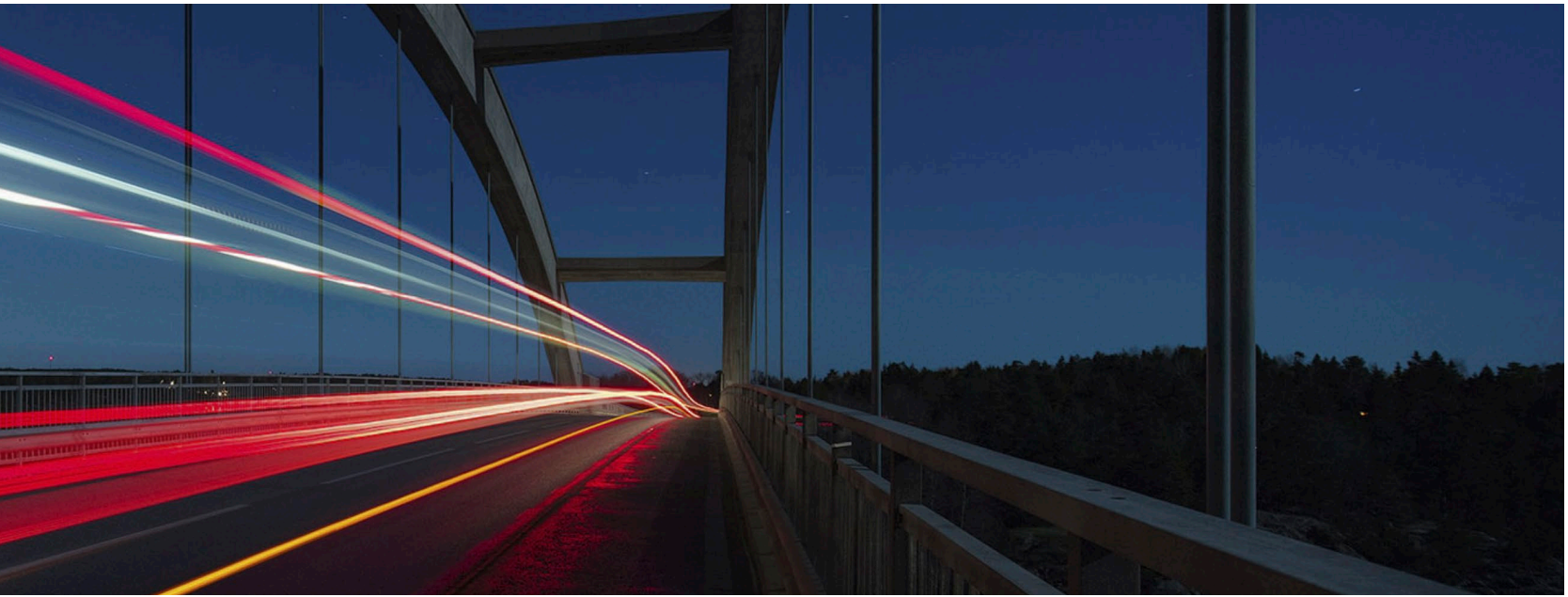
Forum Energii
Analizy i dialog



Energy transition in Poland

2022 Edition

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Forum Energii is a European, interdisciplinary think-tank from Poland whose team consists of experts working in the field of energy. We combine experience gained in business, public administration, media, and science with specialist knowledge in the field of energy.

The mission of Forum Energii is to initiate dialogue, propose knowledge-based solutions, and inspire action for a just and efficient energy transition that leads to climate neutrality.

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Foreword

The world isn't giving us a break. After the extraordinary pandemic of 2020 when energy demand and commodity prices fell to record lows, 2021 was a very different year.

The EU and global economies began to accelerate more than expected. Electricity demand increased significantly and industrial production grew rapidly. Gas prices also started to rise, which was reflected in electricity prices across Europe. The price of CO_2 emission allowances rose. An energy crisis began in the European Union that nobody expected.

In Poland, we started to burn more coal again. For the first time in years, the Polish energy market was one of the cheapest in the EU, the trend of cross-border flows of electricity was reversed, and imports decreased significantly.

The culmination of events forcing a redefinition of terms and a new setting of priorities was Russia's full-scale invasion of Ukraine on February 24, 2022. The anxiety of energy consumers about the future is high. The priority for Poland and other EU countries has become how to move away as quickly as possible from Russian energy resources. Currently, about 30% of the Kremlin's budget revenues is from the sale of raw materials, which in turn finances the Russian war machine.

Despite the rapidly changing external environment, market volatility, and record high prices of raw materials, renewable sources are still being neglected by Polish decision-makers. Although the photovoltaics sector is developing, the development of onshore wind energy is still effectively blocked by regulations on siting of wind turbines.

In our report for 2021, we present the most interesting data on energy.

As always, we are ready for discussion.

