterelbe/LNG-Terminal-in-Stade-Lies-dringt-auf-schnelle-Inbetriebnahme,stade1364.html (download date: 2025-06-02; currently only available in German).*

*24) Depending on the individual data source (Gas Storage Europe, ENSOG, or Destatis), the stock levels and/or the storage balances calculated therefrom deviate from one another. These differences have multiple reasons; they range from different data statuses and level indicators all the way to spatial delineations. For the early estimate of Germany's Energy Balance for 2024 and the natural gas balance derived therefrom (please see Table 8), reference was made to the respective data published by the Federal Statistical Office.*

Table 8

AGEB
AG Energiebilanzen e.V.

## Natural Gas Production and Use for Germany in 2023 and 2024

| | | 2023 | | 2024 [1] | | Change |
|---|---|---|---|---|---|---|
| | | PJ | Billion kWh$_i$ | PJ | Billion kWh$_i$ | in % |
| Domestic Production | | 135 | 37.6 | 133 | 37.0 | -1.5 |
| + | Imports | 3,213 | 892.5 | 2,864 | 795.6 | -10.9 |
| **=** | **Volume** | **3,348** | **930.0** | **2,997** | **832.6** | **-10.5** |
| – | Exports | 710 | 197.3 | 371 | 103.1 | -47.7 |
| **=** | **Primary Energy Consumption** | **2,621** | **728.0** | **2,728** | **757.7** | **4.1** |
| – | Use in Power Plants [2] | 481 | 163.5 | 505 | 171.8 | 4.9 |
| | Including | | | | | |
| | Power Plants Supplying the General Public | 287 | 79.6 | 310 | 86.1 | 8.1 |
| | Industrial Power Plants | 143 | 39.8 | 144 | 40.0 | 0.5 |
| – | Use in Combined Heat and Power Plants (Heat) [3] | 181 | 50.3 | 185 | 51.4 | 2.2 |
| – | Consumption of the Conversion Areas [4] | 73 | 20.4 | 68 | 19.0 | -6.7 |
| – | Non-Energetic Consumption | 77 | 21.3 | 79 | 22.0 | 3.3 |
| + | Statistical Differences / Flare and Line Losses (Balance) | 14 | 3.9 | -53 | -14.7 | - |
| **=** | **Final Energy Consumption** | **1,822** | **476.3** | **1,837** | **478.8** | **0.8** |
| | Industry [5] | 667 | 185.4 | 694 | 192.7 | 3.9 |
| | Including | | | | | |
| | Basic Chemistry | 154 | 42.8 | 192 | 53.3 | 24.6 |
| | Nutrition and Tobacco | 110 | 30.4 | 110 | 30.6 | 0.6 |
| | Traffic | 7 | 1.9 | 2 | 0.6 | -70.6 |
| | Households | 813 | 225.9 | 809 | 224.6 | -0.5 |
| | Trade, Commerce, and Services | 335 | 93.0 | 333 | 92.4 | -0.6 |
| For Information Purposes | | | | | | |
| **Structure of Natural Gas Production by Origin** | | | | | | |
| Domestic Funding [6] | | 5.2 | | 4.9 | | |
| Import Quota [7] | | 96.0 | | 95.6 | | |

*1) Preliminary data for 2024; some figures are estimates*
*2) Natural gas use for electricity generation (total), including feed-in from small CHP plants under 1 MW*
*3) For combined and uncoupled heat generation*
*4) Natural gas consumption by coking plants, hard coal mines and briquette factories, crude oil and natural gas production, mineral oil processing, and other energy producers*
*5) Including natural gas use for heat generation in industrial CHP plants*
*6) Share of domestic natural gas production*
*7) Share of natural gas primary energy consumption*

*Sources: Working Group on Energy Balances (AGEB); Federal Statistical Office (Destatis); Federal Association for Natural Gas, Petroleum and Geothermal Energy (BVEG)*

For comparison: On balance, approximately 4.8 billion kWh ($H_i$) of natural gas had still been stored in 2023.

On the consumption side, the following trends become apparent for 2024 in the individual demand sectors (please see Table 8):

- The demand for natural gas attributable to the plants of mining facilities and the manufacturing industry (industrial enterprises, including the use of natural gas for electricity production in industrial power plants) increased by an estimated total of 3.3 % to 255 billion kWh ($H_i$) in 2024. The outlined increase in industrial natural gas consumption was due, on the one hand, to the decline in natural gas prices and, on the other hand, due to the production growth in a number of particularly natural gas intensive economic branches such as, for example, basic chemistry. When interpreting the differentiation of industry's use of natural gas which was selected here, it should be noted that this representation includes not only the consumption of process energy as well as the consumption in natural gas fired power plants that generate electricity and heat and are operated by the industrial enterprises themselves, but also the non-energetic consumption of natural gas which plays a decisive role primarily when it comes to the manufacture of basic chemicals. Within the delimitation of the German Energy Balance, industry's final energy consumption (without non-energetic consumption and the use of fuels for electricity production) increased by 3.9 % to approximately 193 billion kWh ($H_i$) in 2024 (please see Table 8).

- Natural gas consumption of companies in the trade, commerce, and service sector decreased slightly. In contrast to industry, more than four fifths (2023: Approximately 88 % and/or almost 96 % if and when the natural gas that is used for the provision of hot water is included in the analysis)[25] of the natural gas in this consumption segment are used for space heating purposes. Hence, the milder weather conditions prevailing in 2024 caused the demand for natural gas of the businesses and enterprises in the trade, commerce, and service sector to decrease. Investment as well as attitude, behavior, and price related savings measures reinforced this effect. The overall result shows that the weather, attitude and behavior as well as price induced savings actually overcompensated the increased consumption by the economic trend in this segment (the price-adjusted gross value creation went up by 0.5 % in 2024 when compared to the previous year). All told, a decrease in consumption of approximately 0.6 % to 92.4 billion kWh ($H_i$) can be anticipated in the trade, commerce, and service sector for the year 2024.

- When it comes to private households (including the housing companies supplying them with space heating and hot water), a decline in consumption is to be anticipated as well due to the milder outside temperatures in 2024. Current data indicate a 0.5 % reduction of the natural gas consumption to 224.6 billion kWh ($H_i$) for 2024.

- All told, about 80.3 billion kWh of electricity, which is about 4.8 % more than during the previous year, were generated in the gas-fired power plants of electricity suppliers and industrial enterprises and in combined heat and power plants of other electricity producers in 2024. Furthermore, it is expected that the use of natural gas as a fuel in power plants and heating stations supplying electricity will also increase in 2024 due to the slightly improved competitiveness when compared to the previous year. When it comes to electricity supplied to the general public (including combined heat and power plants), an increase in natural gas consumption to 171.8 billion kWh and, thus, somewhere around 4.9 % is to be anticipated when compared to the previous year.

- The use of natural gas for the coupled and uncoupled provision of district heat went up by 2 % to 50.1 billion kWh ($H_i$) in 2024.

- Sales of natural gas (either in compressed form, CNG, or in liquefied form, LNG) to the transportation sector are likely to have attained a consumption level of 0.6 billion kWh ($H_i$) in 2024. The significant decline when compared to the previous year

*25) At the time of the editorial deadline of this report, the information provided on the breakdown of the final energy consumption according to individual energy carriers (here: Natural gas) and on the requisite application purposes was still based on the data contained in the last and final version of the Energy Balance for 2023 (data status: January 31, 2025). It is expected that the application balances will be updated and/or continued until the end of June 2025 by taking the empirical findings contained in the estimated Energy Balance for 2024 (data status: May 12, 2025) into account.*

(-70.6 %) is, above all, due to substitution effects (of natural gas in favor of biogas). The total use of natural gas and biogas (CNG and LNG) for the propulsion of vehicles decreased only by about 0.9 % in 2024 when compared to the previous year.

According to preliminary data, about 10.8 billion kWh of biogas processed to natural gas quality (biomethane) were fed into the German natural gas grid in 2024 – this is about the same level as the previous year. The potential feed-in capacity increased by almost 4.4 % to 14.3 billion kWh. According to preliminary data released by AGEE-Stat, 3.1 billion kWh were used as a fuel in the transportation sector. The remaining quantities were used to produce electricity and heat. In accordance with the AG Energiebilanzen's balancing scheme, these quantities are recorded both on the volume side and the consumption side under renewable energy and not under natural gas.

Since the liberalization of the energy markets, spot and futures markets have evolved for natural gas. At these virtual trading points, essential supply and demand based price signals are created for the European and, thus, also the German market today. The development of oil prices according to the principle of netback pricing based on oil indexation *(Anlegbarkeitsprinzip)* no longer plays any role in the development of the procurement costs for gas today.

Compared to the peak levels that had been attained during the crisis year 2022, the import price for natural gas dwindled significantly once again in 2024. Between 2022 and 2023, the border-crossing price (on an annual basis) decreased from € 21/GJ (which equals 7.56 ct/kWh) to about € 11.9/GJ (4.29 ct/kWh); thus, it declined by 43.3 % when compared to the previous year (please see Figure 7). In 2024, the price drop continued; albeit to a significantly lesser extent. Compared to the year 2023, the import price for natural gas fell again by 12.8 % so that on average € 10.4 had to be paid for one gigajoule of imported natural gas in 2024. Regardless of the drop in prices described above, the average annual import prices for natural gas still remained at an elevated level in 2024; in fact, they were about 46 % above the value which had been observed prior to the energy crisis (2021: € 7.1/GJ).[26)]

A glance at the monthly development reveals the following picture: After the import price for natural gas had reached its all-time high of € 41.26/GJ (14.85 ct/kWh) in August 2022 and peaked at € 26.1/GJ (9.38 ct/kWh) in December 2022, the border-crossing price for natural gas has once again been quoted persistently below the level of the import price for crude oil since March 2023. In January 2024, the border-crossing price started at € 11.70/GJ (4.2 ct/kWh). Until October 2024, the import price for natural gas ranged (with fluctuations) constantly below the level that had been observed in January 2024. A slight increase of the border-crossing price to more than € 12/GJ became apparent between November and December 2024.

In addition, Figure 7 indicates that the import price for natural gas to some extent had decoupled itself significantly from the development of the border-crossing price for crude oil imports over the course of the crisis year 2022; a phenomenon which had been observed to a less pronounced degree in the periods before the start of the war in Ukraine. Since March, April 2023, a normalization had been observed in the difference of the prices and the progress of the trend for crude oil and natural gas; albeit at an increased price level. For periods of time as of April 2024, a steady decline in the difference between the prices for natural gas and crude oil became apparent, whereby the price levels aligned once again to a substantial degree during the last two months of the year. Compared to the respective months of the previous year, the following picture becomes apparent for 2024: It was only during the months of May, July, August, and December when the import price for natural gas exceeded the price levels of the respective month of the previous year (ranging between 4 % and 18 %).

Parallel to the import prices for natural gas, the price level for natural gas at the energy exchange (spot market) decreased significantly from € 41.58/MWh to € 34.14/MWh (-17.9 %).[27)] For comparison: In 2022,

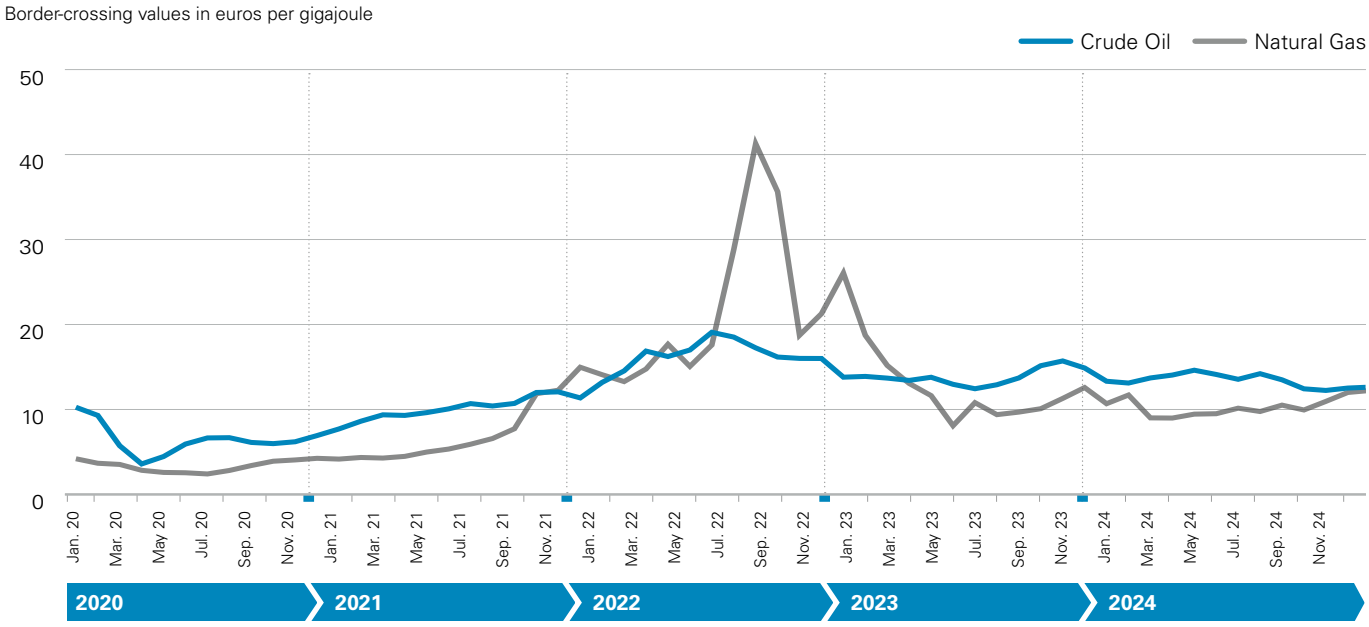
*26) In addition, the annual average for 2024 still continued to noticeably exceed the old peak level that had been attained prior to the crisis in 2012 (€ 8.08/GJ or 2.90 ct/kWh).*

*27) For more details, please see the Gas Price Analysis published by the German Association of Energy and Water Industries (BDEW):* BDEW-Gaspreisanalyse *(last update: February 2025) (currently only available in German).*

Figure 7

AGEB
AG Energiebilanzen e.V.

**Monthly Border-Crossing Values for Crude Oil and Natural Gas between 2020 and 2024**




*Sources: Federal Office of Economics and Export Control (BAFA); Federal Statistical Office (Destatis)*

the spot market price for natural gas had still been quoted at more than € 125/MWh.

The development of import and wholesale prices, i. e. costs for the procurement of natural gas, has different effects on domestic sales prices. Varying procurement periods for diverse customer groups typically result in diverging price trends on the end consumer market. In addition, the relative price changes for bulk consumers are higher because of the lower overall price level.

Against the backdrop of the declining import and wholesale prices for natural gas over the course of the year 2024 when compared to the previous year, the end customer prices and/or sales prices to consumers also decreased noticeably over the course of the year; albeit to a different extent. Particularly when compared to the peak levels that had been attained during the second half of the crisis year 2022, sales prices had dropped significantly across all customer groups already in the year 2023. Prices continued to decline (on the basis of average annual values) across all customer groups during the reporting year 2024; albeit to a lesser extent.

When compared to the previous year, for example, the price for power plant gas went down by 11 % in 2024. The drop in prices for industrial clients was even more significant: In 2024, natural gas prices for industrial clients, also compared to the previous year, even decreased by 19 %.[28)] When it comes to smaller customers of natural gas ("trade and commerce") as well as household customers, price reductions of around 10 % and almost 11% respectively could be observed in 2024 when compared to the previous year (please see Figure 8).

Considering the year under review, prices developed relatively stable for all customer groups in the natural gas market, i. e. no significant price peaks and/or price fluctuations occurred. Variations in natural gas prices around the mean value were more pronounced for

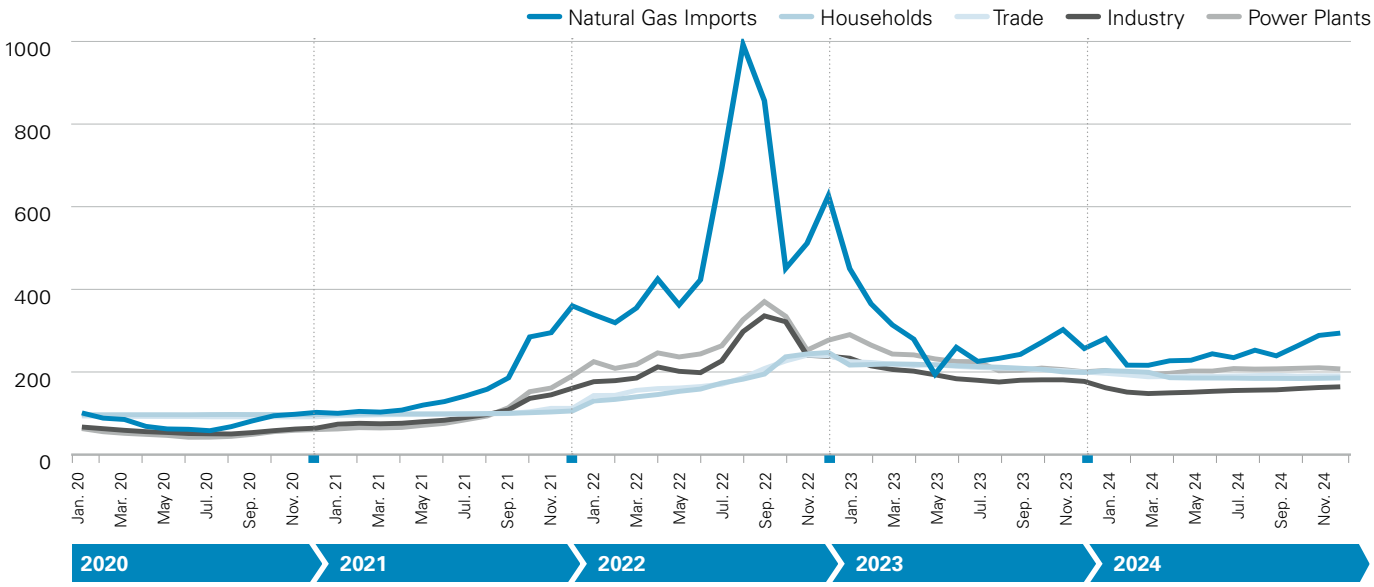
*28) When interpreting these trends, it should be noted that the prices for large industrial clients (annual supply of more than 500 GWh) generally develop differently due to the fact that natural gas has to be procured at shorter notice than is usually the case for small industrial gas consumers (supply of 11.63 GWh/a). For example, the natural gas price for small industrial consumers (supply of 11.63 GWh/a) decreased by 12 % in 2024 when compared to the previous year whereas the price for large consumers (supply of more than 500 GWh/a) dropped by almost 24 % over the same period of time. The natural gas price for sales to industry (supply of 116.3 GWh/a) went down by almost 21 %.*

Figure 8

AGEB
AG Energiebilanzen e.V.