Yours sincerely,
Joanna Maćkowiak-Pandera, PhD
President of Forum Energii

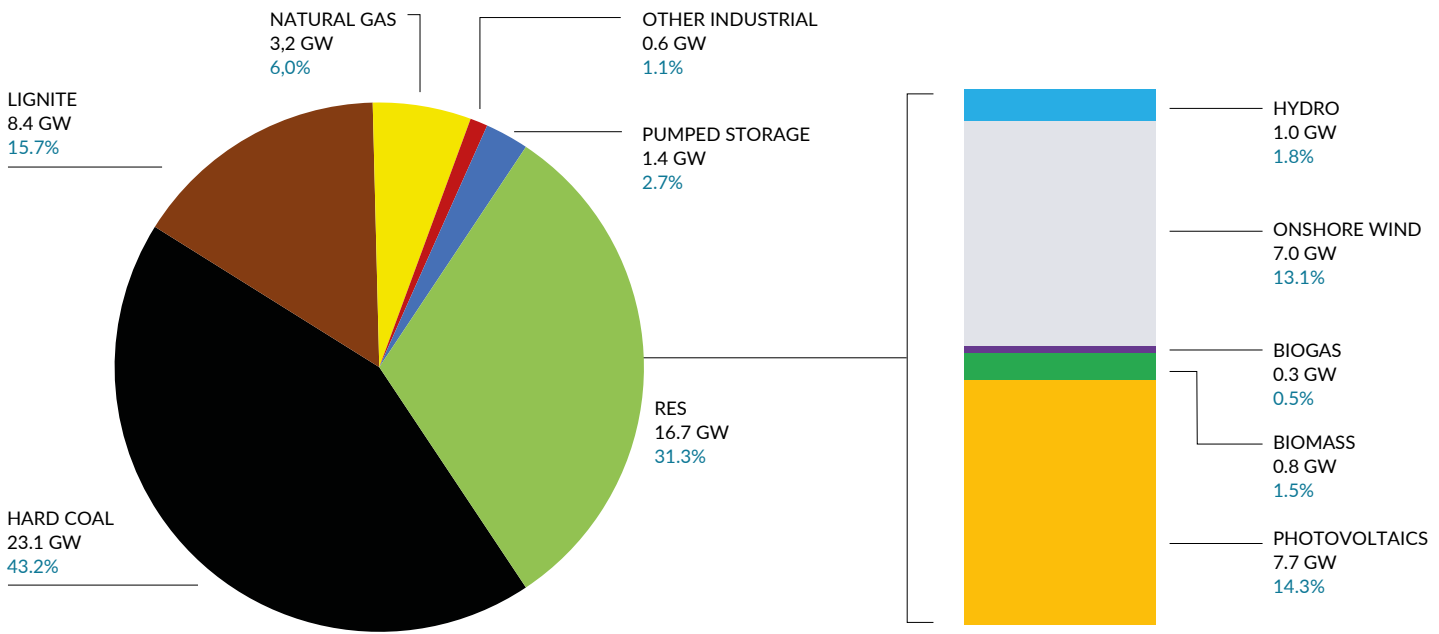
Main conclusions

- Share of coal in electricity generation in 2021 increased and is over 72%.
- Share of renewables fell to about 17% despite record production from these sources (30 TWh).
- In 2021, a record was set in electricity production (179.4 TWh, +14% y/y) and consumption (180.3 TWh, +5.4% y/y).
- Net electricity imports were the lowest in 5 years (at 0.89 TWh).
- Available capacity increased by 3.7 GW (to 53.5 GW).
- Capacity of conventional units has remained stable for years; RES capacity is growing (+4.4 GW y/y), especially photovoltaics (+3.7 GW y/y).
- Pace of expansion and modernisation of generation units is still insufficient to ensure energy security in the face of planned shutdowns in the conventional power generation.
- Despite high CO_2 prices, coal-fired generation was less expensive than natural gas-fired generation, resulting in a record increase in the use of coal-fired capacity and a decrease in the use of natural gas-fired capacity.
- For the first time in years, wholesale electricity prices in Poland were among the lowest in this part of Europe. This resulted in high exports and production.
- The weighted average price of CO_2 in 2021 amounted to 53.13 euro/t CO_2. Poland's revenue from the sale of CO_2 allowances was more than PLN 25 billion in 2021.
- Natural gas prices, and in turn also electricity prices, have risen to record highs across the region.

Generation capacity

Achievable capacity in 2021

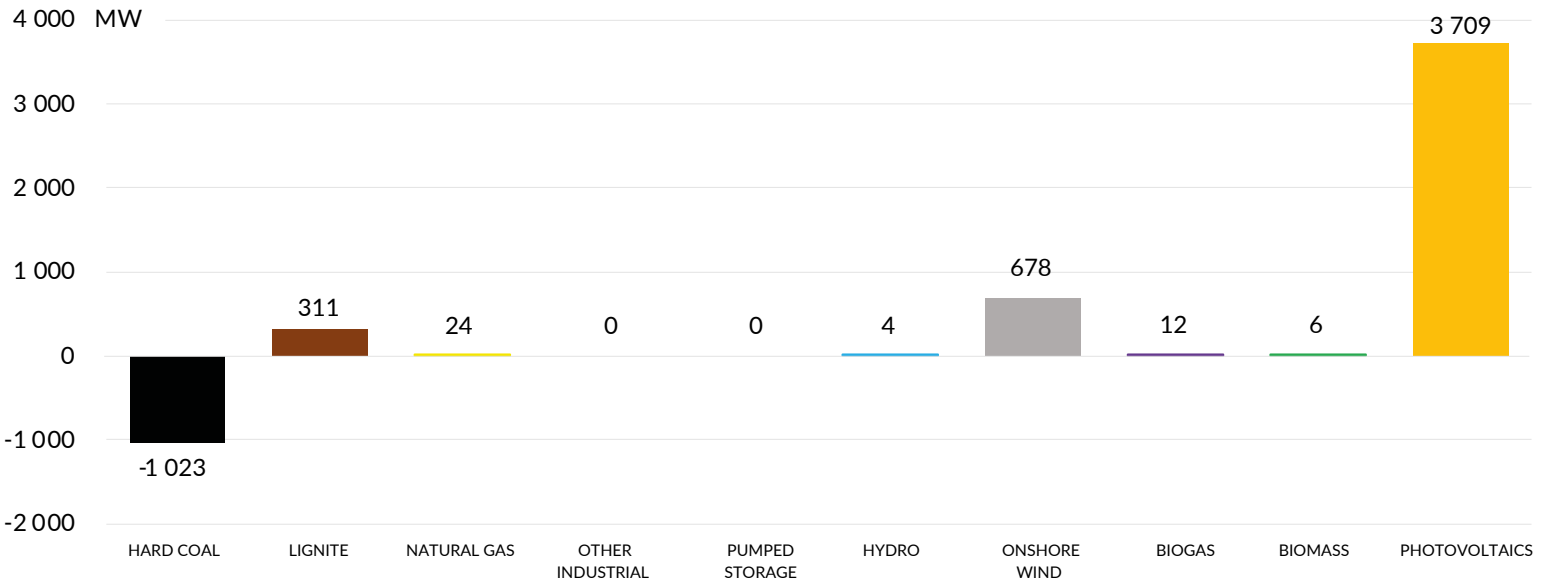
- 53.5 GW - the achievable capacity available at the end of 2021. This is 3.7 GW more than a year earlier.
- Share of renewable energy sources (RES) capacity increased to 31% (from 25%).



Own elaboration based on ARE data.