**Prices for Natural Gas Imports and Natural Gas Sales in Germany between 2020 and 2024**

January 2015 = 100 (basis of producer price indices 2015 = 100)




*Sources: Federal Office for Economic Affairs and Export Control (BAFA); Federal Statistical Office (Destatis)*

industrial clients (minimum: -5.1 %, maximum: +5.4 %) as well as for household customers (minimum: -2.7 %, maximum: +7.5 %) than for the other customer groups.[29] The lowest price fluctuations over the course of the year 2024 were recorded by natural gas consumers in the "trade and commerce" sector; here, the monthly consumer prices varied only between -1.4 % and a maximum of +3 % around the observed annual average value.

*29) As of April 1, 2024, the value added tax on natural gas was raised once again from 7 % to 19 % which resulted in increased gas prices for household customers. In addition, procurement costs increased slightly during the 3rd and 4th quarter of the year; however, this increase was passed on to private end customers and/or contract customers only with some delay. During the first two quarters of the year 2024, the newly increased value added tax had been compensated by reduced procurement costs.*

## Hard Coal

According to preliminary estimates and compared to the previous year, Germany's primary energy consumption based on hard coal decreased by 10.3 % to 772 PJ (26.3 Mtce) in 2024 (please see Table 9). After a period of growth during 2021 and 2022, which for a short period of time interrupted the continuous downward trend that had previously persisted for many years and which was due to special effects and/or the direct consequences of the war in Ukraine, the long-term trend became effective again. The primary energy consumption of hard coal reached a new all-time low in 2024.

Table 9

AGEB
AG Energiebilanzen e.V.

**Hard Coal Balance[1] for Germany in 2023 and 2024**

| | | 2023 | | 2024 [2] | | Change |
|---|---|---|---|---|---|---|
| | | PJ | Mtce | PJ | Mtce | in % |
| Domestic Production | | 0 | 0.0 | 0 | 0.0 | - |
| + | Imports | 912 | 31.1 | 786 | 26.8 | -13.9 |
| **=** | **Volume** | **912** | **31.1** | **786** | **26.8** | **-13.9** |
| +/– | Change in Stocks (Reduction: +, Replenishment: -) | 15 | 0.5 | -44 | -1.5 | - |
| – | Exports | 37 | 1.3 | 58 | 2.0 | 54.0 |
| **=** | **Primary Energy Consumption** | **860** | **29.3** | **772** | **26.3** | **-10.3** |
| – | Use in Power Plants [3] | 322 | 11.0 | 230 | 7.8 | -28.6 |
| – | Use in Combined Heat and Power Plants (Heat) | 52 | 1.8 | 42 | 1.4 | -20.4 |
| – | Use in Blast Furnaces | 145 | 5.0 | 149 | 5.1 | 2.8 |
| – | Other Conversion Input [5] | 303 | 10.3 | 320 | 10.9 | 5.5 |
| + | Conversion Output | 231 | 7.9 | 244 | 8.3 | 5.5 |
| – | Consumption during Production and Conversion as well as Non-Energetic Consumption | 2 | 0.1 | 2 | 0.1 | 13.6 |
| + | Statistical Differences | -12 | -0.4 | -30 | -1.0 | - |
| **=** | **Final Energy Consumption** | **279** | **9.5** | **303** | **10.3** | **8.4** |
| | Industry [6] | 275 | 9.4 | 299 | 10.2 | 8.5 |
| | Including | | | | | |
| | Metal Production [7] | 244 | 8.3 | 270 | 9.2 | 10.4 |
| | Private Households | 3 | 0.1 | 3 | 0.1 | 1.6 |
| | Trade, Commerce, and Services | 1 | 0.0 | 1 | 0.0 | -3.9 |

*1) Hard coal = raw hard coal, hard coal briquettes, and hard coal coke*
*2) Preliminary data for 2024; some figures are estimates*
*3) Used for electricity generation in general utility power plants, industrial power plants, and combined heat and power plants*
*4) For combined and uncoupled heat generation*
*5) Coking plants*
*6) Including the use of hard coal and hard coal products for heat generation in industrial cogeneration plants*
*7) Metal production (Energy Balance Row 54) excluding conversion inputs from blast furnaces and coking plants*

*Sources: Working Group on Energy Balances (AGEB), Industry Association for Hard Coal and Post-Mining (bsn)*

Besides nuclear energy and lignite, hard coal was also one of the energy carriers that were most affected by the overall declining primary energy consumption.

In concrete terms, the use of hard coal in power plants supplying the general public and in industrial power plants generating electricity and heat decreased by more than 30 % to 259 PJ (which translates into 8.9 Mtce) (please see Table 9). Thus, the use of hard coal in power plants fell to a historic low once again. With 28.1 TWh, electricity production from hard coal only accounted for a mere 5.6 % share in Germany's total gross electricity production in 2024.

The use of hard coal in the steel industry, however, increased by 7.3 % to 495 PJ (which translates into 16.8 Mtce) in 2024.[30] Thus, this sector remained the largest economic branch and/or customer in the German hard coal market. During the reporting period 2023/2024, the final energy consumption in the metal production sector (within the classification of the German Energy Balance: Energy Balance Row 54) increased by 10.4 % to 270 PJ (which translates into 9.2 Mtce). The overall development in this sector was primarily attributable to the increase in crude iron production which went up by 673 thousand tons and/or 2.8 % when compared to the previous year. At the same time, crude steel production also increased – when compared to the historic low that had been attained in 2023 – once again; namely, by 1.7 million tons which translates into 5.0 %. Compared to the previous year, the production of oxygen steel grew by 3.1 %, the production of electric steel even by 10.3 %. In terms of volume, the use of hard coal only played a minor role in the other sectors (foundries, district heating plants, small businesses, and private households); it decreased by 3.5 % to about 47 PJ (which equals 1.6 Mtce).

After the termination of domestic hard coal mining at the end of 2018, the volume side of Germany's hard coal market has been sourced merely from imports and existing stocks. According to preliminary data derived from the Federal Statistical Office's Foreign Trade Statistics and when compared to the previous year, Germany's hard coal imports dropped by 13.9 % to 31.2 million tons in 2024 (please see Table 10).

By applying a generalized conversion method based on an average heating value of 7,000 kcal/kg (i. e. without considering the actual heating values), this resulted in hard coal imports amounting to almost 27 Mtce. Of this figure, 49 % accounted for power plant coals, 41 % for coking coals, 1 % for anthracite coals and briquettes as well as 8 % for hard coal coke.

The hard coal embargo issued by the EU against Russian exports had scheduled a transitional period of 120 days as of April 2022. Accordingly, imports of Russian hard coal to the EU had initially been permitted if and to the extent that the underlying supply contracts for coal were concluded before April 9, 2022. As of August 11, 2022, the EU embargo against Russian hard coal entered into full force and effect. Additional hard coal imports from Russia to the EU were from now on strictly forbidden. But even thereafter, the Federal Statistical Office still recorded imports in its monthly reports that were declared with "country of origin: Russia." Last year, these volumes still amounted to nearly 140,000 tons, with a strong downward trend. These remaining Russian supply volumes were imported to Germany from neighboring EU countries (above all, the Netherlands and Belgium) and came, in particular, from storage sites of the Northwest European coal terminals (in Amsterdam, Rotterdam, and Antwerp = ARA ports). There, within the EU, these Russian coals had already been placed in stock before August 11, 2022, which is why they did not fall under the embargo.

Apart from small individual quantities, particularly in the anthracite coal market, Russian coal disappeared almost entirely from German hard coal import statistics. When it comes to Germany's total hard coal imports last year, Australia (29 %), the United States (24 %), and Columbia (11 %) became the most important supplier countries. Broken down into the individual market segments, the following picture becomes apparent: Steam coals were primarily sourced from Columbia (25 %), Australia (23 %), the United States (22 %), and South Africa (14 %). In the coking coal sector, only two countries accounted for about 92 % of the supplies – Australia (52 %) and the United States (40 %). The market for anthracite coals almost halved when compared to the previous

*30) Use of hard coal in the metal production sector (Energy Balance Row 54) plus conversion input of hard coal coke in blast furnaces (Energy Balance Row 17) as well as consumption (difference between conversion input minus conversion output) in coking plants.*

Table 10

AGEB
AG Energiebilanzen e.V.

**German Hard Coal Imports[1] According to Supplier Countries in 2023 and 2024 (January to December)**

| | 2023 | 2024 [2] | Change | 2023 | 2024 |
|---|---|---|---|---|---|
| | in Million Tons | | in % | Proportions in % | |
| Poland | 1.7 | 1.4 | -16.1 | 4.6 | 4.5 |
| Czech Republic | 0.2 | 0.2 | 2.6 | 0.5 | 0.6 |
| Russia | 0.6 | 0.1 | -76.4 | 1.6 | 0.4 |
| South Africa | 3.7 | 1.9 | -49.1 | 10.3 | 6.1 |
| USA | 9.4 | 7.6 | -18.9 | 25.9 | 24.4 |
| Canada | 0.6 | 0.7 | 15.0 | 1.7 | 2.3 |
| Columbia | 5.0 | 3.5 | -30.0 | 13.9 | 11.3 |
| Australia | 8.6 | 8.9 | 4.5 | 23.6 | 28.7 |
| Other/Statistical Differences [3] | 6.5 | 6.8 | 4.6 | 17.9 | 21.8 |
| **Total Imports** | **36.2** | **31.2** | **-13.9** | **100.0** | **100.0** |

*1) Including coke imports; coke converted into coal*
*2) Preliminary data for 2024*
*3) Including unassignable delivery quantities*

*Source: Federal Statistical Office (Destatis)*

years due to the extremely short supply. Here, it was above all suppliers from Europe who dominated more than half of the field; over a fifth of the supplies were contributed by the United States. And finally in the coke market as well, the vast majority of the supplies came primarily from European neighboring countries (more than 70 %). Just Poland alone accounted for a share of 58 %; another 16 % were sourced from China.

According to initial estimates of the German Coal Importers Association (VDKi), a new record volume in global hard coal production amounting to almost 8.5 billion tons becomes apparent for 2024. When compared to the previous year, this would translate into a plus of nearly 6 %. The driving forces behind this development were, above all, Asian countries. For example, China increased its coal production by 259 million tons, India by 178 million tons, and Indonesia by 149 million tons. When compared to the previous year, these figures correspond to growth rates of +6 % (China), +21 % (India), and +25 % (Indonesia). In contrast, hard coal production declined, above all, in the United States (-120 million tons), Russia (-9 million tons), and Kazakhstan (-5 million tons).

About 16 %, i. e. more than 1.3 billion tons, of the global hard coal production were traded on international markets in 2024. With imports of 352 million tons, China once again turned out to be a "glutton of raw materials" which means that it skimmed off more than a fourth of the global trading volume. Together with its huge domestic production volume amounting to 4.7 billion tons, and minus its low volume of exports (7 million tons), this resulted in the world's highest volume of hard coals amounting to 5.1 billion tons. In 2024, the most important exporting countries in global hard coal trade were Indonesia (with a share of 29 % in the total export market including domestic trade), Australia (27 %), and Russia (13 %).

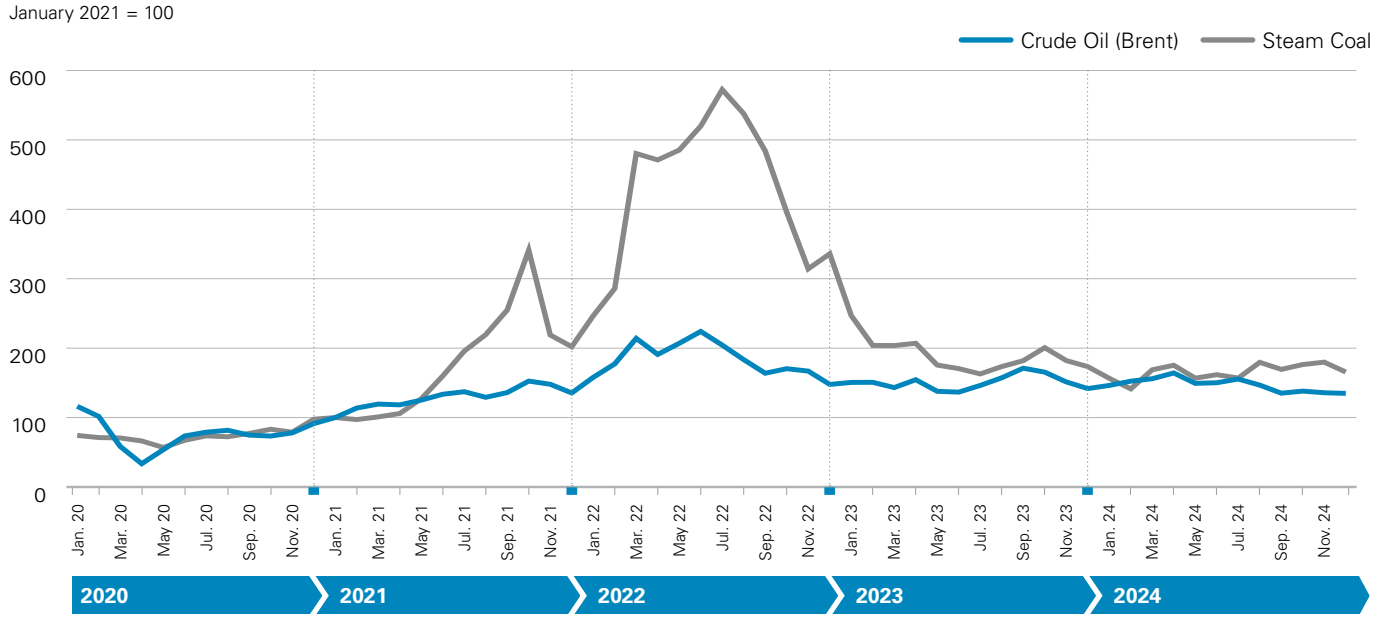
Figure 9 conveys an indication of the long-term price trend for power plant coals also in comparison to the changes experienced by crude oil. The import price for steam coals,[31] which had reached a peak level of almost US-$ 338/tce (annual average) in 2022, dropped to approximately US-$ 150/tce in 2023.

*31) Spot price for power plant coals cif, NWE; average over the weekly quotations according to the MCIS Steam Coal marker; expressed in US-$/tce.*

Figure 9

AGEB
AG Energiebilanzen e.V.

**Global Market Prices for Crude Oil (Brent) and Steam Coal between January 2020 and December 2024**




*Sources: German Coal Importers Association (VDKi); en2x-Fuels & Energy Business Association*

In 2024, prices continued to normalize. The import price for steam coals decreased once again when compared to the previous year 2023; it went down by about US-$ 19/tce (-12.9 %). With US-$ 131/tce, it fell, thus, below the pre-crisis level for the first time again in 2024 (2021: Approximately US-$ 140/tce); namely, by about US-$ 9/tce which translates into 6.3 %.

Based on a level of US-$ 123/tce, the price for steam coals increased since January 2024 to more than US-$ 142/tce in August 2024. Until November 2024, the steam coal price hovered more or less at this level before it dropped again to a value of about US-$ 131/tce in December 2024.

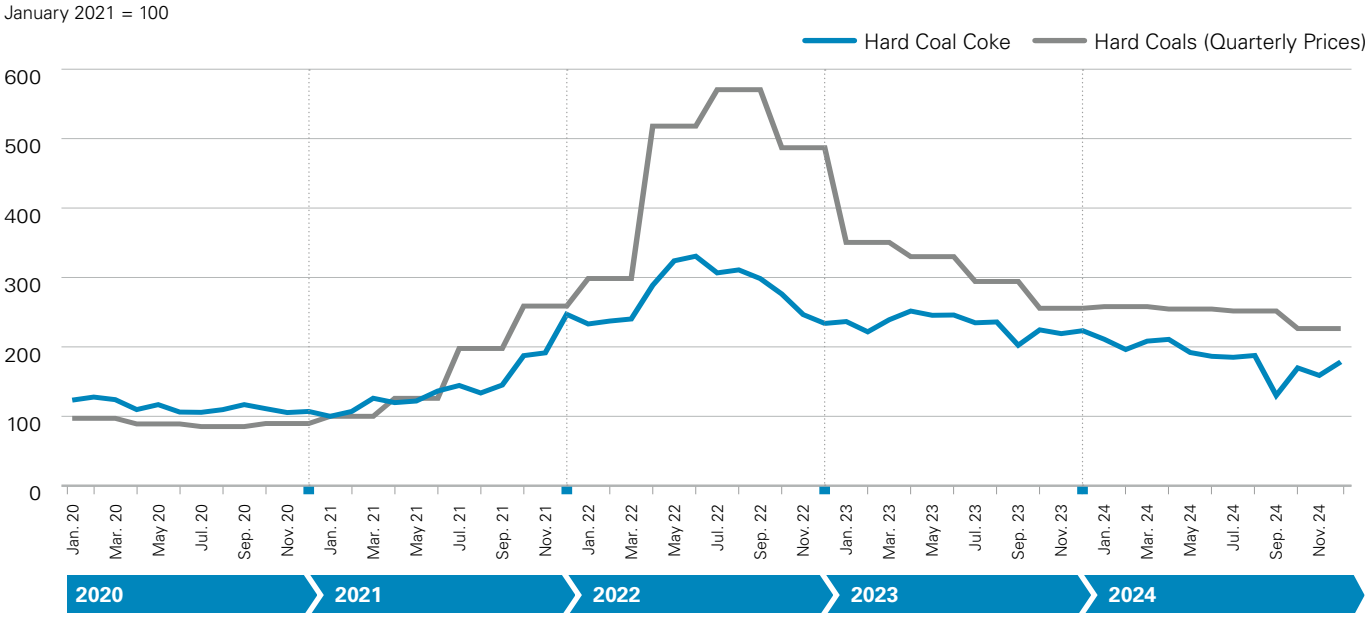
Figure 10 shows in addition the import prices for hard coal coke and coal from third countries (power plants and steel producers). The overall picture reveals that the import prices for hard coal coke as well as steam coals and power plant coals which, after the invasion of Ukraine by Russian troops on February 24, 2022, had initially skyrocketed and reached their individual peak levels in the case of hard coal during the third quarter of 2022 (about € 400/tce) and/or in the case of hard coal coke in May 2022 (almost € 600/tce), declined again by the end of the year. This trend essentially continued over the course of the year 2023. While the import price for hard coal (steam coal) dropped from about € 245/tce during the first quarter to € 179/tce during the fourth quarter of 2023, which equaled a reduction of more than 27 %, the import price for hard coal coke went down by about 6 % between January and December 2023 and reached an absolute level of € 408/tce by the end of the year.

During the first three quarters of the reporting year 2024, the import price for hard coal remained virtually unchanged at the level that had already been attained in the fourth quarter of 2023 so that the import price remained constant between approximately € 177/tce and € 178/tce during this period of time. A price reduction to about € 158/tce was only observed during the fourth quarter of 2024. The import price for hard coal coke, which had amounted to € 386/t in January 2024, dropped to an annual low of almost € 238/t by September 2024 and, thus, to a price level that had last been observed in mid-2021. An increase in the import price for hard coal coke to € 326/t was recorded by December 2024.

On an annual basis and compared to 2023, both the import prices for steam coals and hard coal coke decreased by about 20 % in 2024. Thus, the price reductions in the hard coal market turned out to be

Figure 10

**Development of Selected Hard Coal Import Prices between 2020 and 2024**




*Sources: German Coal Importers Association (VDKi); Federal Office for Economic Affairs and Export Control (BAFA); Federal Statistical Office (Destatis)*

much more substantial than those in the crude oil market in 2024 (related to the year 2023, the import price for a ton of crude oil went down by more than 3 % in 2024).

## Lignite

With 91.9 million tons in 2024, lignite production as a whole was about 10.1 % below the previous year's yield. In 2024, the calorific value of the extracted coal was all told on average lower than the previous year. The energy content of the mined lignite was with 28.2 Mtce (826 PJ) 9.9 % below the previous year's value. Lignite's share in domestic energy generation amounted, therefore, to almost 25 %.

Production developed differently in the individual mining districts: In Central Germany, extraction decreased by 17 %. In both the Rhineland and Lusatia, production dropped by 9 %. This change generally corresponds to the development of deliveries to power plants supplying the general public (a total of 80.9 million tons; -10.0 %) which received around 90 % of the production. In Germany, electricity production based on lignite decreased from 86 TWh during the same period last year to 79 TWh in 2024. The reasons for this development were the lower electricity production as a whole, the increased electricity production from renewables as well as the reduction of additional production capacities within the context of the phase-out from coal-fired power generation. Germany's Federal Government had temporarily extended the operating time of five lignite-fired power plant units that had been in a standby mode for backup purposes in order to assure and secure the electricity supply during the energy crisis and to reduce natural gas consumption. Two additional units were to have gone offline at the end of 2022 in accordance with the Coal Phase-Out Act (KohleAusG). This step was suspended due to the natural gas shortage. The standby operation to secure the supply reserve of these power plants amounting to a total of 3.1 GW ended on March 31, 2024. An additional unit was shut down as scheduled at the Weisweiler power plant in the Rhenish District on January 1, 2025. Lignite's share in the gross electricity production still amounted to 16 % in 2024. Lignite, thus, continued to be an important and a reliable source of energy for power generation in Germany.

The manufacture of refined products based on lignite also decreased by 10 % to 3.9 million tons. This resulted in specific changes of minus 29 % for briquettes, minus 7 % for pulverized coals, minus 4 % for coking coals, and a plus of 9 % for fluidized bed coals.

With 27.5 Mtce (807 PJ), the primary energy consumption of lignite was nearly 10 % below the previous year's level (please see Table 11).[32)] Lignite, thus, covered almost 8 % of the entire domestic demand for energy.

In 2024, the final energy sectors reduced the use of lignite and lignite products by about 0.9 % when compared to the previous year (please see Table 11). In industry, the use of lignite increased by 4.5 %. The high demand area for the use of lignite products in industry is to be found in the "processing of stones and soils" sector (here, primarily such other lignite products as, for example, pulverized and dry coals are used). Sales to private households declined by 36.3 % (please see Table 12).

*32) Deviations from Table 1 due to minor variations in data statuses and rounding-off differences.*

Table 11

AGEB
AG Energiebilanzen e.V.

## Volume and Use of Lignite in Germany in 2023 and 2024

| | Unit | 2023 | 2024 [1] | Change |
|---|---|---|---|---|
| | | | | in % |
| **1. Domestic Raw Lignite** | | | | |
| **Total Lignite Production** | **Million Tons** | **102.3** | **91.9** | **-10.1** |
| | **Mtce** | **31.3** | **28.2** | **-9.9** |
| | **PJ** | **916** | **826** | **-9.9** |
| **2. Foreign Trade** | | | | |
| Total Imports | 1,000 tce | 31.0 | 34.3 | 10.7 |
| Total Exports | 1,000 tce | 745.0 | 658.2 | -11.6 |
| Foreign Trade Balance | 1,000 tce | 714.0 | 623.9 | - |
| **3. Primary Energy Consumption** | | | | |
| | Mtce | 30.5 | 27.5 | -9.8 |
| | PJ | 895 | 807 | -9.8 |
| **4. Sales** | | | | |
| **Total Sales** | **Million Tons** | **90.6** | **81.6** | **-10.0** |
| to Power Plants Supplying the General Public | Million Tons | 89.9 | 80.9 | -10.0 |
| to Other Customers | Million Tons | 0.7 | 0.7 | -3.6 |
| Use for Refinement | Million Tons | 9.8 | 8.8 | -10.6 |
| Use in Lignite-Fired Power Plants | Million Tons | 1.7 | 1.6 | -7.6 |
| Change in Stocks | Million Tons | 0.1 | -0.1 | - |
| **5. Electricity Production from Lignite** | | | | |
| Power Plants Supplying the General Public | Billion kWh | 83.9 | 77.2 | -8.0 |
| Industrial Power Plants | Billion kWh | 2.4 | 2.0 | -16.7 |
| **Total Electricity Production from Lignite** | **Billion kWh** | **86.3** | **79.2** | **-8.2** |

*1) Preliminary data; some figures are estimates*

*Source: The German Coal Industry's Statistical Office*

Table 12

AGEB
AG Energiebilanzen e.V.

## Lignite Balance[1] for Germany in 2023 and 2024

in PJ and Mtce

| | | 2023 | | 2024 [2] | | Change |
|---|---|---|---|---|---|---|
| | | PJ | Mtce | PJ | Mtce | in % |
| Domestic Production | | 916 | 31.3 | 826 | 28.2 | -9.9 |
| + | Imports | 1 | 0.0 | 1 | 0.0 | 9.8 |
| **=** | **Volume** | **917** | **31.3** | **827** | **28.2** | **-9.9** |
| +/– | Change in Stocks (Reduction: +, Replenishment: -) | 1 | 0.0 | -2 | -0.1 | - |
| – | Exports | 22 | 0.7 | 19 | 0.7 | -11.7 |
| **=** | **Primary Energy Consumption** | **895** | **30.5** | **810** | **27.6** | **-9.5** |
| – | Use in Power Plants [3] | 793 | 27.1 | 727 | 24.8 | -8.3 |
| – | Use in Combined Heat and Power Plants (Heat) | 24 | 0.8 | 18 | 0.6 | -24.0 |
| – | Other Conversion Input [4] | 95 | 3.2 | 86 | 2.9 | -9.6 |
| + | Conversion Output | 95 | 3.2 | 85 | 2.9 | -9.7 |
| – | Consumption during Production and Conversion as well as Non-Energetic Consumption | 19 | 0.6 | 17 | 0.6 | -5.8 |
| + | Statistical Differences | -8 | -0.3 | -19 | -0.6 | - |
| **=** | **Final Energy Consumption** | **66** | **2.2** | **65** | **2.2** | **-0.9** |
| | Industry [5] | 57 | 2.0 | 60 | 2.0 | 4.5 |
| | Including | | | | | |
| | Processing of Stones and Soils | 38 | 1.3 | 35 | 1.2 | -5.6 |
| | Private Households | 9 | 0.3 | 6 | 0.2 | -36.3 |

*1) Lignite = raw lignite, lignite briquettes, other lignite products, and hard lignite*
*2) Preliminary data for 2024; some figures are estimates*
*3) Used for electricity generation in general utility power plants, industrial power plants, and combined heat and power plants*
*4) Use in coking plants and briquette factories*
*5) Including the use of raw lignite and lignite products for heat generation in industrial cogeneration plants*

*Sources: Working Group on Energy Balances (AGEB), The German Coal Industry's Statistical Office*

## The Electric Power Industry

In 2024, the electric power industry was characterized by a slight recovery in the consumption of electricity; albeit coming from a very low level in 2023. Despite the continued sluggish economy, the decrease in electricity prices resulted in a demand-driven increase in consumption in some subsectors of industry when compared to the previous year. Nonetheless, the price level continued to be relatively high so that the consumption of electricity stayed at a below average level when compared to the previous years.

In 2024, the consumption of electric power (gross domestic electricity consumption) increased by an estimated 1.3 % to 527.4 billion kWh when compared to the previous year. Despite the increase in consumption, the gross electricity production decreased by 2 % during the same period of time. The difference resulting from the production decline and the increased consumption was compensated through higher electricity imports. Germany's electricity exchange balance registered an import surplus of 26.3 billion kWh while this figure had still amounted to 9.2 billion kWh in the previous year. Germany was, thus, a net importer of electricity for the second year in a row because during phases of low wind and times of little sunshine, cheaper production options from abroad contributed towards satisfying the domestic demand for electricity.

The electricity production mix in 2024 was, above all, influenced by the general economic development, price effects, and the weather. At the end of March, this was accompanied by the decommissioning of those conventional power plants whose shutdown had been postponed as a result of the energy crisis or which had been taken off the market and back into the reserve position (so-called market reenterers). In addition, reduced wholesale prices for natural gas and the somewhat lower $CO_2$ prices all had a considerable impact on the production infrastructure. While natural gas fired power plants generated slightly more electricity (+4.8 %) in 2024 than in the previous year, the electric power generated in hard coal fired power plants decreased significantly by more than a quarter (27.2 %); and a reduction of more than 8 % was observed in lignite-based power generation. According to preliminary figures, nearly 285 billion kWh of electricity were generated from renewables in 2024 and, thus, around 3.6 % more than in 2023. The proportion of renewables in the gross electricity consumption, thus, amounted to almost 57 % in 2024 (please see Table 13).

The share of renewables in the gross electricity consumption – the decisive quota in achieving the target for renewable energies – amounted to 54 %.

In 2024, wind power was the most important energy carrier in the German electric power mix with a total electricity production of 138.9 billion kWh. This was followed by natural gas with 80.3 billion kWh and lignite with 79.1 billion kWh. Electricity production from photovoltaic systems followed directly behind with 74.3 billion kWh.

Lignite-fired power plants generated, as already pointed out above, 79.1 billion kWh of electricity. This translates into an 8.3 % decrease in production when compared to the previous year. A net power plant capacity of 15,119 MW was installed at the end of the year. This was 3,205 MW less than at the end of 2023, of which 1,886 MW are attributable to the delayed decommissioning of the supply reserve as well as 1,319 MW to the power plants which were decommissioned in accordance with the German Coal-Fired Power Generation Termination Act (KVBG) or on a voluntary basis.

With an estimated 28.1 billion kWh, hard coal fired power plants delivered once again significantly less electricity in 2024 than in the previous year. Their electricity production dropped by more than 27 % after electricity production from hard coal had already decreased by about 40 % (this translates into 25.2 billion kWh) in the previous year. By the end of the year, the installed capacity of hard coal fired power plants amounted to 15,973 MW; a decrease of 2,571 MW which was the result of the exit from coal-fired power generation. Furthermore, an additional 6,372 MW continued to be in the grid reserve and,

Table 13

AGEB
AG Energiebilanzen e.V.

## Gross Electricity Production in Germany between 1990 and 2024 According to Energy Carriers

| | 1990 | 2020 | 2021 | 2022 | 2023 | 2024 | 2024/ 2023 | 2024/ 1990 |
|---|---|---|---|---|---|---|---|---|
| | Gross Electricity Production and Gross Electricity Consumption in Billion kWh | | | | | | Average Annual Change in % | |
| Lignite | 170.9 | 91.7 | 110.1 | 116.2 | 86.3 | 79.1 | -8.3 | -2.2 |
| Hard Coal | 140.8 | 42.8 | 54.6 | 63.7 | 38.5 | 28.1 | -27.2 | -4.6 |
| Nuclear Energy | 152.5 | 64.4 | 69.1 | 34.7 | 7.2 | 0.0 | -100.0 | -100.0 |
| Natural Gas | 35.9 | 94.7 | 90.3 | 79.1 | 76.7 | 80.3 | 4.8 | 2.4 |
| Mineral Oil | 10.8 | 4.7 | 4.6 | 5.7 | 4.9 | 5.0 | 2.3 | -2.2 |
| Renewables | 19.7 | 251.5 | 233.9 | 254.6 | 275.1 | 284.9 | 3.6 | 8.2 |
| Other | 19.3 | 24.8 | 24.5 | 23.8 | 22.6 | 23.7 | 4.8 | 0.6 |
| **Gross Electricity Production** | **549.9** | **574.7** | **587.1** | **577.9** | **511.3** | **501.2** | **-2.0** | **-0.3** |
| Electricity Flows from Foreign Countries | 31.9 | 48.0 | 51.7 | 49.3 | 69.3 | 81.7 | 17.8 | 2.8 |
| Electricity Flows into Foreign Countries | 31.1 | 66.9 | 70.3 | 76.6 | 60.1 | 55.4 | -7.8 | 1.7 |
| Foreign Electricity Exchange Balance | 0.8 | -18.9 | -18.6 | -27.3 | 9.2 | 26.3 | - | - |
| **Gross Electricity Consumption** | **550.7** | **555.8** | **568.5** | **550.6** | **520.5** | **527.4** | **1.3** | **-0.1** |
| *Change versus Previous Year in %* | *X* | *-3.4* | *2.3* | *-3.2* | *-5.5* | *1.3* | | |
| | Structure of Gross Electricity Production in % | | | | | | | |
| Lignite | 31.1 | 16.0 | 18.8 | 20.1 | 16.9 | 15.8 | | |
| Hard Coal | 25.6 | 7.5 | 9.3 | 11.0 | 7.5 | 5.6 | | |
| Nuclear Energy | 27.7 | 11.2 | 11.8 | 6.0 | 1.4 | 0.0 | | |
| Natural Gas | 6.5 | 16.5 | 15.4 | 13.7 | 15.0 | 16.0 | | |
| Mineral Oil | 2.0 | 0.8 | 0.8 | 1.0 | 1.0 | 1.0 | | |
| Renewables | 3.6 | 43.8 | 39.8 | 44.1 | 53.8 | 56.9 | | |
| Other | 3.5 | 4.3 | 4.2 | 4.1 | 4.4 | 4.7 | | |
| **Gross Electricity Production** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | | |

*1) Some figures are preliminary and estimates*

*Discrepancies in the totals are due to rounding off*

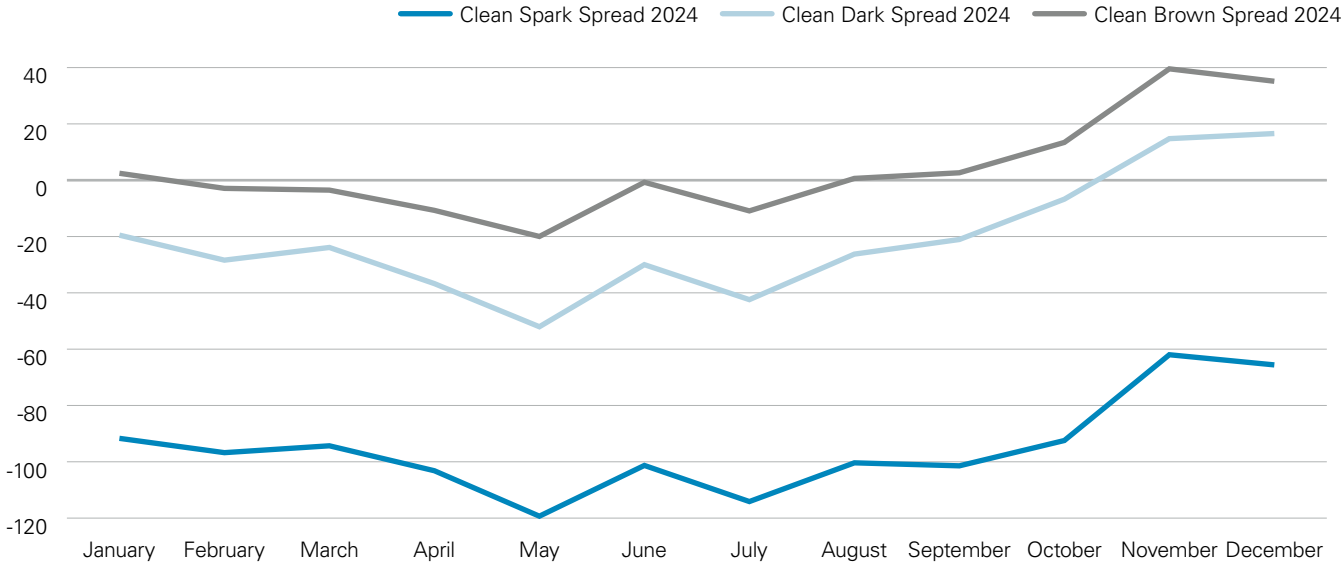
*Sources: German Association of Energy and Water Industries (BDEW); The German Coal Industry's Statistical Office; Working Group on Energy Balances (AGEB); Federal Statistical Office (Destatis); Working Group on Renewable Energies-Statistics (AGEE-Stat) (for renewables)*

Figure 11

AGEB
AG Energiebilanzen e.V.

**Profit Situation of Different Power Plant Types in 2024**

2024, in EUR/MWh (existing power plants)




*Sources: Our own calculations in line with the Federal Statistical Office (Destatis), European Energy Exchange AG (EEX), and The German Coal Industry's Statistical Office*

thus, were not active on the electricity market, but kept in an operational-ready mode.