Changes in achievable capacity in 2021 as compared to 2020

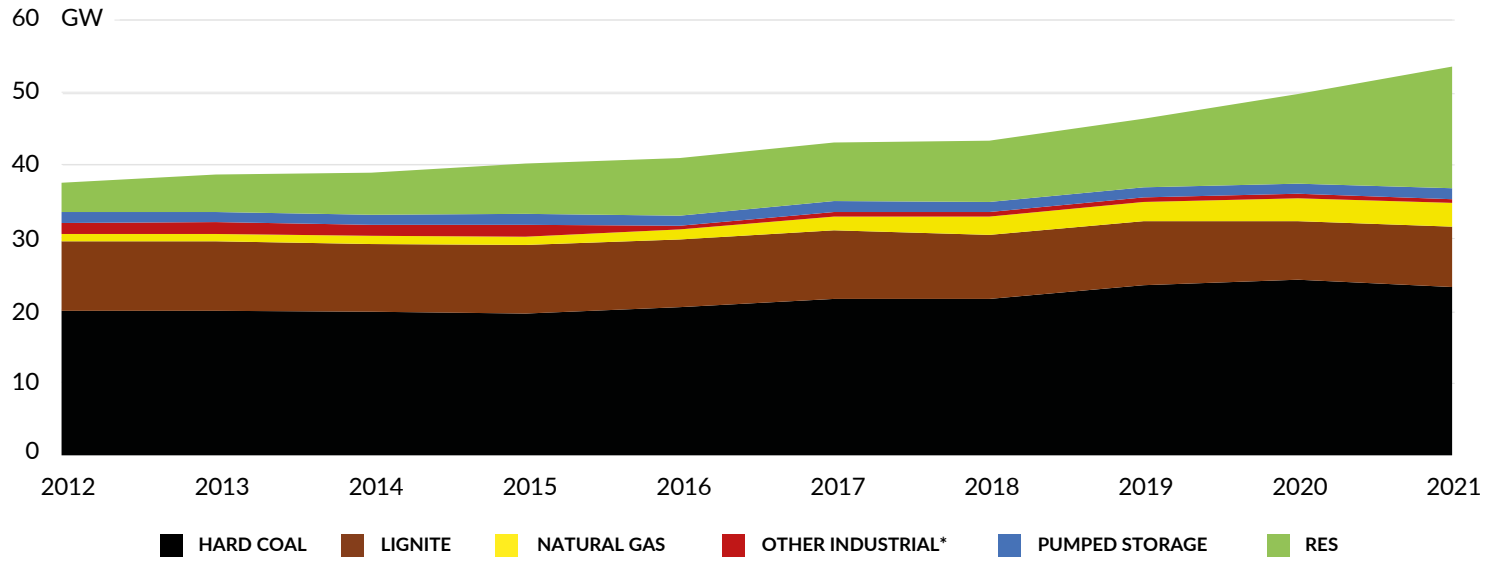
- The decrease in hard-coal power plant capacity results from the shutdown of 12 units (two units each in the power plants Dolna Odra, Rybnik, Łaziska, Łagisza, Siersza, and Stalowa Wola).
- The increase in lignite-fired plant capacity is due to the commissioning of a new 496 MW unit at the Turów power plant.
- The largest increase in capacity was in renewable energy, especially in prosumer photovoltaics.



Own elaboration based on ARE data.

Changes in achievable capacity over the last decade

- Conventional capacity has fluctuated between 32 GW and 35 GW for years, with a decline of 0.7 GW last year to 35.3 GW.
- RES capacity has quadrupled over the decade, from 4.1 GW in 2012 to 16.7 GW in 2021.

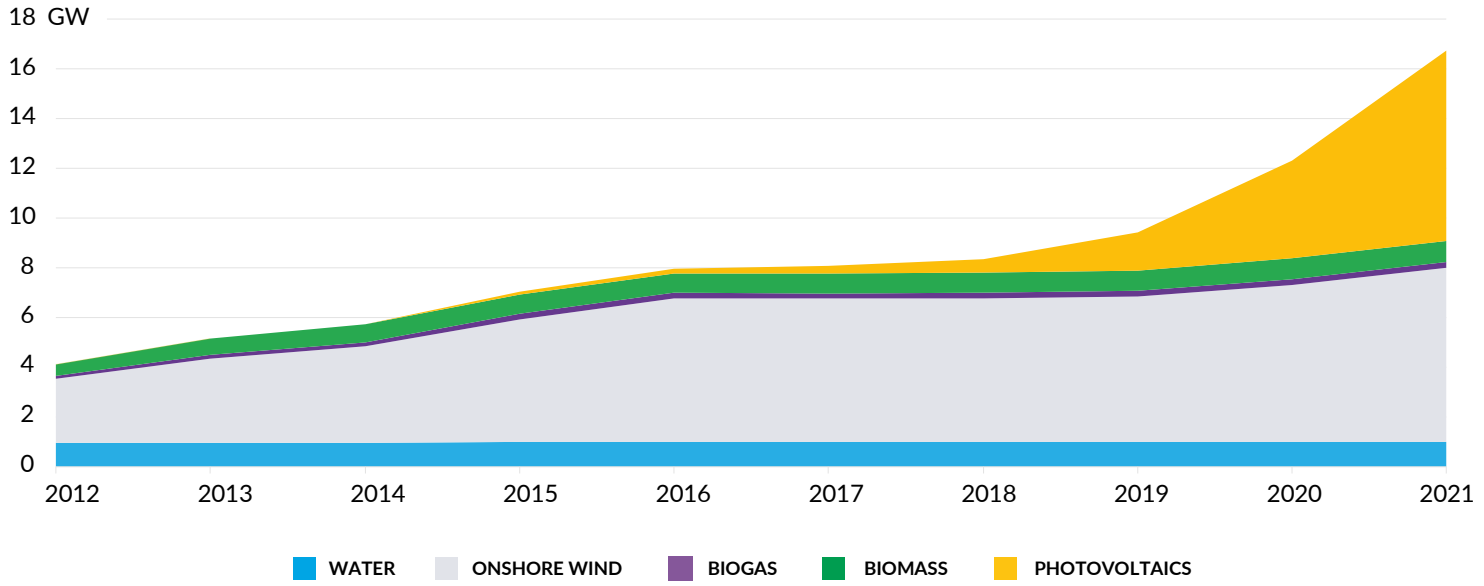


Own elaboration based on ARE data.

*Until 2016, the „other industrial" category also includes capacity in natural gas and hard coal.

Changes in achievable renewable capacity over the last decade

- At the end of 2021, 16.7 GW was installed as RES, an increase of 4.4 GW (+36% y/y).
- Solar PV capacity increased by 3.7 GW (+94% y/y), reaching 7.7 GW. In 2021, solar PV capacity surpassed that of wind farms.
- RES development in 2021 was mainly driven by the rapidly growing number of prosumers, and to a lesser extent, by RES auctions.

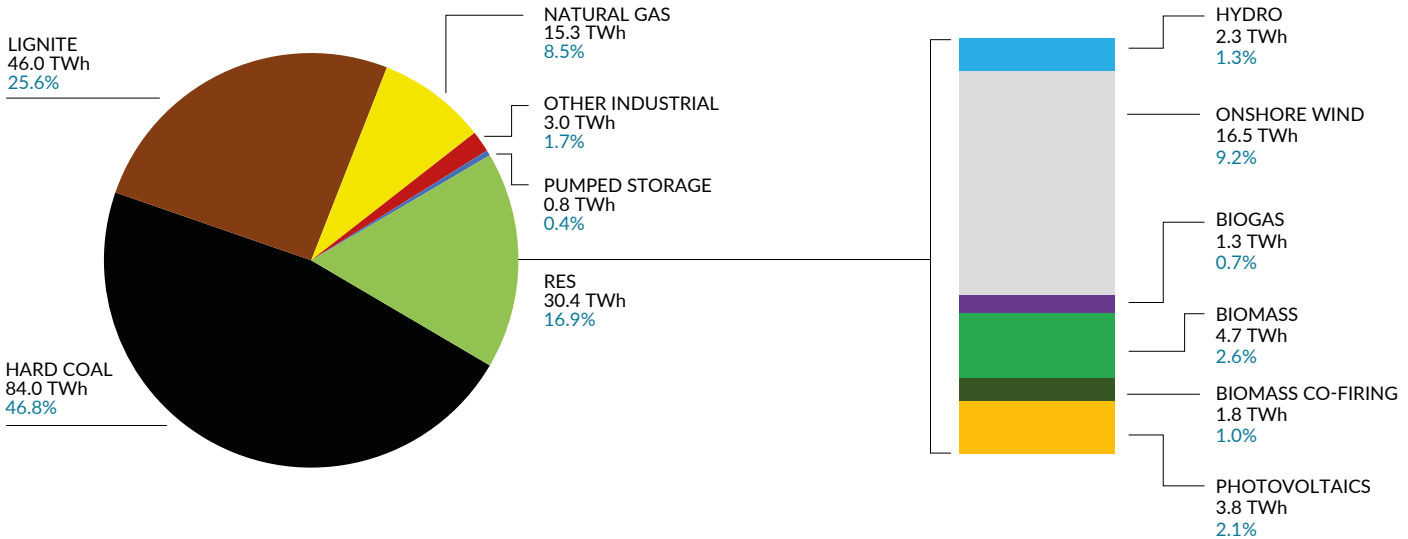


Own elaboration based on ARE data.

Electricity production

Electricity production in 2021

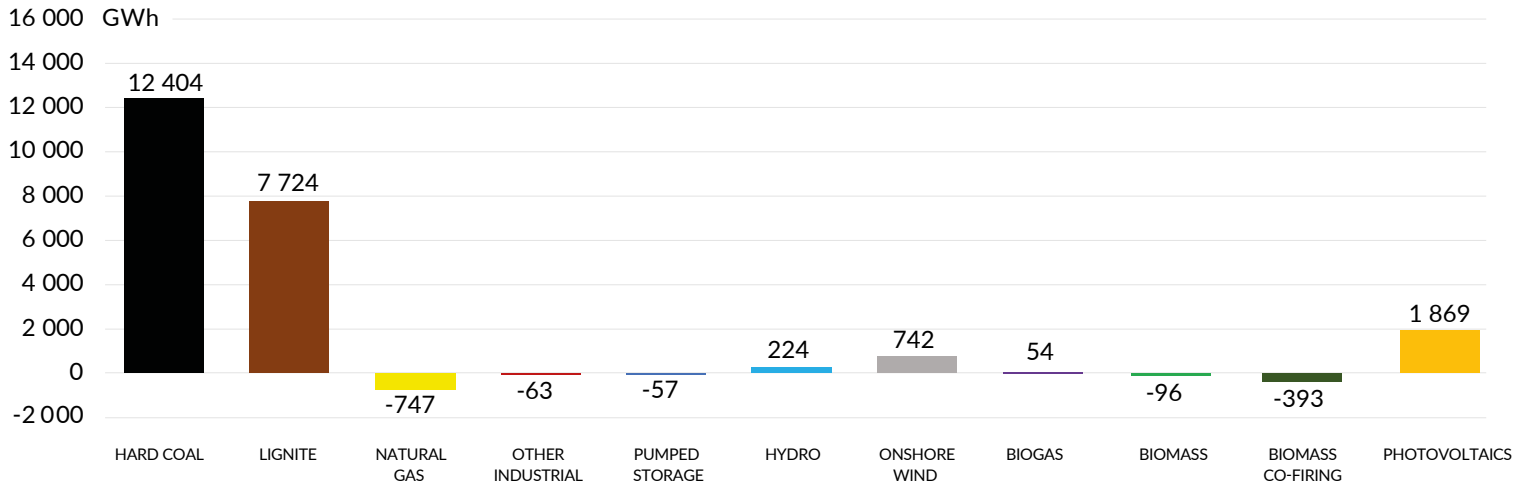
- 72.4% was the share of coal in electricity generation in 2021 – 2.7 p.p. more than a year earlier.
- Production from hard coal reached its highest level in 10 years at 84 TWh (+1.4 p.p.).
- Production from natural gas fell by 0.7 TWh, which translated into a 1.6 p.p. decline in the share of gas.
- Production from photovoltaics doubled from 2020 to 3.8 TWh.
- Energy production from all RES sources last year amounted to a record 30 TWh. Despite this, the share of RES in the generation mix fell to 16.7% (from 17.7% in 2020).



Own elaboration based on ARE data.