According to preliminary figures, a total of 80.3 billion kWh of electricity were generated from natural gas in the power plants of electricity suppliers, in industrial enterprises, and in the combined heat and power plants of other electricity producers during the year under review. Thus, electricity production from natural gas fired power plants increased by 4.6 %. The gas prices on the spot market, which were lower than in 2023, managed to maintain the competitive situation of gas-fired power plants even though a slight increase of the wholesale prices was observed once again in 2024. The indicators which are typically used to measure the contribution margin of power plants in a specific market environment (fuel prices, $CO_2$ price, EEX spot market price, degree of efficiency) are the so-called "clean spark spread" (gas-fired power plants), the "clean dark spread" (hard coal fired power plants) as well as the "clean brown spread" (lignite-fired power plants).[33] Figure 11 shows the changes in the profit situation of natural gas fired power plants in relation to coal-fired power plants over the course of the year 2024.[34]

After the installed capacity of gas-fired power stations had increased considerably in 2023 as a result of, above all, the commissioning of special grid-technical equipment (bnBM) which support the system security and reliability in the grid, it decreased slightly in 2024 and amounted to about 33,735 MW at the end of 2024. 1,340 MW of which were in the grid reserve while another 1,375 MW were in the capacity reserve and 988 MW of which assumed the role of special grid-technical equipment (bnBM) designed to stabilize the grid in accordance with § 11 Para. 3 of the Energy Industry Act (EnWG). 1,466 MW were temporarily decommissioned, i. e. more than 15 % of the installed capacity were not active on the electricity market.

*33) The calculation of "clean spreads" represents an approximation of the costs incurred from the conversion of fuels into electric power while also taking the $CO_2$ costs into account. Consequently, this indicator helps assess whether the production in the individual type of power plant under review will be profitable with regard to the specific market situation or whether the production should be limited and/or suspended. The "clean spreads" shown herein were ascertained with the help of average degrees of efficiency in the existing power plant pool, which means that they do not refer to the competitive situation of any single plants or new plants.*

*34) For lignite, a constant fuel price of € 833/MWh was assumed while for power plant coal (hard coal), the average price for coal from third countries (and since 2018, its price as updated by the German Coal Importers Association (VDKi)) and for power plant gas, the updated price in line with the Coal Industry's Statistics published by the Statistik der Kohlenwirtschaft e. V. association were used.*

With the decommissioning of the last three power plant units (Neckarwestheim 2, Emsland, and Isar 2) on April 15, 2023, nuclear power in Germany no longer made any contributions to the energy supply in 2024.

Wind energy continued to be the most important renewable energy source in Germany, even though onshore wind turbines produced with 112.8 billion kWh about 4.3 % less electricity than in 2023 due to the months in autumn which had relatively low wind. In contrast, offshore wind turbines increased their output; with 26.1 billion kWh, they actually supplied over 9 % more electricity than in the previous year. The reason for this development was, on the one hand, the continued growth of offshore wind turbines in 2023 and 2024, but, on the other hand, also the reduced curtailment of wind turbines in 2024 when compared to the previous year. All told, onshore and offshore wind turbines, thus, produced a total of 138.9 billion kWh in 2024 which translates into a share of 27.7 % in the entire (gross) electricity production. In 2024, the installed capacity of onshore wind energy grew by about 2,600 MW to now approximately 63,600 MW according to preliminary calculations. With about 3,300 MW, the gross capacity increase was considerably higher; however, the first generation of a large number of installed wind turbines are now reaching the end of their operating life so that the additional construction of wind turbines is offset by the decommissioning volumes which were higher than in previous years. The installed capacity of offshore wind turbines grew by 742 MW to now 9,215 MW.

With an electricity production output of 74.3 billion kWh, photovoltaic systems recorded a significant increase of more than 16 % in 2024. And this despite a year of below average sunshine hours. When interpreting the electricity production from photovoltaic systems, it needs to be kept in mind that this includes not only the electric power fed into the grid supplying the general public, but also the plants' own in-house consumption on site. The main reason for the significant increase in electricity production from photovoltaic systems was once again to be found in the record expansion of the existing capacities by about 17,000 MWp in 2024 after a production capacity of about 15,300 MWp had already been added in 2023. All told, the installed photovoltaic capacity in Germany has currently reached a level of 100,000 MWp.

According to preliminary data, 43.5 billion kWh of electricity were produced from solid, liquid, and gaseous biomass (including landfill gas, sewage gas as well as sewage sludge) in 2024 and, thus, slightly less (-0.5 %) than during the previous year. With the proportionate volume produced in waste-fired power plants (domestic trash divided equally into regenerative and non-regenerative) from biogenic waste, a total of about 49 billion kWh of electricity were produced from biogenic energy sources in Germany in 2024.

Electricity production from hydropower increased by more than 13 % to 22.5 billion kWh due to the to some extent above average precipitation and, related thereto, the correspondingly higher volume of available water in 2024. In the final analysis and when compared to the previous years, electricity production from hydropower reached, thus, not only an above average high production level; in fact, it was the highest production value since 2013.

In 2024, power storage facilities connected to the German electricity grid (with a net nominal capacity of at least 1 MW and/or a storage capacity of at least 1 MWh) collected a total of 8.6 billion kWh of electric power and fed 6.6 billion kWh back into the grid again. Pumped storage plants accounted for the largest proportion in this development: While the pumping capacity was 8.3 billion kWh, 6.3 billion kWh were withdrawn from the plants. The usable storage capacity of these large-scale storage facilities amounted to 140.3 GWh at the end of 2024.[35)]

Furthermore, a large number of small battery storage units (with a net nominal capacity of less than 1 MW and/or a storage capacity of less than 1 MWh), mostly so-called home storage units, must be added as well. On the basis of data from the Core Energy Market Data Register, there were more than 1.7 million small battery storage units in Germany at the end of 2024 which translates into an increase of 0.6 million units.

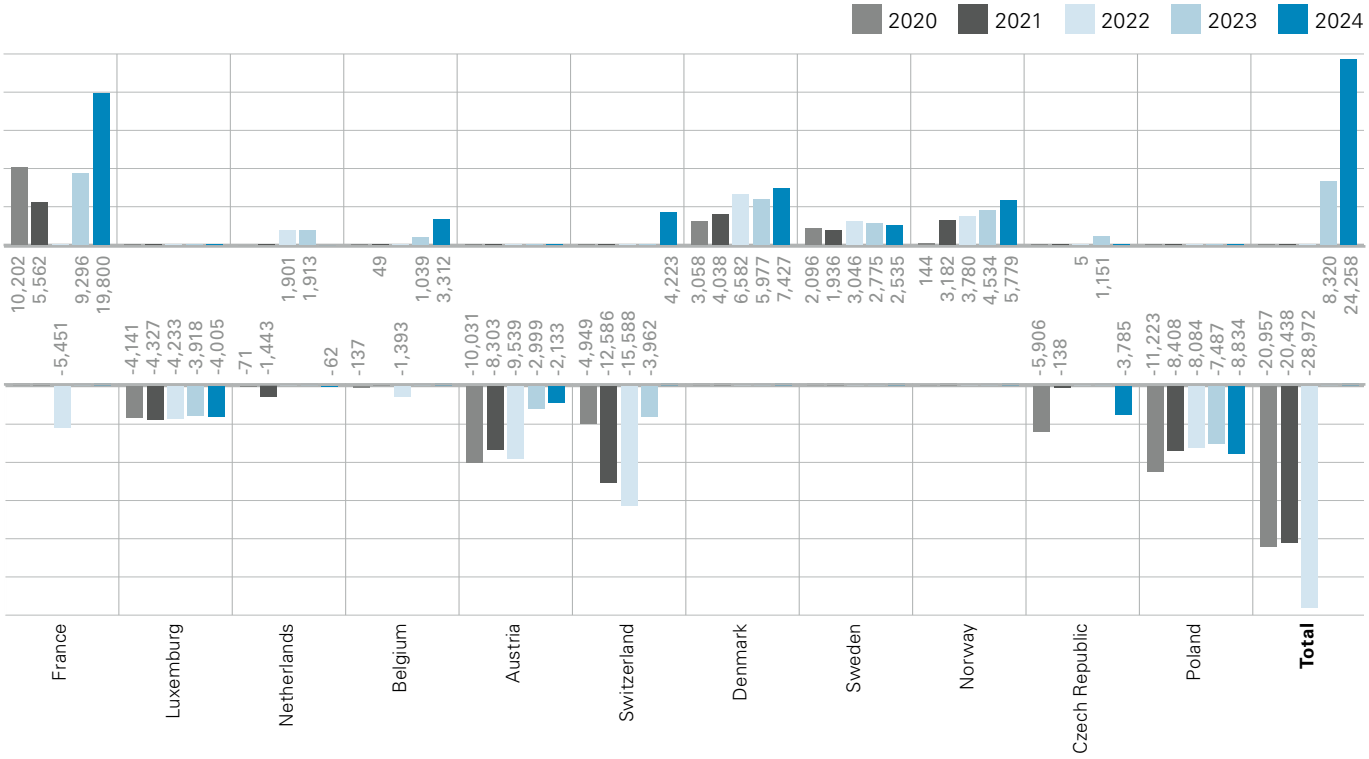
*35) In addition, pumped storage facilities exist in Austria and Luxemburg which are connected exclusively to the German power grid. According to the Core Energy Market Data Register, these storage facilities provide an additional capacity of 3.6 GW and a storage capacity of about 960 GWh.*

Figure 12

AGEB
AG Energiebilanzen e.V.

**Germany's Electricity Exchange Balance with Neighboring Countries between 2020 and 2024**

Electricity flows in billion kWh




*Source: German Association of Energy and Water Industries (BDEW)*

The installed small battery storage units had on average a usable storage capacity of 9.3 kWh. The accumulated storage capacity of all installed storage units having this size was 15.9 GWh at the end of 2024, of which 5.1 GWh had actually been added just during the reporting year alone. The accompanying feed-in capacity amounted to 10.1 GW at the end of the year which translates into an increase of almost 53 % in 2024.

In 2024, 24.3 billion kWh more electric power flowed from abroad to Germany than the other way around from Germany to neighboring countries.[36] Germany was, thus, once again a net importer of electricity after 2023. Electricity imports grew by 16.2 % to 80.3 billion kWh when compared to the previous year while electricity exports dropped by 7.8 % to 56.0 billion kWh (please see Figure 12).

Particularly high import surpluses were recorded, in the order of their relevance, for the exchange with France (19.8 billion kWh), Denmark (7.4 billion kWh), and Norway (5.8 billion kWh). Import surpluses were also observed in the electricity exchange with Switzerland, Belgium, and Sweden in 2024. Whereas an export surplus was attained in the electricity exchange with Poland (8.8 billion kWh), Luxemburg (4 billion kWh), the Czech Republic (3.8 billion kWh) as well as Austria (2.1 billion kWh) and the Netherlands.

The changes in the exchange of electricity are a sign of a functioning single European electricity market. Also in 2024, cheaper production options were at times available in neighboring countries to meet the electricity demand in Germany than would have been the case domestically. Electricity production from hard coal dropped not only due to the transfer of hard coal fired power plants into the grid reserve, but was also

*36) The official data which are also used in the Energy Balance for Germany, please see Table 12 of this report, cannot be used hereinafter due to data confidentiality of the federal states. Against this backdrop, the deviations in the foreign trade with electricity indicated in Table 12 are based on another data source (ENTSOE).*

Table 14

AGEB
AG Energiebilanzen e.V.

## Electricity Balance of Germany's Power Supply between 2020 and 2024

| | 2020 | 2021 | 2022 | 2023 | 2024 | Changes 2024/2023 |
|---|---|---|---|---|---|---|
| | Billion kWh | | | | | Change in % |
| **Gross Electricity Production** | **574.7** | **587.1** | **577.9** | **511.3** | **501.2** | **-2.0** |
| Self-Consumption in Power Plants | -27.7 | -29.8 | -28.3 | -24.9 | -22.0 | -11.4 |
| **Net Electricity Production** | **547.0** | **557.3** | **549.5** | **486.4** | **479.1** | **-1.5** |
| Electricity Flows from Foreign Countries | 48.0 | 51.7 | 49.3 | 69.3 | 81.7 | 17.8 |
| Electricity Flows into Foreign Countries | 66.9 | 70.3 | 76.6 | 60.1 | 55.4 | -7.8 |
| **Net Domestic Electricity Volume** | **528.1** | **538.7** | **522.3** | **495.6** | **505.4** | **2.0** |
| Pump Current Consumption | 8.8 | 7.2 | 8.1 | 7.3 | 8.3 | 13.9 |
| Grid Losses and Unrecorded Factors | 26.9 | 26.6 | 26.3 | 25.8 | 26.1 | 1.2 |
| **Net Electricity Consumption** | **492.4** | **504.9** | **487.8** | **462.5** | **471.0** | **1.8** |
| Proportion of: | | | | | | |
| Mining and Manufacturing Industries | 206.7 | 214.4 | 201.4 | 185.8 | 188.1 | 1.3 |
| Households | 128.0 | 139.3 | 135.2 | 131.4 | 133.0 | 1.2 |
| Commerce and Trade, Public Institutions | 135.6 | 128.0 | 126.8 | 119.9 | 123.5 | 3.0 |
| Transportation | 11.5 | 12.9 | 14.1 | 16.0 | 17.0 | 6.1 |
| Energy Consumption in the Conversion Sector (without Power Plants' Own In-House Consumption) | 10.6 | 10.4 | 10.4 | 9.5 | 9.4 | -1.7 |
| **Gross Domestic Electricity Consumption** | **555.8** | **568.5** | **550.6** | **520.5** | **527.4** | **1.3** |

*1) Some figures are preliminary and estimates*

*Sources: Working Group on Energy Balances (AGEB); Federal Statistical Office (Destatis); German Association of Energy and Water Industries (BDEW)*

increasingly pushed out of the market in Germany because the electricity consumption level continued to be low. The expansion of renewable energies is moving ahead not only in Germany, but also in other European countries and resulted there in a higher electricity production from renewables during sunny months as well as during phases of high winds.

Higher electricity imports do not necessarily indicate any dependence on other European countries when it comes to the supply of electricity nor do they indicate any shortfall in Germany because sufficient domestic production capacities to cover the energy demand in Germany would have been available at any time. The utilization of cheaper production options in other European countries – in particular from renewable energies as well as from nuclear power plants – actually substituted fossil-based electric power generation in Germany. Consequently, the importation of electricity actually led to a reduction of emissions in the German $CO_2$ balance.

According to initial data, the end consumption of electricity (net electricity consumption) amounted to 471 billion kWh in 2024; this translates into an increase of 1.8 % when compared to the previous year. The growth in electricity consumption included all consumption sectors (please see Table 14).

In 2024, the largest electricity consumer by far was still industry with a share of nearly 40 %, irrespective of significant absolute declines in the consumption of electricity which had been partially observed in this sector during the previous years; followed by private households with a share of 28.2 %. The share of the trade, commerce, and service sector was more than 26 %, and the share of the transportation sector nearly 4 %.

The electricity consumption of industry (mining and manufacturing industries, in the classification of the German Energy Balance, Energy Balance Row 60; that is, without electricity input in such energy conversion

sectors as, for example, refineries, coking plants, etc.) is expected to have amounted to a total of 188 million kWh during the year under review which translates into an increase of 1.3 % when compared to 2023. The electricity consumption of private households increased by 1.2 % over the same period of time. According to first data and/or estimates, the transportation sector is expected to exhibit a plus of 6.1 % for the traction current of rail vehicles and for electric mobility. The electricity consumption of enterprises in the trade, commerce, and service sector rose by 3 % to more than 123 billion kWh in 2024.

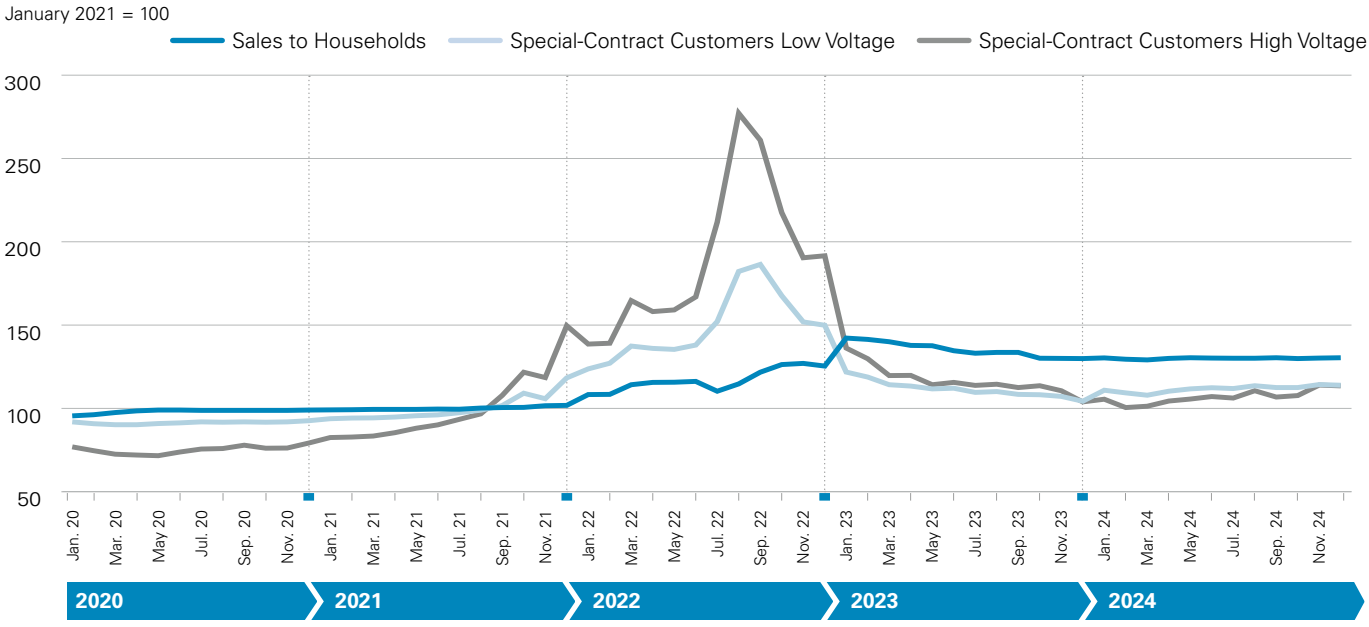
The average electricity price for industry (160,000 kWh to 20 million kWh, supply in the medium voltage range, including electricity tax) dropped to 16.99 ct/kWh in 2024 when compared to the previous year. This translates into a reduction of 7.47 ct/kWh (or 30.5 %) when compared to the average price of the previous year. The reason for the decline in the industrial electricity price when compared to 2023 was the reduction of taxes, duties, and levies for industrial customers (concession fee, CHP levy, § 19 Electricity Grid Charges Ordinance (StromNEV) levy, offshore grid levy, and electricity tax) to 1.46 ct/kWh. For comparison: In 2023, the taxes, duties, and levies imposed on the industrial electricity price had still amounted to a total of 2.86 ct/kWh.

In particular, the reduction of the electricity tax for the production industry became effective on January 1, 2024. By raising the relief amount in accordance with § 9b of the Electricity Duty Act (StromStG), the electricity tax was reduced from the current € 15.37/MWh or 1.537 ct/kWh to € 0.50/MWh or 0.05 ct/kWh within the framework of the so-called Budget Financing Act (HFinG) of 2024. With this electricity price package, the electricity tax was lowered permanently for all enterprises of the production industry to the minimum value that is permitted by the European Union. In 2024, this development was counterbalanced by an increase in the offshore grid levy and the § 19 Electricity Grid Charges Ordinance (StromNEV) levy which, though, was overcompensated by the reduction of the electricity tax (and of the CHP levy).[37)]

Figure 13

AGEB
AG Energiebilanzen e.V.

**Electricity Producer Price Index for Special-Contract Customers and Sales to Households in Germany between 2020 and 2024**

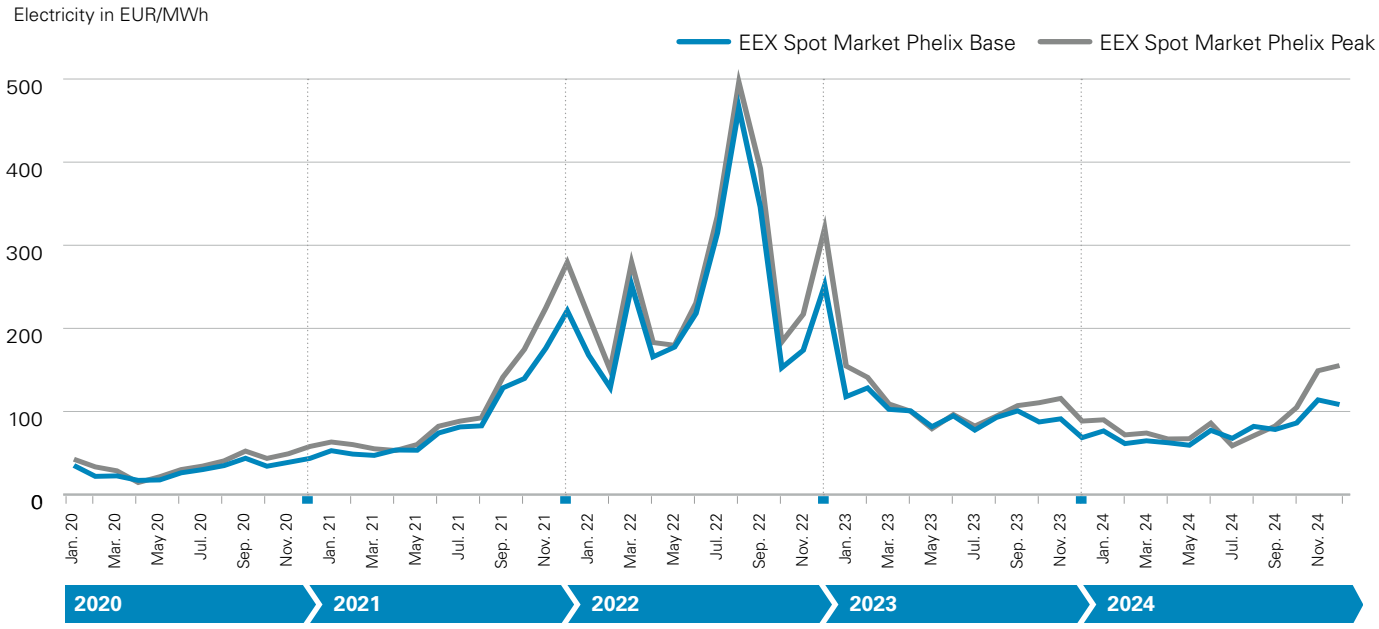



*Source: Federal Statistical Office (Destatis)*

37) *For more details and data, please see the Electricity Price Analysis published by the German Association of Energy and Water Industries (BDEW):* BDEW-Strompreisanalyse, Haushalte und Industrie, Dezember 2024. *Internet: https://www.bdew.de/media/documents/BDEW-Strompreisanalyse_12-2024_Q796OxD.pdf (download date: 2025-03-05; currently only available in German).*

Figure 14

**Development of Electricity Prices on the EEX Spot Market (Phelix Base and Peak) between 2020 and 2024**




*Source: Udo Leuschner,* Energiechronik *(Internet: https://www.energie-chronik.de/phelix.htm, download date: 2025-04-07; currently only available in German)*

When interpreting the development of electricity prices for industrial customers (average electricity price for new contracts in industry in ct/kWh, annual consumption between 160,000 kWh and 20 million kWh, supply in the medium voltage range), one must also consider that the prices for the procurement, power grid charges, and distribution costs also sank in 2024; namely, by about 6.1 ct/kWh (which corresponds to 28.2 %).

Electricity prices for customers from private households decreased by 10.5 % to an average level of 40.92 ct/kWh in 2024 when compared to the previous year.[38] This was due to the falling prices in the wholesale trade. Even though the effect only has an impact on the household tariffs with a slight time delay and not with the same dynamism, the proportion of the procurement and distribution costs of the electricity price, which is primarily influenced by the wholesale price, decreased by 6 ct/kWh and/or from 52 % to 43 % in 2024.

The governmental charges and fees consisting of taxes, duties, and levies also decreased from 12.38 ct/kWh to 11.82 ct/kWh in 2024 when compared to the previous year. Based on the total price, however, their share actually increased slightly by 2 percentage points to 29 % since the governmental charges and fees decreased to a lesser extent when compared to the wholesale prices. This development was thwarted to some degree by the adjustment of the grid charges. They increased on average from 9.52 ct/kWh to 11.82 ct/kWh so that their share in the electricity price increased to 28 % (please see Figure 13).

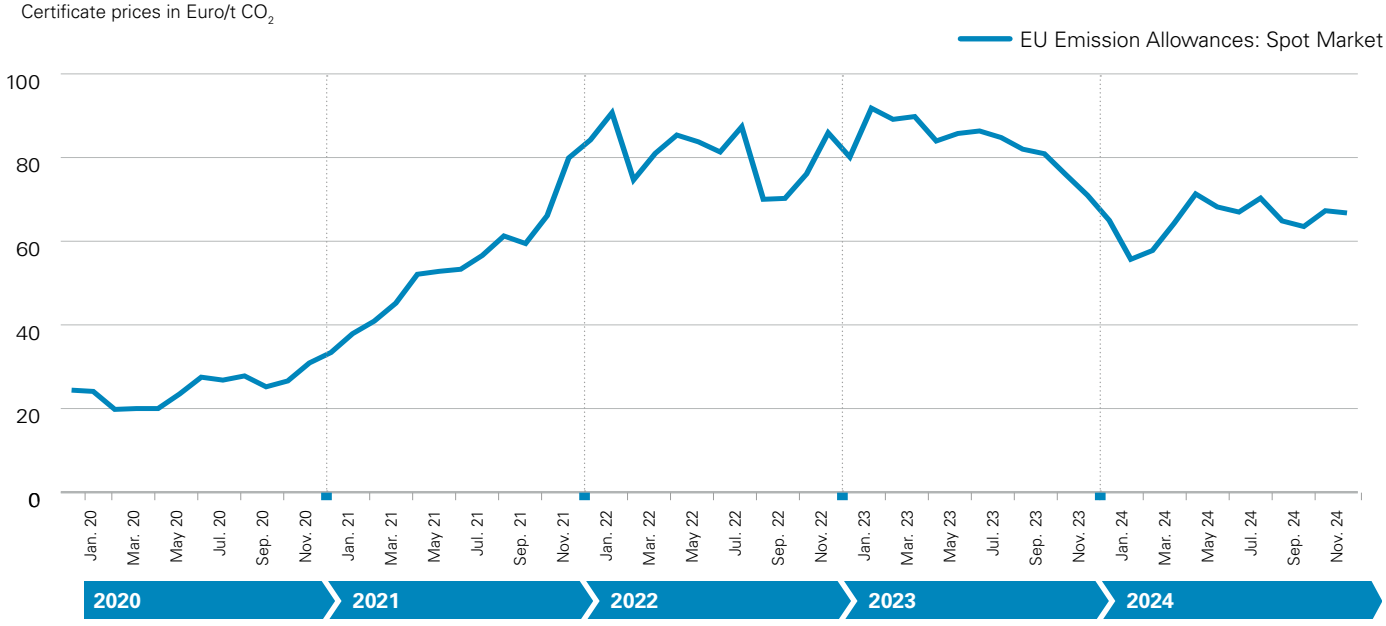
If one were to take a look at the monthly development of the exchange prices for electricity (spot market), then the following picture emerges: In 2022, the electricity exchange price had undergone strong fluctuations and reached a new all-time high with € 465.18/MWh (Phelix Base) in August 2022. During the fourth quarter of the year, the situation on the market calmed down, the wholesale price dropped significantly again, and

38) *Average electricity price for a private household in ct/kWh; annual consumption of 3,500 kWh; base price pro rata share included; tariff-based products, basic supply tariffs, and new customer tariffs included; not volume-weighted. For more details, please see the Electricity Price Analysis published by the German Association of Energy and Water Industries (BDEW):* BDEW-Strompreisanalyse, Haushalte und Industrie, Dezember 2024. *Internet: https://www.bdew.de/media/documents/BDEW-Strompreisanalyse_12-2024_Q796OxD.pdf (download date: 2025-03-05; currently only available in German).*

Figure 15

AGEB
AG Energiebilanzen e.V.

**European Emission Allowances on the EEX Spot Market between 2020 and 2024**




*Source: European Energy Exchange AG (EEX)*

ended at a level of € 251.62/MWh in December 2022. The price level in 2023 underwent comparably few fluctuations when compared to the previous year. In January, the electricity exchange price began at € 117.83/MWh and ended with € 68.52/MWh in December. In 2024, the wholesale price started at € 76.57/MWh in January and rose to € 108.32/MWh until the end of the year (please see Figure 14).

In 2024, the annual average of the electricity exchange price (Phelix Base) decreased by 18 % to about € 78.17/MWh when compared to 2023, and the EEX electricity price (Phelix Peak) declined by almost 16 % to € 89.74/MWh during the same period of time.

The $CO_2$ emissions of the electric power industry fell once again sharply over the course of the year 2024 which can be traced back in particular to the nearly 16 % decline in coal-fired power generation.

A further driving force is to be found in the fact that Germany imported considerably more electricity than it exported it in 2024. In addition, the continued expansion of renewable energies as well as the relatively minor increase in electricity consumption also reinforced this development.

However, relevant and decisive for Germany to reach its climate targets in line with the Climate Protection Act (KSG) is the energy industry sector which is categorized differently when it comes to electricity production and which includes not only $CO_2$, but also other greenhouse gas emissions. The largest proportion of the emissions are actually produced here in electric power generation plants; however, the energy industry sector does not include any emissions of the electric power generation plants of industry, but instead, for example, emissions coming from district heating plants, mineral oil refineries, or diffuse emissions from the gas supply. In 2024, the emissions in the energy industry sector sank according to preliminary calculations by 18 million tons of $CO_2$ equivalents. With 185 million tons of $CO_2$ equivalents, the energy industry reached a 61 % reduction of the $CO_2$ emissions when compared to 1990 and, thus, significantly exceeded the indicative reduction path for the sector between the target years 2022 and 2030 as specified in the Climate Protection Act (KSG) which was to have been 220 million tons of $CO_2$ equivalents for the year 2024.

According to preliminary calculations, the $CO_2$ emissions of the electric power industry – in other words, the $CO_2$ emissions of all electric power

generation plants as a whole (including the plants of industry and electricity generation from CHP plants within the classification of the German Energy Balance) in Germany – dropped significantly by nearly 10 % to 136.7 million tons of $CO_2$ in 2024 (in 2023: 151 million tons of $CO_2$). This was accompanied by an additional reduction of specific emissions in electric power generation.

Prices for $CO_2$ emissions certificates developed primarily sideways and ranged between approximately € 55.00 and € 70.00 per ton of $CO_2$ during the course of the year 2024; by the end of the year, they reached a level of approximately € 67.00 per ton of $CO_2$. The annual average price was around € 65.00 per ton of $CO_2$; in 2023, the average price had still been € 83.00 per ton of $CO_2$ (please see Figure 15).

## Renewable Energy [39)]

In 2024, the primary energy consumption of renewable energy sources amounted to a total of 2,110 PJ (please see Table 15). When compared to the previous year (2,079 PJ), this equals an increase of 1.5 %.

The main reasons were an increase of 14 % in power generation based on photovoltaics as well as an increase of 15 % in environmental heat and geothermal energy utilized with the help of heat pumps. In the transportation sector, approximately 12 % less biofuels were used when compared to the previous year which was, in part, due to an amendment to the 38th Federal Immission Control Ordinance (BImSchV).

The entire electricity production from renewable energy sources amounted to a total of about 285 billion kWh in 2024. Compared to the previous year, this translates into an increase of 3.6 % (2023: 275.1 billion kWh).

In 2024 as well, wind energy was again the most important energy carrier in the German electricity mix; it ranked far ahead of natural gas and lignite. Onshore and offshore wind turbines covered about 26 % of the gross electricity consumption. Even though the production on shore declined by 4.3 % due to average weather conditions when compared to the very windy previous year, onshore wind turbines produced more electricity than lignite and hard coal fired power plants taken together. Furthermore, the electricity production of offshore wind farms increased by 9 %. In addition to the influence of the weather, the continued expansion of production capacities also contributed to this development: While 742 MW of new production capacities went into operation off shore, the net addition on shore reached 2,595 MW in 2024 (this translates into a decline of about 13 % when compared to the previous year). Thus, a total wind power capacity of about 63.6 GW was installed on shore and approximately 9.2 GW off shore at the end of 2024 (source: Core Energy Market Data Register published by the Federal Network Agency (BNetzA); data status: February 2025).

In 2024, electricity production from photovoltaics covered already 14 % of the domestic gross electricity consumption. With 74.3 billion kWh, it attained a share of 26 % in the total electricity production from renewable energy sources. Once again, the installed capacities were expanded substantially; with the addition of 16,735 MW, solar-based electricity production increased by 16 % and/or, in absolute terms, by 10.4 billion kWh even though the global solar radiation was slightly lower than that of the previous year. Thus, a total PV module capacity of 99.8 GW was installed at the end of the year 2024 (source: Core Energy Market Data Register published by the Federal Network Agency (BNetzA); data status: February 2025).

Electricity production from biomass including biogenic waste was with about 49.0 billion kWh in 2024 about 1 % below the previous year's level. Due to the weather conditions with very high precipitation, electricity production from hydropower increased by 2.6 billion kWh; with 22.5 billion kWh, it attained the highest value since 2013. When it comes to the primary-energetic balancing of electricity production from renewable energy sources, it needs to be pointed out that a special energy-statistical feature, the so-called efficiency principle, is applied here: In the absence of a physically ascertainable calorific value, a fictitious efficiency of 100 % is assumed for the conversion of energy in the balance sheets for the energy carriers hydropower, wind power, and photovoltaics while the use of biogenic fuels in power plants and other production facilities is entered with their actual energy content in the balance sheets. The efficiency principle, thus, results in the fact that, for example, the primary energy contribution of electricity production from photovoltaics (conversion input: 267 PJ) shown in Table 15 is entered in the balance sheet as being 29 % lower than the fuel input for

*39) This text is based on the work conducted by the Working Group on Renewable Energies-Statistics (AGEE-Stat; last update: 2025-05-12). For further information on the development of renewables in 2024, please turn to the background paper published by the Federal Environmental Agency (UBA) under the title:* Erneuerbare Energien in Deutschland - Daten zur Entwicklung im Jahr 2024: *https://www.umweltbundesamt.de/publikationen/erneuerbare-energien-in-deutschland-2024 (currently only available in German).*

Table 15

## Renewable Energy in Germany in 2023 and 2024 According to Its Use and Energy Sources

| | Hydropower | | | Wind Energy (Onshore and Offshore) | | | Solar Energy | | | Geothermal Energy | | | Biomass | | | Waste | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2023 | 2024 | Changes | 2023 | 2024 | Changes | 2023 | 2024 | Changes | 2023 | 2024 | Changes | 2023 | 2024 | Changes | 2023 | 2024 | Changes | 2023 | 2024 | Changes |
| | Petajoules | | % | Petajoules | | % | Petajoules | | % | Petajoules | | % | Petajoules | | % | Petajoules | | % | Petajoules | | % |
| Domestic Production | 72 | 81 | 12 | 510 | 500 | -2 | 263 | 299 | 12 | 103 | 116 | 12 | 1,007 | 1,016 | 1 | 130 | 129 | -1 | 2,085 | 2,142 | 2.7 |
| Foreign Trade Balance | | | | | | | | | | | | | -5 | -32 | | | | | -5 | -32 | |
| **Primary Energy Consumption** | **72** | **81** | **12** | **510** | **500** | **-2** | **263** | **299** | **12** | **103** | **116** | **12** | **1,002** | **984** | **-2** | **130** | **129** | **-1** | **2,079** | **2,110** | **1.5** |
| Use in Power Plants (Electricity) | 72 | 81 | 12 | 510 | 500 | -2 | 230 | 267 | 14 | 7 | 8 | 9 | 322 | 319 | -1 | 61 | 58 | -4 | 1,201 | 1,233 | 2.6 |
| Use in Power and Heating Plants (Heat) | | | | | | | 0 | 0 | 27 | 6 | 6 | 2 | 49 | 50 | 1 | 48 | 49 | 3 | 103 | 105 | 2.2 |
| **Consumption during Conversion, Losses** | | | | | | | | | | | | | 16 | 17 | 2 | 3 | 2 | -3 | 19 | 19 | 1.2 |
| **Final Energy Consumption** | | | | | | | **33** | **31** | **-4** | **90** | **103** | **13** | **613** | **598** | **-3** | **19** | **19** | **0** | **754** | **751** | **-0.5** |
| Industry | | | | | | | 0 | 0 | 0 | 1 | 1 | 0 | 96 | 96 | 0 | 19 | 19 | 0 | 116 | 116 | 0.0 |
| Transportation | | | | | | | | | | | | | 132 | 116 | -13 | | | | 132 | 116 | -11.7 |
| Households, Trade, Commerce, Services | | | | | | | 33 | 31 | -4 | 89 | 102 | 13 | 385 | 385 | 0 | 0 | 0 | -20 | 507 | 519 | 2.4 |

*All values are preliminary (last update: May 12, 2025)*

*Source: AGEEStat*

electricity production from biomass including biogenic waste (conversion input: 377 PJ) even though electricity production from photovoltaics exceeded electricity production from biomass including biogenic waste by 52 %.