Changes in electricity generation in 2021 as compared to 2020

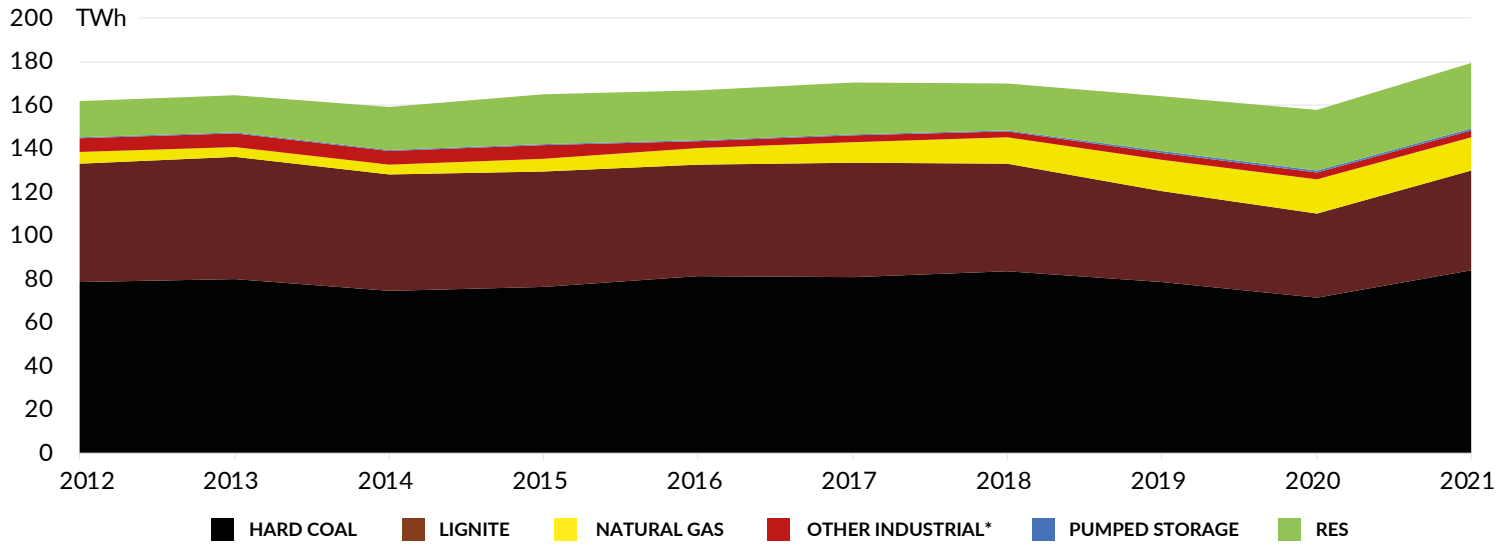
- Production from coal and lignite increased by 20.1 TWh compared to the pandemic year 2020. This is a result of increased electricity exports, among other things. The large scale of the increase is also due to low production from coal in 2020.
- Coal-fired generation replaced gas-fired plants, among others. The latter fell in 2021 for the first time in more than 10 years due to the very high price of natural gas.
- Among renewable sources, electricity production from photovoltaics grew most dynamically (+95% y/y, +1.9 TWh), while biomass co-firing recorded the largest decline (-18% y/y). Production from wind farms increased by 5% y/y.



Own elaboration based on ARE data.

Changes in electricity generation over the last decade

- Domestic electricity production totalled 179.4 TWh. This record result is 14% higher than in 2020 and is the first increase in electricity production since 2017.
- The increased demand for electricity mostly has been met by an increase in coal-fired capacity generation, especially from hard coal.

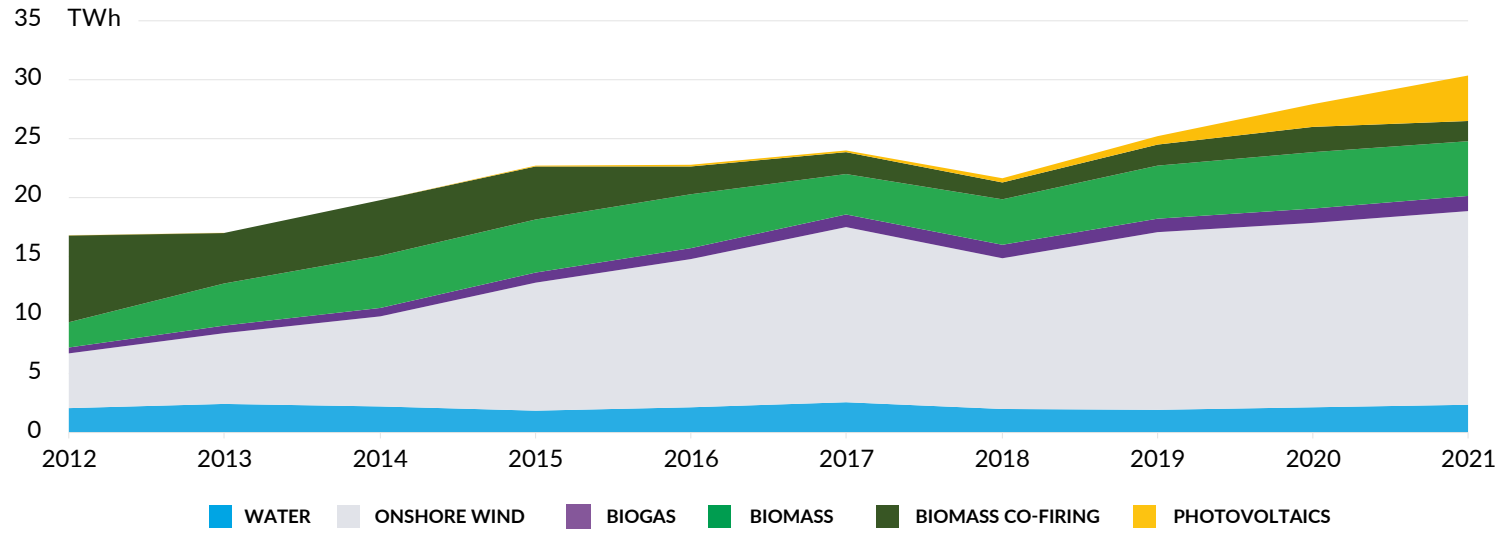


Own elaboration based on ARE data.

*Until 2016, the „other industrial" category also includes capacity in natural gas and hard coal.