The entire primary energy consumption of biomass and biogenic waste amounted to 1,113 PJ in 2024 and was, thus, approximately 2 % below the previous year's value (1,132 PJ). About 45 % of which were used in the conversion sector, i. e. essentially as a fuel for the generation of electricity and district heat including the in-house consumption of the production plants. The majority (55 %) of the energetic use of biomass, however, accounted for the final energy consumption as had been the case in the previous years. More than three fifths (385 PJ, +0 %) thereof were consumed by private households as well as enterprises in the trade, commerce, and service sector while the share of the transportation sector amounted to approximately a fifth (116 PJ, -12 %) due to the admixture of liquid and gaseous biofuels, and the share of the industrial sector was also nearly a fifth (115 PJ, +0 %). Nevertheless, estimates on the final energy consumption of biogenic fuels are still associated with great uncertainties at this time because the requisite empirical data will only be available over the course of the year.

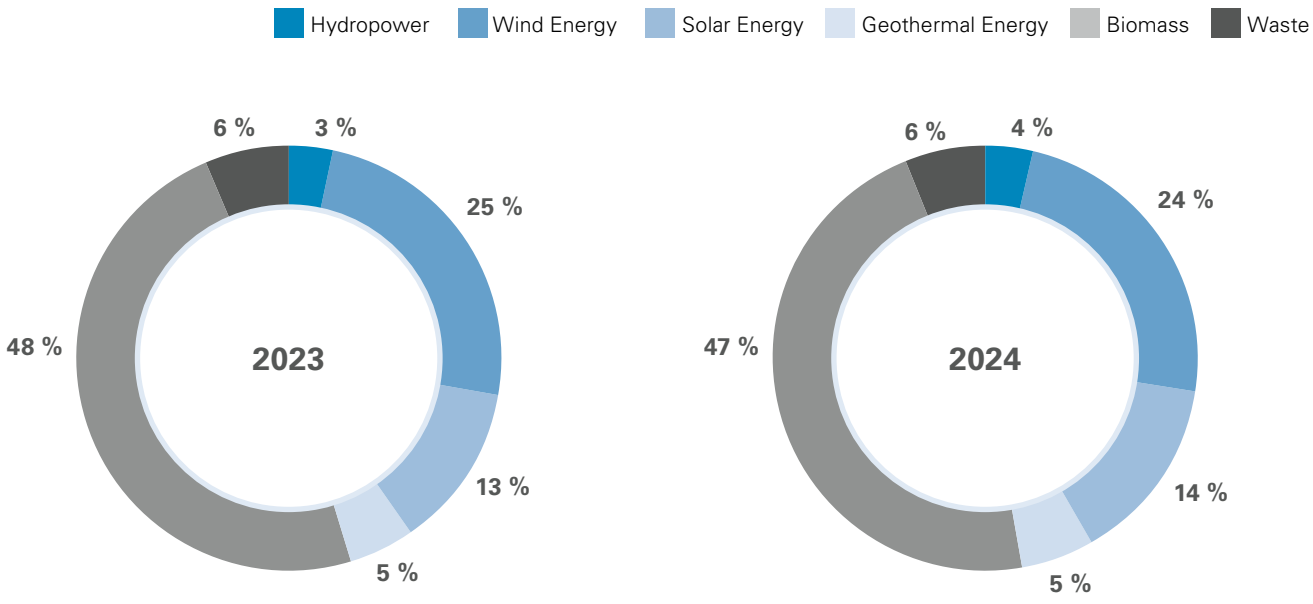
Other renewable energy carriers including environmental heat, near-surface geothermal energy, deep geothermal energy, and solar thermal energy accounted for a share of 7 % in the total primary energy consumption of renewables in 2024. Despite a sharp decline in the sales of electric heat pumps by approximately 47 percent (source: German Federal Heat Pump Association (BWP)), the total number of heat pumps increased by approximately 10 % to about 2.3 million heat pumps that were installed in 2024. Consequently, the utilizable environmental heat and near-surface geothermal energy generated through these heat pumps increased as well; namely, by 15 % to 102 PJ. In addition, about 17 PJ of primary energy were used for the deep geothermal production of electricity and heat. Solar thermal heat generation decreased proportionally by 4 % to 32 PJ due to the lesser amount of solar radiation in the year 2024. According to the German Solar Industry Association (BSW), the demand for new solar thermal units to support the hot water and heating systems

Figure 16

AGEB
AG Energiebilanzen e.V.

**Structure of Renewable Energy Sources in Germany between 2023 and 2024**

Share of total primary energy consumption of renewable energies in %




*Source: Working Group on Renewable Energies-Statistics (AGEE-Stat)*

experienced a decline once again in 2024. When also considering the decommissioning of units, then the total collector surface installed in Germany dropped slightly to 22.2 million square meters.

An analysis of the individual technologies designed to utilize renewables clearly illustrates that the energy carrier specific primary energy consumption shows different tendencies (please see Figure 16). When compared to 2023, wind power lost shares (-0.8 percentage points) due to the reduced supply of wind (despite the addition of new wind turbines). The same applies to biomass and biogenic waste (renewable) whose market shares in the entire primary energy consumption of renewables (-1.5 % and -0.1 % respectively) decreased again in 2024 when compared to the previous year. In contrast, solar energy (+1.5 percentage points), geothermal energy (+0.6 percentage points), and hydropower (+0.4 percentage points) were able to increase their shares in the growing market of renewables.

Biomass (including renewable waste) continued to be by far the most significant energy carrier amongst renewable energies with a share of about 52.8 % in 2024, followed by wind energy with 23.7 % and solar energy with 14.2 %.

## Energy Efficiency in Germany

Already within the scope of Germany's national Sustainable Development Strategy, the Federal Government had established the objective of doubling the macroeconomic energy productivity by 2020 when compared to the respective figures ascertained for 1990. The Energy Efficiency Strategy 2050 also continues to see improvements in increasing the energy efficiency as a key strategy for the success of the targeted energy turnaround.

It should be kept in mind, though, that empirically determining energy efficiency is by no means clear and simple, and not every technically feasible increase in energy productivity is, at the same time, also economically viable. Because efficiency improvements actually require not only time, but usually also the application of innovative technologies and, thus, the increased use of physical capital.

A typical indicator for the measurement of energy efficiency is considered to be the energy intensity; namely, the consumption of primary or final energy in relation to such guiding economic parameters as, for example, the gross domestic product or the population. Every reduction of the energy intensity defined that way is synonymous with an increase in energy productivity and/or energy efficiency.

While the macroeconomic performance decreased by 0.2 % in light of an even more considerable decline in energy consumption, the macroeconomic energy productivity in Germany improved by about 1.1 % in 2024 when compared to the previous year (based on the original values ascertained for primary energy consumption). By using a unit of primary energy (GJ), it was possible to generate an estimated gross domestic product of € 342.60 in 2024; in 2023 (final data), this value had still amounted to € 339.

Compared to 1990 and on an annual average, the macroeconomic energy productivity (unadjusted values) increased by about 2.9 %.

A further (consumption-dampening) impact which is reflected in the development of the original values of the macroeconomic energy consumption and/or energy productivity emanated from the mild weather conditions in 2024 when compared to the long-term average between 1990 and 2023 (as well as to the previous year). By excluding the temperature influence when compared to the long-term average (1990 to 2023) and adjusted by stock level effects,[40] the macroeconomic energy productivity would have decreased slightly when compared to the previous year 2023; namely, by 0.1 %. Related to the long-term trend (1990 to 2024), the adjusted value hovered around a level of 2.8 % per annum (please see Table 16 and Figure 17). All told, the decoupling process between the overall economic development and energy consumption continued during the current reporting year 2024 (as measured by the long-term trend); albeit to a lesser extent.

When interpreting the indicator macroeconomic energy efficiency and/or energy productivity, it should be kept in mind that their development is typically due to numerous, partially overlapping causes. In particular, efficiency is determined by such influencing factors as economic growth (utilization of the capital stock and/or production system), energy prices, technical improvements of production processes (degree of modernity of the capital stock) as well as the demand-induced intersectoral and intrasectoral structural change.[41] In the past, the sectoral structural change tended to have had an energy consumption reducing effect in Germany.

*40) Unadjusted and/or observed original values are not only co-determined and/or influenced by the weather, but also by changes in the stocks and inventories of storable energy carriers (such as, for example, light fuel oil). Due to mild weather conditions and reduced prices, for example, when it comes to light fuel oil, private consumers increased the filling levels of their storage tanks by an estimated volume of 87 PJ (which equals approximately 2 million tons). All told, private and commercial consumers (trade, commerce, and service sector) stocked up on light fuel oil to refill their tanks by about 96 PJ in 2024. Increasing the tank levels causes sales to increase as well but has a consumption-dampening effect when taking adjusted figures into account; in contrast, mild weather causes sales to decline but has a consumption-enhancing effect when taking adjusted figures into account.*

*41) In the market economy, intersectoral structural change is defined as the change in the share that an economic sector and/or branch has in macroeconomic production. In contrast, intrasectoral structural change describes the change in the production structure and/or product portfolio at the level of homogeneous economic branches. In the paper industry, for example, the entire output consists of a varying product structure due to permanent shifts in the demand for individual types of paper (printing and newsprint papers, graphic papers, technical papers and, finally, tissue and toilet papers) whose production requires different inputs of energy and raw materials. The structural change (both intersectoral and intrasectoral) can both decrease and increase energy consumption if and when the shifts caused by the structural change act either in favor of or to the detriment of the respective energy-extensive branches and/or products.*

Table 16

AGEB
AG Energiebilanzen e.V.

## Macroeconomic Energy Productivity in Germany between 1990 and 2024

| | Unit | 1990 [1] | 2020 | 2021 | 2022 | 2023 | 2024 [2] | Average Annual Change in % | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 2024/2023 | 2024/1990 |
| Gross Domestic Product (Price-Adjusted; Reference Year 2020) | Concatenated Volume Figures in Billion Euros | 1,959.1 | 3,449.6 | 3,576.2 | 3,625.2 | 3,615.5 | 3,608.0 | -0.2 | 1.8 |
| Population [3] | 1,000 | 79.8 | 83.2 | 83.2 | 83.8 | 84.5 | 84.7 | 0.2 | 0.2 |
| Primary Energy Consumption (Unadjusted) | Petajoules | 14,905 | 11,887 | 12,443 | 11,675 | 10,651 | 10,530 | -1.1 | -1.0 |
| Primary Energy Consumption (Adjusted) [5] | Petajoules | 15,014 | 12,105 | 12,466 | 11,882 | 10,840 | 10,829 | -0.1 | -1.0 |
| Total Electricity Consumption [4] | Billion kWh | 550.7 | 555.8 | 568.5 | 550.6 | 520.5 | 527.4 | 1.3 | -0.1 |
| Energy Productivity (Unadjusted) | Euros/GJ | 131.4 | 290.2 | 287.4 | 310.5 | 339.4 | 342.6 | 0.9 | 2.9 |
| Energy Productivity (Adjusted) [5] | Euros/GJ | 130.5 | 285.0 | 286.9 | 305.1 | 333.5 | 333.2 | -0.1 | 2.8 |
| Electricity Productivity | Euros/kWh | 3.6 | 6.2 | 6.3 | 6.6 | 6.95 | 6.84 | -1.5 | 1.9 |

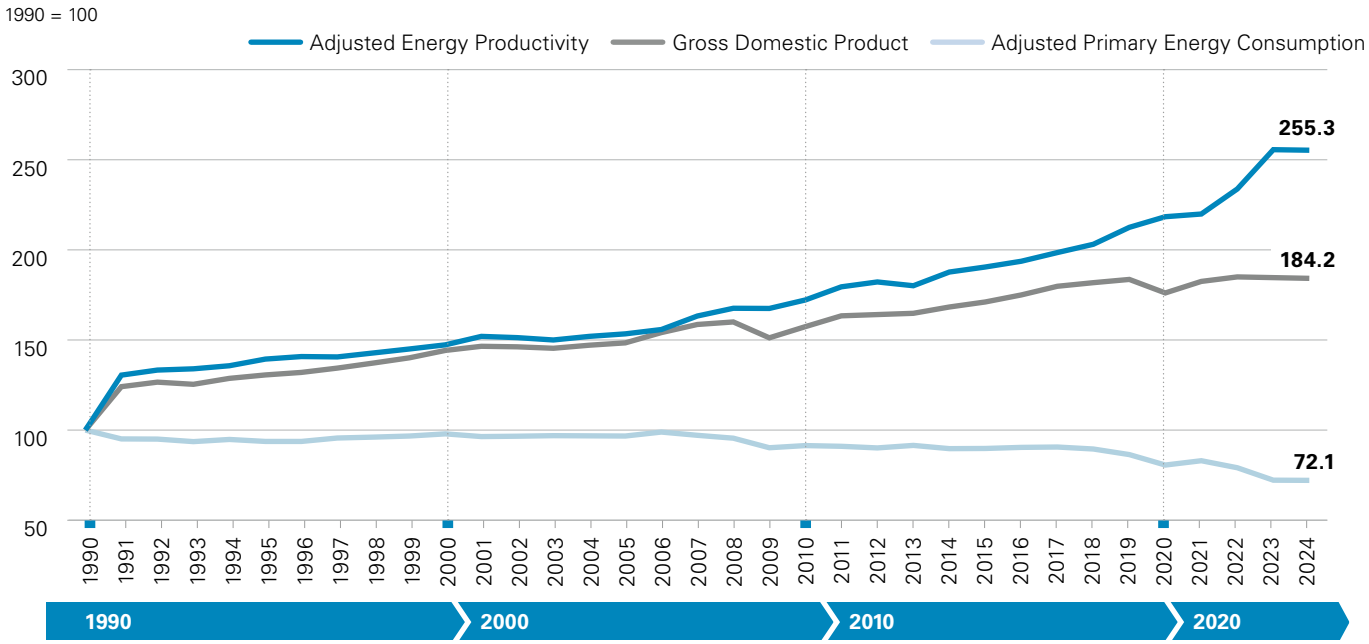
*1) Some figures are estimates*
*2) Preliminary information for 2024, partially estimated*
*3) Average population based on the 2011 census (result as per the closing date May 9, 2011: 80,219,695 inhabitants)*
*4) Including pump current generation*
*5) Values adjusted for temperature, mineral oil adjusted for inventory*

*Sources: Federal Statistical Office (Destatis); Germany's National Meteorological Service (DWD); German Association of Energy and Water Industries (BDEW)*

Figure 17

AGEB
AG Energiebilanzen e.V.

## Gross Domestic Product, Primary Energy Consumption, and Energy Productivity in Germany between 1990 and 2024




*All values for 2024 are provisional*

*Sources: Federal Statistical Office (Destatis); Federal Ministry for Economic Affairs and Energy (BMWi); Federal Ministry of Finance (BMF); Working Group on Energy Balances (AGEB)*

It should also be considered that such a review of the macroeconomic energy productivity, which is based on primary energy consumption, also reflects statistical effects. These effects are associated with the assessment of hydropower, wind energy, photovoltaics as well as nuclear energy from a primary energy perspective (which are all used for electricity production) and for which no uniform conversion standard such as the calorific value (for fossil fuels) exists. Within the scope of preparing its Energy Balances, the AG Energiebilanzen evaluates and assesses these energy carriers according to the so-called efficiency method (which is also applied internationally for calculating the primary energy consumption and for preparing energy balances). In the past, the substitution method used to be the common evaluation standard in Germany. Depending on the respective substitution processes in the mix of energy carriers, any decision made in favor of the one or the other method actually influences not only the level, but also the development of primary energy consumption and the associated macroeconomic energy productivity. Details of the effects both assessment methods have on primary energy consumption can be found, for example, in the AGEB publication *Energy Consumption in Germany in 2019,* p. 38, which is available in English and can be downloaded from the AG Energiebilanzen's website at: https://ag-energiebilanzen.de/wp-content/uploads/2020/05/ageb_jahresbericht2019_20200505_engl_web.pdf.

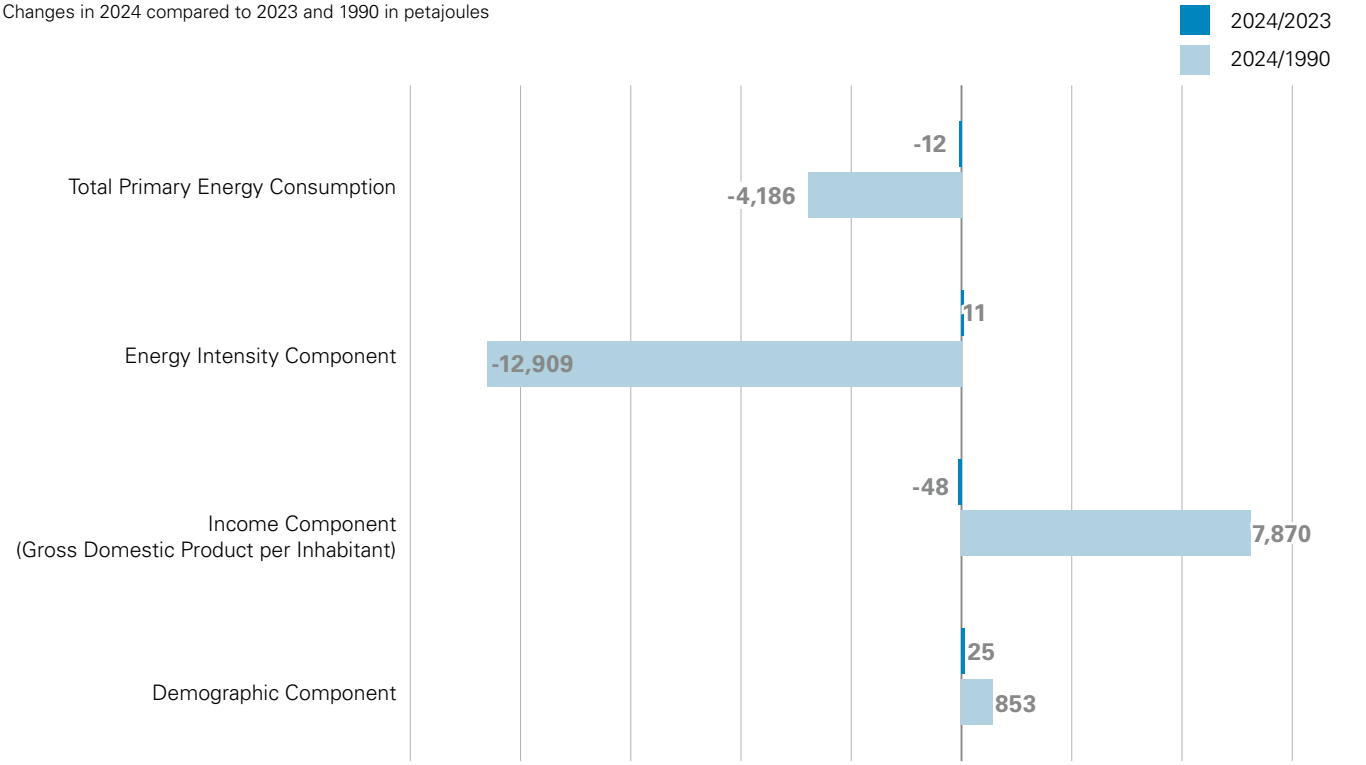
The highly aggregated focus on macroeconomic energy efficiency actually prevents a clear view of many other factors already mentioned above which characterize energy consumption. With the help of the component decomposition method, it is possible to at least illustrate the key factors which influence the changes in the (adjusted) primary energy consumption (please see Figure 18). Towards this end, the long-term changes (1990-2024) clearly demonstrate the considerable influence of the decreased energy intensity (in other words, the improvement of energy efficiency) on the reduction of the

Figure 18

AGEB
AG Energiebilanzen e.V.