Changes in renewable electricity generation over the last decade

- In 2021, 30.4 TWh of electricity was generated from RES, which is 8.5% more than in 2020.
- Wind power was responsible for more than half of the production from RES (54%), with the share of biomass at 15% and photovoltaics at 13%.
- In 10 years, production from RES has increased by 80%, from 16.8 TWh in 2012 to 30.4 TWh in 2021.
- Excluding PV, the largest increase in production was seen in wind power, at +250% in a decade.

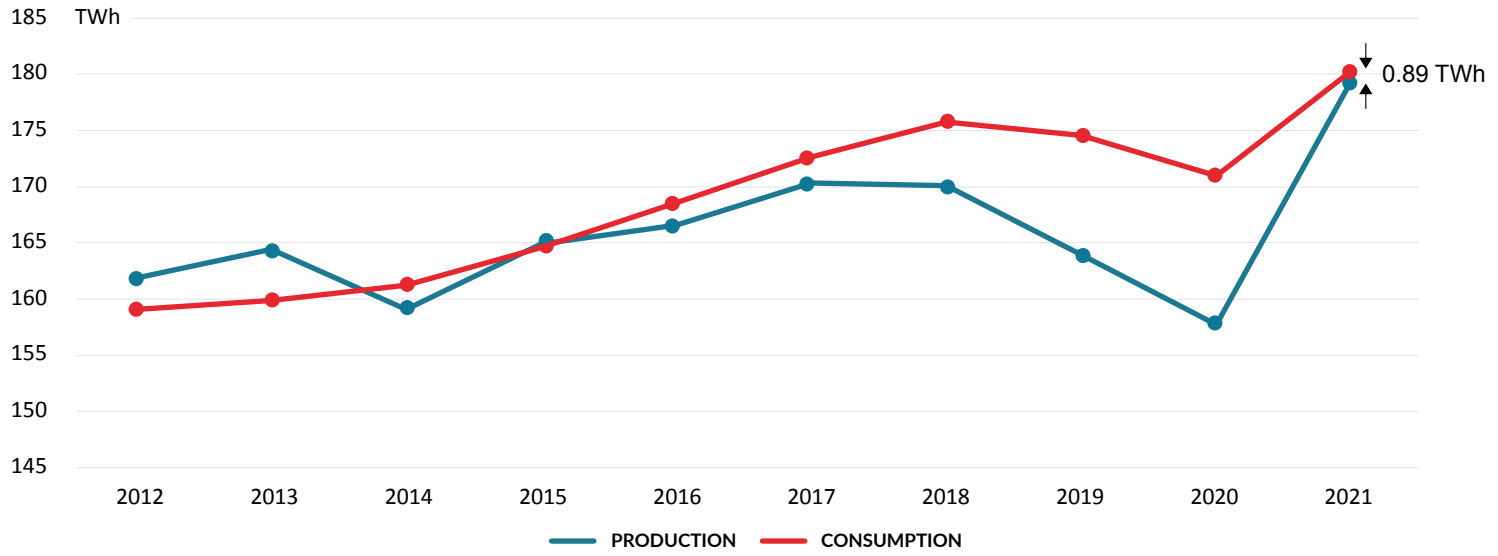


Own elaboration based on ARE data.

Energy balance

Balance of domestic electricity production and consumption

- Electricity production in 2021 was the highest in Polish history at 179.4 TWh.
- Electricity demand was also a record 180.3 TWh.
- Net imports of electricity were the lowest in 5 years.
- 99.5% of electricity demand was met by domestic generation.

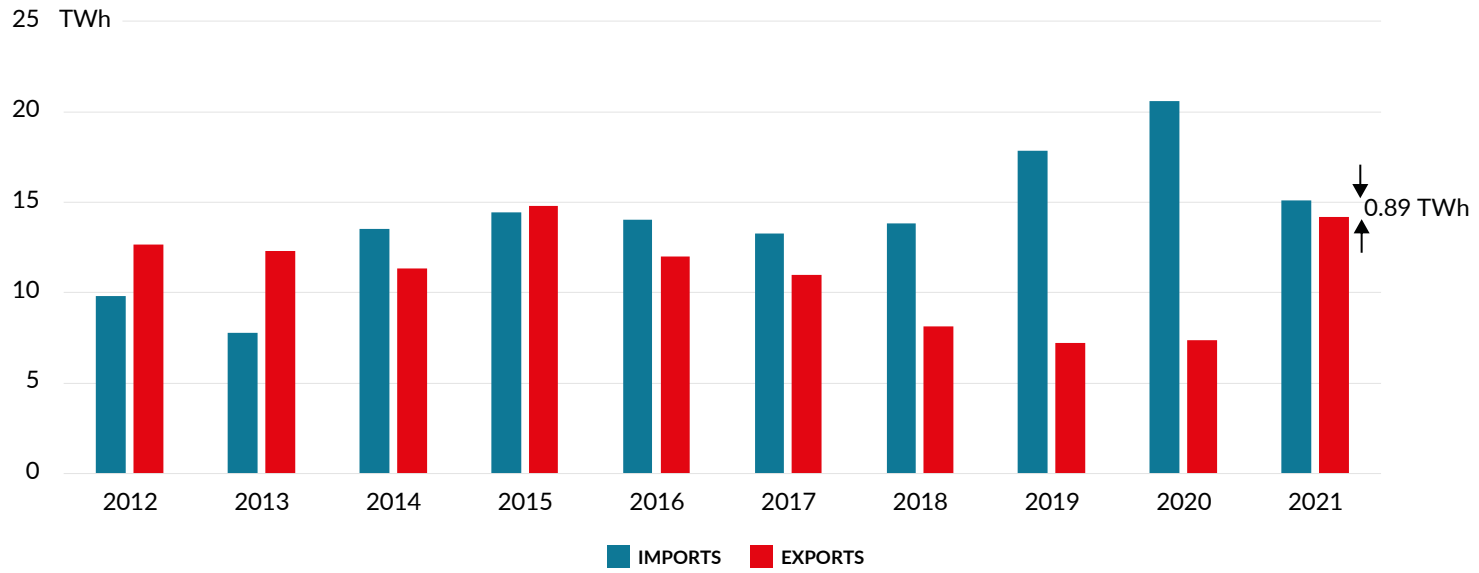


Own elaboration based on ARE data.