**Contributions of Diverse Influencing Factors to the Changes in the Adjusted Primary Energy Consumption in Germany**

Changes in 2024 compared to 2023 and 1990 in petajoules




*Sources: Federal Statistical Office (Destatis); Germany's National Meteorological Service (DWD); Working Group on Energy Balances (AGEB)*

(temperature-adjusted) primary energy consumption (-12,909 PJ). This way, it was possible to significantly overcompensate the consumption-enhancing effects of macroeconomic growth (+7,870 PJ) and the increase in population (+853 PJ). All told, the adjusted primary energy consumption decreased by 4,186 PJ between 1990 and 2024.

The correlations outlined above apply in a similar way to the short-term consideration of the changes between 2023 and 2024: The gains in efficiency associated with the utilization of energy did not lead to any decline in primary energy consumption in the short run when compared to the long-term perspective. In fact, the opposite is true: The reduction of the (adjusted) macroeconomic energy productivity resulted in a slight increase in primary energy consumption by about 11 PJ when compared to 2023. The dwindling economic performance reduced the adjusted primary energy consumption by 48 PJ in 2024 when compared to the previous year (as opposed to the long-term development since 1990 during which this impact factor had still set an expansionary impulse). When seen from the short-term perspective, a consumption-enhancing effect emanated additionally from the population component (+25 PJ) which, when also seen from the long-term perspective and viewed absolutely, had a relatively low impact on the absolute values of primary energy consumption. In 2024, this resulted in a slight decline of the (adjusted) primary energy consumption by 12 PJ (when compared to 2023).

Nevertheless, when assessing the results of such a component decomposition, it should be noted that the changes in primary energy consumption are, of course, not only influenced by the factors which are taken into account here (economic growth, population trend, and macroeconomic energy efficiency). In fact, the development of energy consumption can neither be sufficiently explained from a monocausal perspective nor in an extremely simplified form; it is rather the result of a very complex interaction between numerous (partially interdependent) determinants which, in addition to the influencing factors considered within this component decomposition, also have an impact on the consumption trend. In particular, the effects of the structural change already referred to hereinabove are not included in the macroeconomic component decomposition for primary energy consumption which is assumed here in a simplified manner.

In Germany, the sectoral structural change tended to cause energy consumption to decrease in the past. In order to substantiate this hypothesis with more precise empirical data, an isolated component decomposition was additionally conducted here which, in addition to the activity and intensity components (gross production value and energy efficiency), also takes a structural component into account. This structural component records the influence of the intersectoral structural change (by categorizing the industrial sectors in the Energy Balance for Germany, Energy Balance Rows 46 to 59, whereby the economic branches "basic chemistry" and "other chemical industry" were summarized as one sector) on industry's final energy consumption (Energy Balance Row 60).[42)]

Against this backdrop, Figure 19 illustrates that the intersectoral structural change contributed substantially towards reducing the total final energy consumption of industry between 2003 and 2024. Only during the period between 2003 and 2009 did the increase in energy efficiency have a stronger consumption-reducing impact on the development of industry's final energy consumption than the sectoral structural change. As expected, but with the exception of the recession year 2009, a distinctly positive impetus for industrial energy consumption came from economic growth.

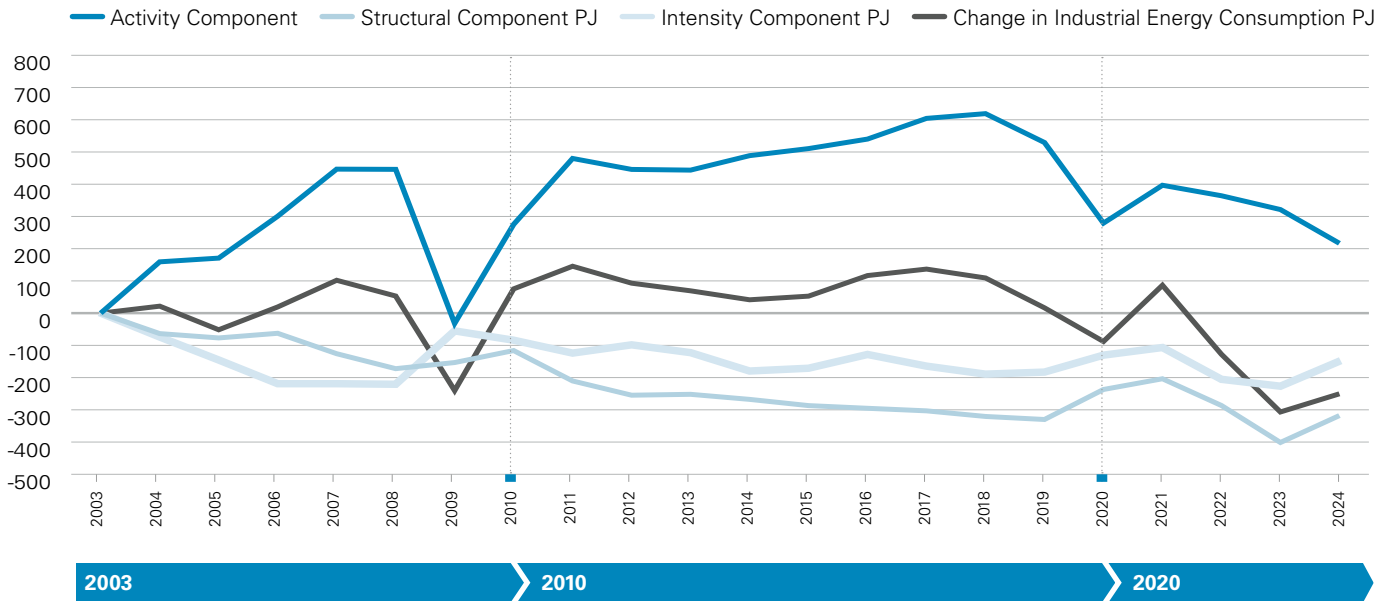
When assessing the macroeconomic energy productivity (please see Figure 17), it must also be kept in mind that above average gains in efficiency in the use of fuels and heat are often contrasted by comparably moderate savings in the specific consumption of electricity. This is due to the fact that an improvement of the energy productivity in numerous economic branches can often only be attained through the increased use of state-of-the-art plant engineering, and that many of the applied process technologies which are designed to save fuels

*42) This report uses the so-called Log-Mean Divisia Index Method I (LMDI I) for the component decomposition of industry's final energy consumption. For more details on this topic, please see: Ang, B. W., Liu, F. L., 2001. A new energy decomposition method: perfect in decomposition and consistent in aggregation. Energy 26 (2001), 537-548.*

Figure 19

**Decomposition Analysis of Final Energy Consumption in Industry Based on the LMDI Methodology**

2003 - 2024




*Source: Calculations made by the Working Group on Energy Balances (AGEB)*

actually increase the specific electricity consumption. Yet there are also the increased requirements with regard to matters revolving around environmental protection as well as the persistent trend towards automation and the electronic control of processes which, for example, resulted in the fact that the electricity savings potentials, which are to be rated lower anyway, were partially compensated for by the increased use of this energy carrier in new fields of application.

Against this backdrop, the macroeconomic electricity productivity (expressed as the ratio of the price-adjusted gross domestic product to gross electricity consumption) deteriorated by 1.5 % in 2024 when compared to 2023 due to the slight increase in electricity consumption (by 1.3 % to 527.4 billion kWh) while the price-adjusted gross domestic product declined by 0.2 % to 3,608 billion euros during the same period of time. As a result, a gross domestic product of about € 6.84 was generated by using one kilowatt hour of electric energy in 2024; in 2023, the same figure had been € 6.95.

When taking the long-term period between 1990 and 2024 into account, the electricity productivity increased by an annual average of 1.9 %. For comparison: The total energy productivity (adjusted) increased by 2.8 % per annum over the same period of time (for more details on this topic, please see Table 16 as well as Figures 20 and 21).

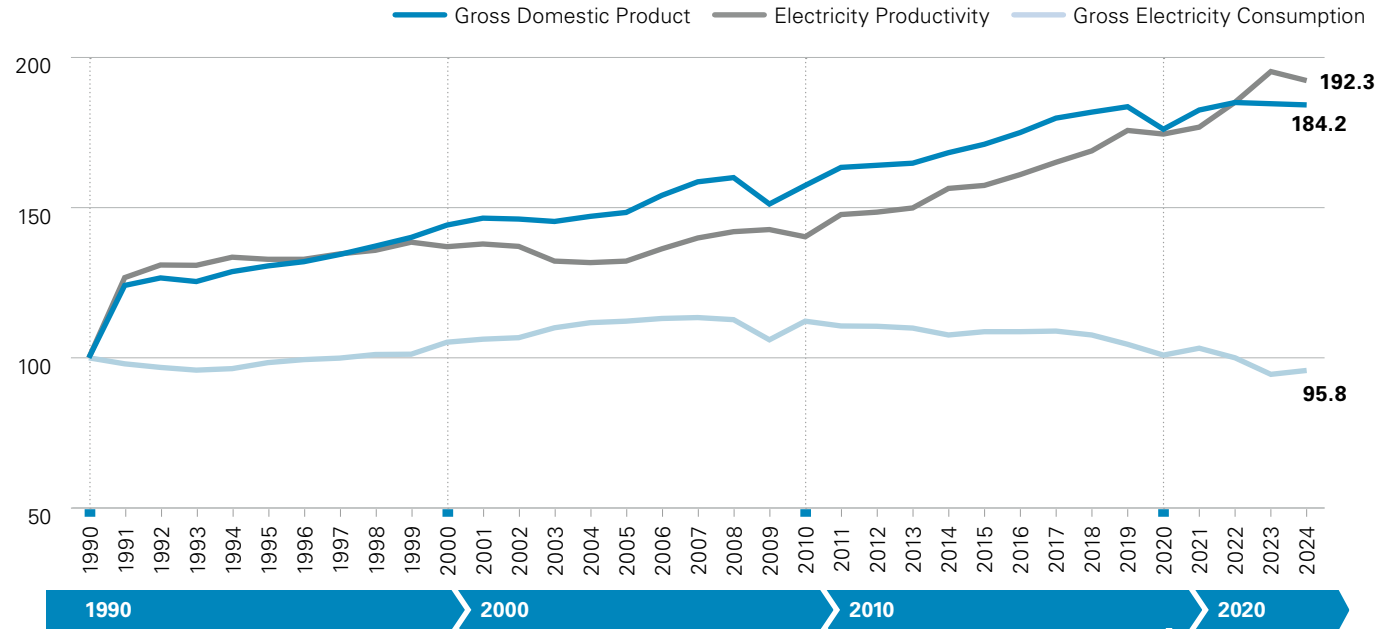
The impact of select components (economic growth, population trend, and electricity productivity) on the development of gross electricity consumption in Germany between 1990 and 2024 and/or 2023/2024 is illustrated in Figure 22. In contrast to the component decomposition of the total primary energy consumption, the following representation of electricity consumption is based on observed values that are not temperature-adjusted. The diagram shows that the increase in gross electricity consumption by 6.9 billion kWh in 2024 was caused, on the one hand, by the reduced electricity productivity (current intensity component) when compared to the previous year 2023 (+8.0 billion kWh) and, on the other hand, by the growth in population (+1.2 billion kWh).

Figure 20

AGEB
AG Energiebilanzen e.V.

## Gross Domestic Product,[1] Gross Electricity Consumption, and Macroeconomic Electricity Productivity[2] in Germany between 1990 and 2024

1990 = 100




1) Price-adjusted
2) Gross domestic product per unit of gross electricity consumption

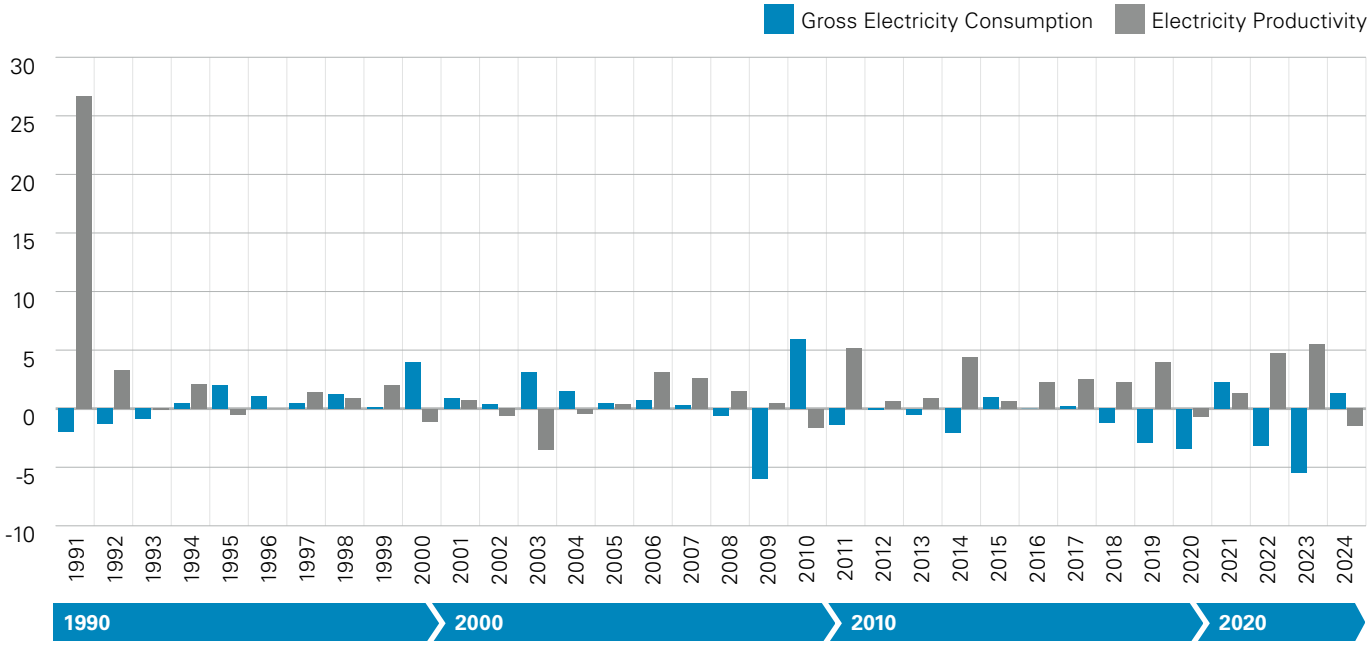
Sources: Working Group on Energy Balances (AGEB); Federal Statistical Office (Destatis); Federal Ministry for Economic Affairs and Energy (BMWi); Federal Ministry of Finance (BMF); German Association of Energy and Water Industries (BDEW)

Figure 21

AGEB
AG Energiebilanzen e.V.

## Changes in Gross Electricity Consumption and Electricity Productivity between 1991 and 2024

Changes compared to the previous year in %




Sources: Federal Statistical Office (Destatis); German Association of Energy and Water Industries (BDEW); Working Group on Energy Balances (AGEB)

The efficiency component of electricity consumption during the reporting year was also characterized once again by mild weather conditions as well as, when compared to the previous year, the decline in electricity prices which, in turn, can influence the short-term consumer behavior.

In 2024, the shrinking economic performance had a consumption-reducing effect. Just the drop in the macroeconomic production and/or economic performance alone caused electricity consumption to decrease, in mathematical terms, by 2.3 billion kWh whereby this decline was unable to compensate the increased consumption resulting from the development of the demographic component and the current intensity component in the short run.

When considering the entire period between 1990 and 2024, i. e. over the long-term perspective, the continuous increase in electricity productivity led "in purely mathematical terms" to an absolute decrease in electricity consumption; namely, by almost 374 billion kWh. However, when it comes to the use of electric energy, the achieved gains in efficiency were to a large extent offset again by increased consumption due to the noticeably expanding economy (+316 billion kWh) when compared to 1990 as well as the demographic component and/or the growing population (+35 billion kWh).