Gross consumption (including the power plant's own needs) is shown.

Cross-border exchange of electricity

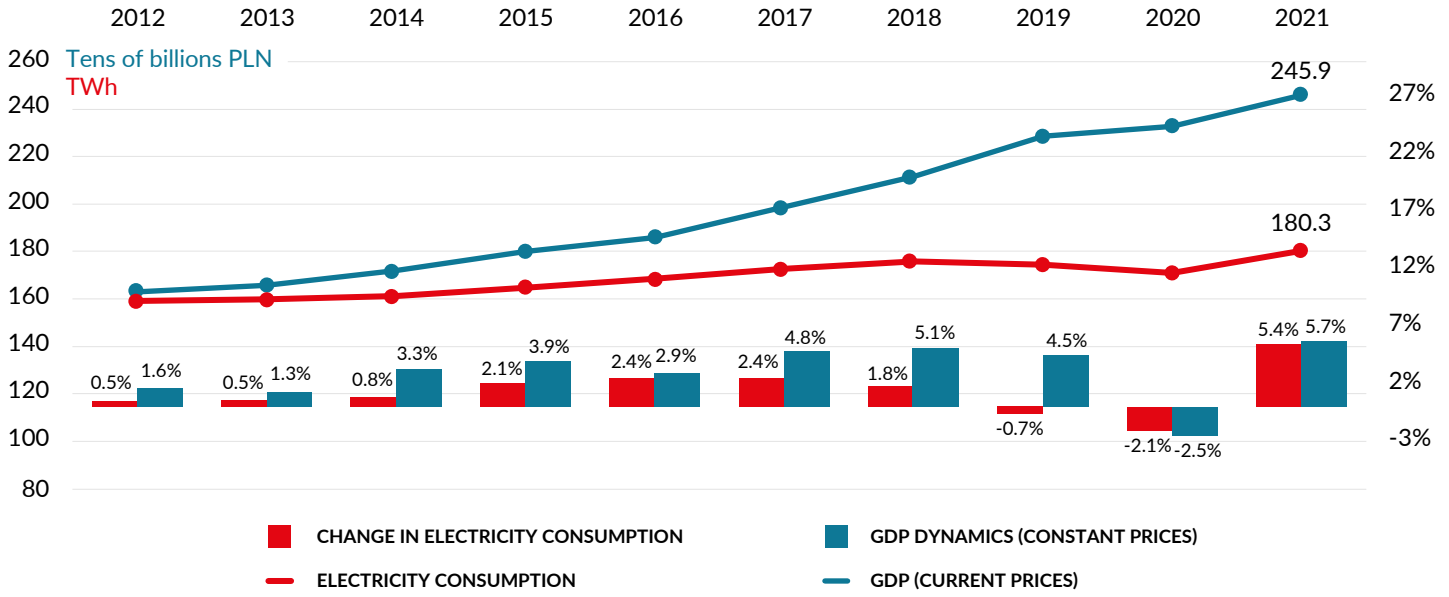
- In 2021, electricity imports were 15.10 TWh, while exports were 14.21 TWh. The balance of exchange with foreign systems was 0.89 TWh.
- Electricity exports were the highest since 2016, mainly due to lower prices on the wholesale market in Poland. This stemmed from the lower cost of electricity production from coal in Poland than from natural gas in neighbouring countries (even after taking into account the high price of CO_2 emission allowances).



Own elaboration based on ARE data.

Change in electricity demand versus GDP

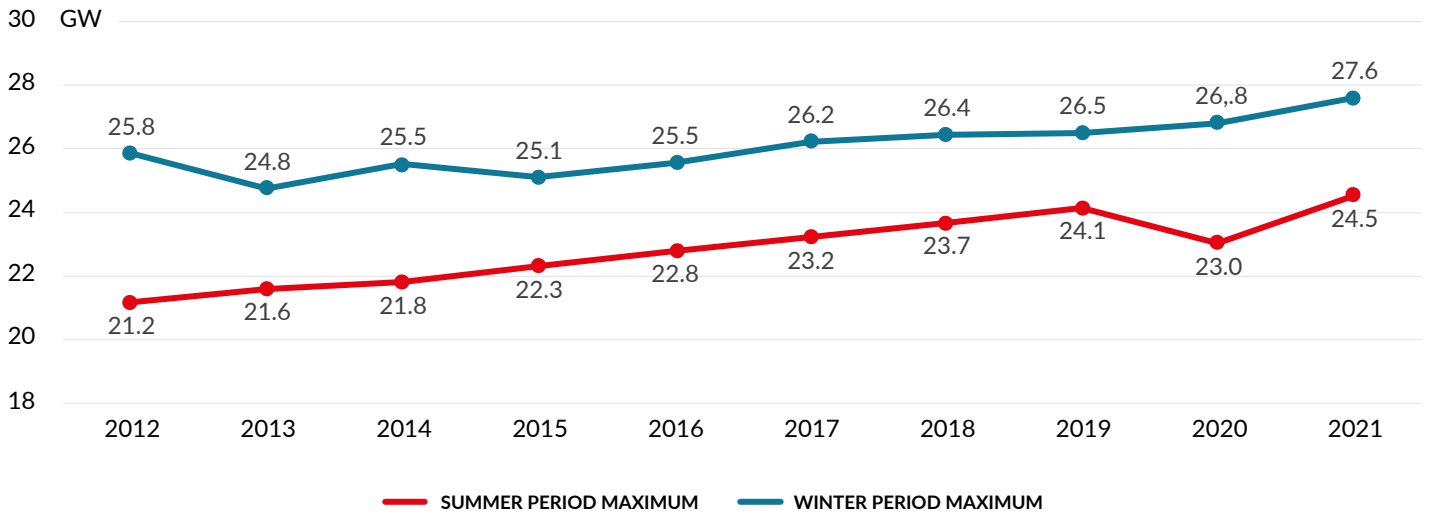
- In 2021, GDP grew by 5.7% and electricity consumption by 5.4%.
- This is the first year in more than a decade in which electricity consumption growth was roughly equal to GDP growth. This is due to the unusual reference year (2020), which was the first year of the COVID-19 pandemic.



Own elaboration based on ARE and GUS data.