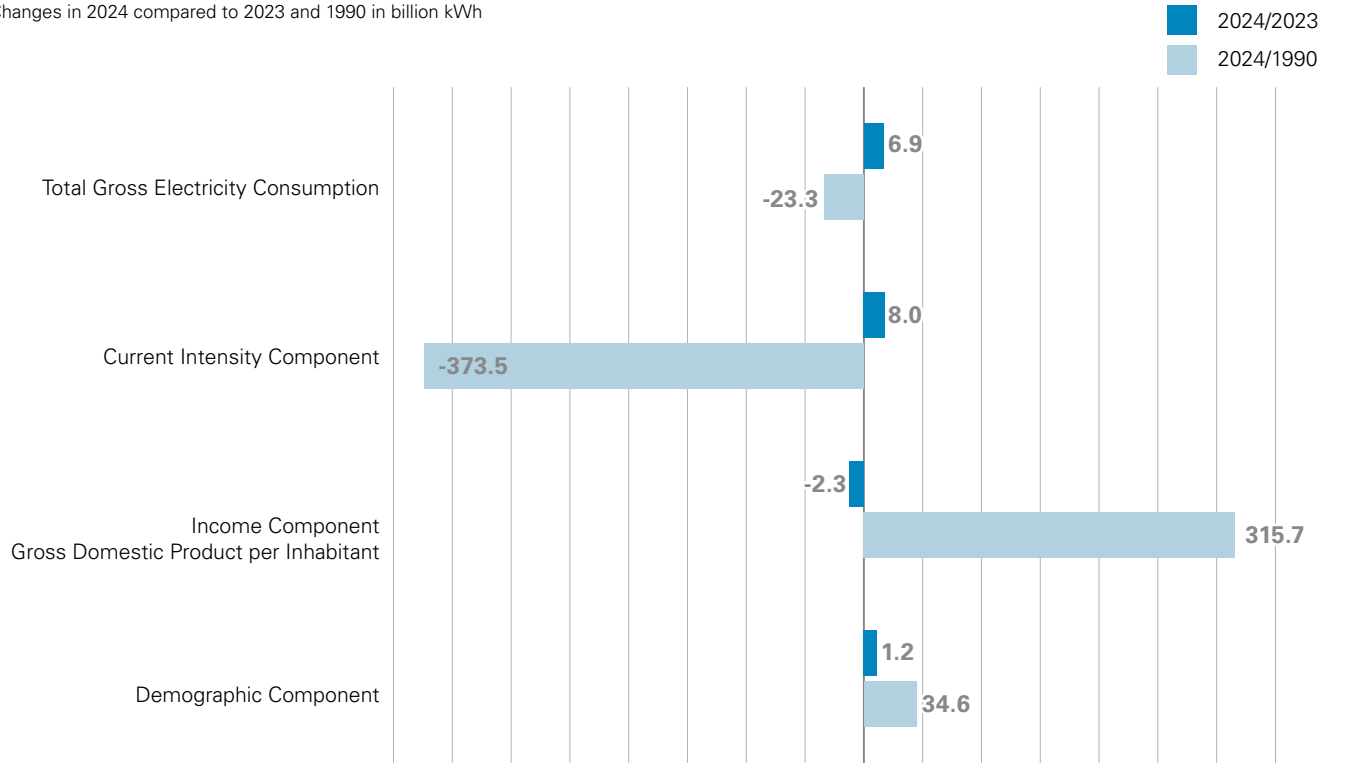
Electricity consumption as a whole dropped by about 23.3 billion kWh (which equals a decrease of about 4.2 %) when compared to 1990; in 2024, it was, thus, still approximately 28.4 billion kWh (-5.1 %) below the Covid-driven low point of 2020 (555.8 billion kWh) and, all told, at the second lowest level since 1990.

Figure 22

AGEB
AG Energiebilanzen e.V.

**Contributions of Diverse Influencing Factors to the Changes in Gross Electricity Consumption in Germany**

Changes in 2024 compared to 2023 and 1990 in billion kWh




*Sources: Federal Statistical Office (Destatis); Federal Ministry for Economic Affairs and Energy (BMWi); Federal Ministry of Finance (BMF); Working Group on Energy Balances (AGEB); German Association of Energy and Water Industries (BDEW)*

# Energy-Related $CO_2$ Emissions

Against the backdrop of the developments in the energy industry outlined in the individual chapters of this report and according to current calculations made by the Federal Environmental Agency (UBA), Germany's energy-related emissions in 2024 amounted to a total of nearly 531 million tons of $CO_2$.[43] Compared to the previous year, energy-related $CO_2$ emissions decreased by about 21.4 million tons, which translates into almost 4 %, in 2024.[44] Based on the early estimate of Germany's Energy Balance for 2024 (dated February 12, 2025), whose data were also used in this report, the Federal Environmental Agency (UBA) estimates the total $CO_2$ emissions (including processes and other sources) to have declined by around 21.3 million tons of $CO_2$ in 2024 (minus 3.6 % when compared to 2023).

When interpreting the Federal Environmental Agency (UBA)'s Trend Tables (with emission data for the period between 1990 and 2024), it needs to be considered that the representation follows, above all, the requirements laid down in the Federal Climate Protection Act (KSG) and, thus, does not reflect the horizontal breakdown according to economic branches as is applied in the Energy Balance for Germany. In fact, the representation also encompasses cross-sectional areas (such as, for example, the building sector) or specific assignments, for example, $CO_2$ emissions associated with electricity production in industrial power plants which are categorized under the economic segments "energy industry" and/or "manufacturing industry." [45] That is why the "sectoral" information on the development of $CO_2$ emissions (energy-related) is not fully comparable to the developments in the energy industry outlined in this report.

Despite these restrictions (with regard to the classification made in the Energy Balance for Germany), Table 17 provides essential clues about the direction

Table 17

AGEB
AG Energiebilanzen e.V.

**Change in Energy-Related $CO_2$ Emissions**

2023 and 2024, in million tons

| | 2023 | 2024 | Change | |
|---|---|---|---|---|
| | | | in % | Million Tons |
| Energy-Related $CO_2$ Emissions (UBA Trend Tables) | 551.8 | 530.5 | -4.0 | -21.4 |
| **Including** | | | | |
| Energy Industries (CRF 1A1)[1] | 193.9 | 176.5 | -9.8 | -17.4 |
| Manufacturing Industries and Construction (CRF 1A2)[2] | 104.9 | 105.0 | 0.1 | 0.1 |
| Commercial/Institutional, Residential, Other (CRF 1A4a, 1A4b, 1A5) | 101.7 | 99.3 | -2.4 | -2.4 |
| Civil Aviation, Road Transportation, Railways, Navigation (CRF 1A3a to 1A3d) | 143.6 | 141.5 | -1.4 | -2.0 |
| Agriculture/Forestry/Fisheries (Stat. and Mobile Furnaces, CRF 1A4c) | 7.9 | 8.1 | 3.2 | 0.3 |

*1) Incl. $CO_2$ emissions from fuel use in industrial power plants in the energy sector*
*2) Incl. $CO_2$ emissions from fuel use in industrial power plants in the manufacturing sector*

*Source: Federal Environmental Agency (UBA)*

*43) Energy-related $CO_2$ emissions which are directly attributable to the use of fuels and, thus, combustion processes in accordance with the emission quantities as classified under the Common Reporting Format (CRF) sectors 1A1 (Energy Industries), 1A2 (Manufacturing Industries and Construction), 1A4a (Commercial/Institutional), 1A4b (Residential), 1A5 (Other), 1A3a to 1A3d (Civil Aviation, Road Transportation, Railways, Navigation) as well as 1A4c (Agriculture/Forestry/Fisheries).*
*44) For more details on this topic, please see the Federal Environmental Agency (UBA) (2025):* Aktuelle Treibhausgas-Projektionen. *Internet: https://www.umweltbundesamt.de/themen/klima-energie/klimaschutz-energiepolitik-in-deutschland/szenarien-fuer-die-klimaschutz-energiepolitik/integrierte-energie-treibhausgasprojektionen#2025 (download date: 2025-03-31; currently only available in German).*
*45) In the Energy Balance for Germany, the fuel input of industrial power plants producing electricity and the associated $CO_2$ emissions are recorded in Row 12.*

and extent of the changes in energy-related $CO_2$ emissions in the most important sectors of the energy system.

As already in the previous year, it was particularly the energy industry sector which recorded a disproportional reduction of $CO_2$ emissions (by a total of 17.4 million tons, which translates into 9.8 %, to 176.5 million tons of carbon dioxide in 2024). According to the available preliminary data and despite the discontinuation of electricity production from nuclear energy that has been in effect since April 2023, the $CO_2$ emissions of all power generation plants (power generation plants supplying the general public as well as power generation plants of mining facilities and the manufacturing industry, including the electricity produced in cogeneration plants) decreased to 146 million tons in 2024. Compared to the previous year, this equals a reduction of $CO_2$ emissions of around 12.4 % which translates into 18.2 million tons of $CO_2$. The reason for this development was that the electricity production mix in Germany became more $CO_2$-extensive when compared to 2023, which means that specifically the proportion of renewables was increased even further and the contribution of coal to electricity production continued to decrease. Another aspect is that Germany once again (and to a greater extent than had been the case in the previous year) imported more electricity from abroad than it exported into neighboring countries in 2024.

The production of district heat (in heating plants and cogeneration plants) and the associated $CO_2$ emissions also decreased in 2024 (primarily due to the milder exterior temperatures); namely, by about 1.8 million tons of $CO_2$ which translates into more than 11 %.

From the preliminary data and estimates compiled in this report on the energy consumption trend in 2024 and from the Federal Environmental Agency (UBA)'s Trend Tables on the development of greenhouse gas emissions, initial indications can also be derived for the estimated development of energy-related carbon dioxide emissions in other sectors, primarily those related to final energy consumption:

- According to first estimates, the consumption (and/or sale) of fuel and energy in the transportation sector ought to have decreased slightly in 2024. This development is reflected in the $CO_2$ emissions which dropped by 2.3 million tons and/or 1.4 % in 2024 when compared to the previous year. The outlined decline in the traffic-related carbon dioxide emissions is the result of various, partially contrasting developments: A reduction of the $CO_2$ emissions amounting to about 1.5 million tons (which equals a decline of 1.1 % when compared to 2023) appears to have occurred in road traffic due to the continuously high fuel prices as well as the weakened economy (commercial passenger car and truck traffic). According to our calculations, reduced $CO_2$ emissions are to also be expected in rail traffic in 2024 (2023/2024: -3.8 %). And in air traffic as well, the $CO_2$ emissions decreased by approximately 2.9 % and/or about 0.8 million tons when compared to the previous year. Thus, $CO_2$ emissions due to air traffic reached a level of more than 28.2 million tons in 2024 (for comparison: In 2019, the emissions in this sector had amounted to nearly 32 million tons; during the Covid-19 crisis year 2020, less than 15 million tons). In contrast, inland water transportation is likely to have emitted more $CO_2$ in 2024 than in 2023 (+2.6 %). In absolute terms, however, the $CO_2$ emissions of this traffic carrier hovered at a rather low level (2024: 0.73 million tons) so that changes in this subsector did not have any particular impact on the $CO_2$ balance of the transportation sector as a whole.

- In the manufacturing industry (including electricity production in industrial power plants which are attributable to the manufacturing industry), it can be anticipated on the basis of the currently available estimates that despite the slight decline in industrial production, energy-related $CO_2$ emissions are not likely to have decreased in 2024; instead, they even increased (2023/2024: +4.1 % and/or +4 million tons) which was due, for example, to the growth of such particularly energy-intensive branches as the chemical industry.

- Due to the milder weather conditions when compared to the previous year and the persistently high energy prices, which continued to produce impulses for savings, private households and the trade, commerce, and service sector seem to have consumed less energy for heating private homes and commercial premises in 2024 which is probably

also associated with a development in emissions heading in the same direction. Against this backdrop and according to first estimates, the $CO_2$ emissions of private households could have declined by about 1.8 million tons and/or 2.3 % and those of the trade, commerce, and service sector by 0.3 million tons and/or 0.9 % in 2024 when compared to the previous year.

- For the building sector as a whole, this resulted in a 2.4 % decline in $CO_2$ emissions to an emission level of 99.3 million tons in 2024 (please see Table 17).

## Summary of the Trends

According to preliminary calculations made by the AG Energiebilanzen, energy consumption in Germany decreased by 1.2 % to 10,529 petajoules (PJ), which translates into 359.2 million tons of hard coal equivalents (Mtce), in 2024. It, thus, dropped to the lowest level since 1990.

Responsible for this drop in energy consumption were primarily the still fairly high energy prices, the weakening economy and/or even shrinking economic performance as well as the mild weather. In addition, those determinants of energy consumption which are more likely to have a long-term effect continued to be effective in 2024 as well. It was, above all, improvements of the energy efficiency, energy-saving substitution processes as well as the sectoral structural change which generated consumption-reducing impulses for the development of primary energy consumption. Energy-intensive industrial branches in particular recorded disproportionate declines in production during the recession which, in turn, had a major impact on energy consumption. In 2024, the consumption-enhancing effect of the growing population became less important than the outlined consumption-reducing influencing factors, and/or was overcompensated significantly.

A glance at the individual energy carriers reveals, also in light of the developments already described above, the following picture for 2024: When compared to the previous year, the consumption of renewable energies increased by 1.5 % in 2024. In contrast, all other energy carriers, with the exception of natural gas, exhibited a dwindling consumption trend. The use of nuclear energy dropped to zero in 2024 after the end of the so-called stretch-out operations of the last three nuclear power plants (Neckarwestheim 2, Emsland, and Isar 2) and their final decommissioning on April 15, 2023. During the same period of time, the consumption of hard coal decreased by 10.3 %, the consumption of lignite by about 9.5 %. Finally, the consumption (and/or sales) of mineral oil went down by 1.7 %.

Consequently, renewables as well as natural gas gained market shares in the overall shrinking energy market. Consumption of natural gas accounted for a share of 25.9 % in 2024 (2023: 24.6 %) while renewables covered 20 % of the primary energy consumption (2023: 19.5 %). Whereas in the (ascending) order of their relevance, nuclear energy (-100 percentage points), hard coal (-10.3 %), lignite (-9.5 %), and mineral oils (-1.7 %) lost market shares. In 2024, lignite still covered 7.7 % and hard coal still 7.3 % of the demand for primary energy. In 2024 as well, mineral oil continued to be by far the most significant energy carrier; it covered a total of 36.2 % (2023: 36.4 %) of the primary energy demand in that year. The outlined structural changes in the composition of primary energy consumption reveal that the energy mix in 2024 became once again less carbon-intensive when compared to the previous year 2023.

As measured by the original values, the macroeconomic energy productivity continued to improve in 2024 (according to preliminary calculations). It increased by 0.9 % so that almost € 343 $GDP_{2020}$ were generated in 2024 while utilizing one gigajoule of primary energy (GJ); in 2023, this value had still amounted to about € 339 $GDP_{2020}$/GJ. The average annual increase in the macroeconomic energy productivity between 1990 and 2024 currently amounts to 2.9 %; by excluding weather effects and inventory movements, this value would amount to 2.8 %.

In contrast to primary energy consumption, gross electricity consumption increased in 2024 primarily as a consequence of the production growth in energy-intensive branches which were able to recover again after the previous year's economic downturn, and driven by substitution processes in favor of the use of electric energy. Gross electricity consumption increased to 527.4 million kWh and was, thus, 1.3 % above the value of 2023. Despite the increase outlined above, which is based on the low level that had been attained in 2023 (520 billion kWh), gross electricity consumption in 2024 was still 0.1 % below the lowest level that has been measured so far in 1993 (528 billion kWh).

Compared to the previous year, the macroeconomic electricity productivity decreased slightly by an

estimated 1.5 % in 2024 and dropped to a value of € 6.84/kWh after it had amounted to € 6.95/kWh in 2023 (according to the data indicated in the final Energy Balance for Germany). All told, the development of the macroeconomic energy productivity during the reporting year fell below the long-term development that can be seen in the average value for the years between 1990 and 2024. Between 1990 and 2024, it was actually possible to increase the electricity productivity on average by 1.9 % per annum.

Gross electricity production decreased by approximately 2 % to about 501 billion kWh in 2024 (2023: 511.3 billion kWh). The structure of electricity production according to the individual energy carriers continued to change as well: While electricity production based on the use of nuclear energy finally came to an end after the last nuclear power plants had been shut down in April 2023, its share amounted to zero percent for the first time ever in 2024. Parallel to this, electricity production based on the use of hard coal (-27 %) and lignite (-8 %) exhibited a noticeable decline. In contrast, electricity production based on the use of natural gas and renewables recorded a plus of 4.8 % and 3.2 % respectively in 2024. Electricity production based on the use of mineral oil (+2.3 %) and other energy sources (+4.8 %) were also higher in 2024 than in the previous year.

All told, renewable energies were able to maintain their top position with a total production volume of 285 billion kWh and a share of almost 57 % in the power generation mix; for the second year in a row, renewables actually managed to provide more than half of the electric power produced in Germany. Natural gas was in second place with a contribution of 16 % and power generation from lignite was in third place with a contribution of approximately 15.8 % to the power generation mix. Hard coal still contributed about 5.6 % to the total electricity production in 2024.

When it comes to gross electricity consumption, renewable energies accounted for a share of 54 % in 2024; in the previous year (final data), this share had still amounted to approximately 52.9 %.

The electricity exchange balance[46)] experienced additional changes in 2024. In 2024, 26.3 billion kWh more electricity flowed from foreign countries into Germany than flowed from Germany into neighboring countries. This made Germany a net importer of electric power once again after 2023. When compared to the previous year, imports of electric power increased by 16.2 % to 80.3 billion kWh whereas exports of electric power decreased by 7.8 % to 56 billion kWh. Particularly high import surpluses were recorded, in the order of their relevance, for the exchange with France (19.8 billion kWh), Denmark (7.4 billion kWh), and Norway (5.8 billion kWh). Import surpluses also occurred in the electricity exchange with Switzerland, Belgium, and Sweden in 2024. In contrast, the electricity exchange with Poland (8.8 billion kWh), Luxemburg (4 billion kWh), the Czech Republic (3.8 billion kWh), and Austria (2.1 billion kWh) resulted in export surpluses.

Importing electric power instead of generating it in Germany's natural gas, hard coal, or lignite fired power plants represents an economically viable option if and to the extent that more favorable production possibilities (also from renewables) are available in foreign countries.

At the moment, it is not yet possible to precisely ascertain the energy-related $CO_2$ emissions for 2024 on the sole basis of final statistical data. However, a rough estimate of the development of energy-related $CO_2$ emissions can be made on the basis of the preliminary estimates of Germany's Energy Balance for 2024 (data status: February 12, 2025) in combination with the respective $CO_2$ content of the individual energy sources. In total, the overall structure of energy consumption continued to shift even further in favor of renewable and $CO_2$-reduced fossil energy carriers in 2024.

In light of the significant decrease in primary energy consumption (2024: -1.2 % when compared to the year before) in combination with the described shifts within the energy carrier mix as well as the sectoral consumption structure, energy-related $CO_2$ emissions ought to have decreased by some 4 % in 2024 according to initial calculations of the Federal

*46) The data on international electricity trading which are used in this report generally relate to the physical exchange of electricity with foreign countries.*

Environmental Agency (UBA) based on estimated data from the energy balance sheet. This reduction would correspond, related to the emission level of the previous year, to an absolute reduction of energy-related $CO_2$ emissions by 21.4 million tons to nearly 531 million tons of $CO_2$.