Change in peak power demand

- Winter peak power demand in 2021 was 27.617 GW, which was 0.818 GW more than in 2020.
- Summer peak power demand also increased, in this case to 24.533 GW, or 1.5 GW more than in the pandemic year 2020.
- The increase in demand is related to the electrification of heating (heat pumps during the winter peak) and the increase in air-conditioned spaces (summer peak), among other factors.

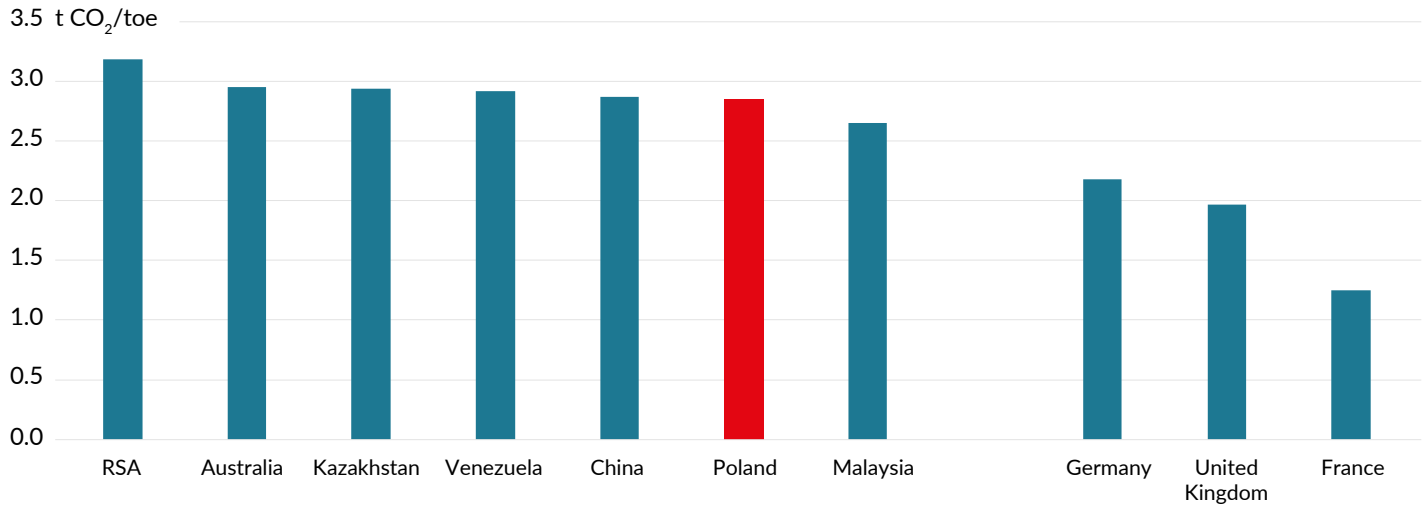


Own elaboration based on PSE data.

Emissions

Specific emissions of primary energy consumption

- In 2020, Poland was ranked 6th in the world in terms of carbon intensity of primary energy consumption.
- The country with the highest carbon factor was South Africa (3.18 t CO_2/toe). Poland, with 2.85 t CO_2/toe, was just behind China (2.87 t CO_2/toe). For comparison, the British economy emitted 31% less than Poland (1.97 t CO_2/toe) and the French economy 56% less (1.25 t CO_2/toe).

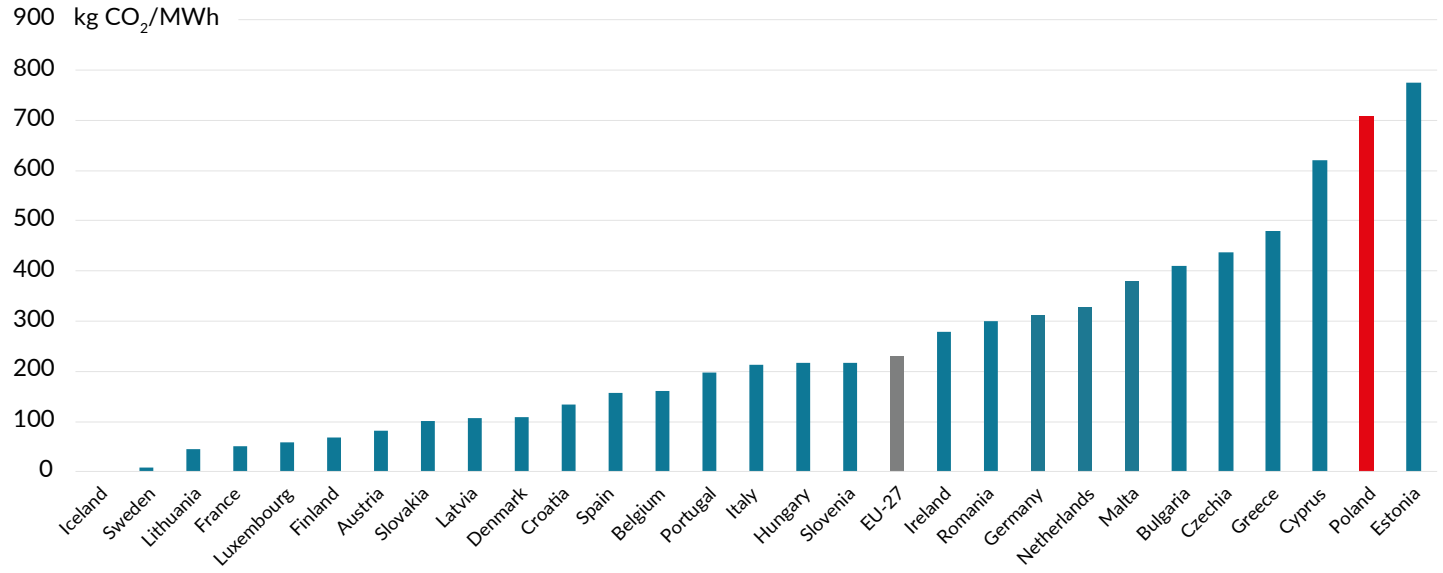


Own elaboration based on Enerdata data.

The specific carbon intensity of primary energy consumption shows how many tonnes of CO_2 were emitted on average when 1 unit of primary energy was consumed (toe - tons of oil equivalent, 1 toe ≈ 41.9 GJ). In other words, it is the emissivity of energy consumption, regardless of its form (heating, fuels, electricity, etc.).

Specific emissions of electricity generation

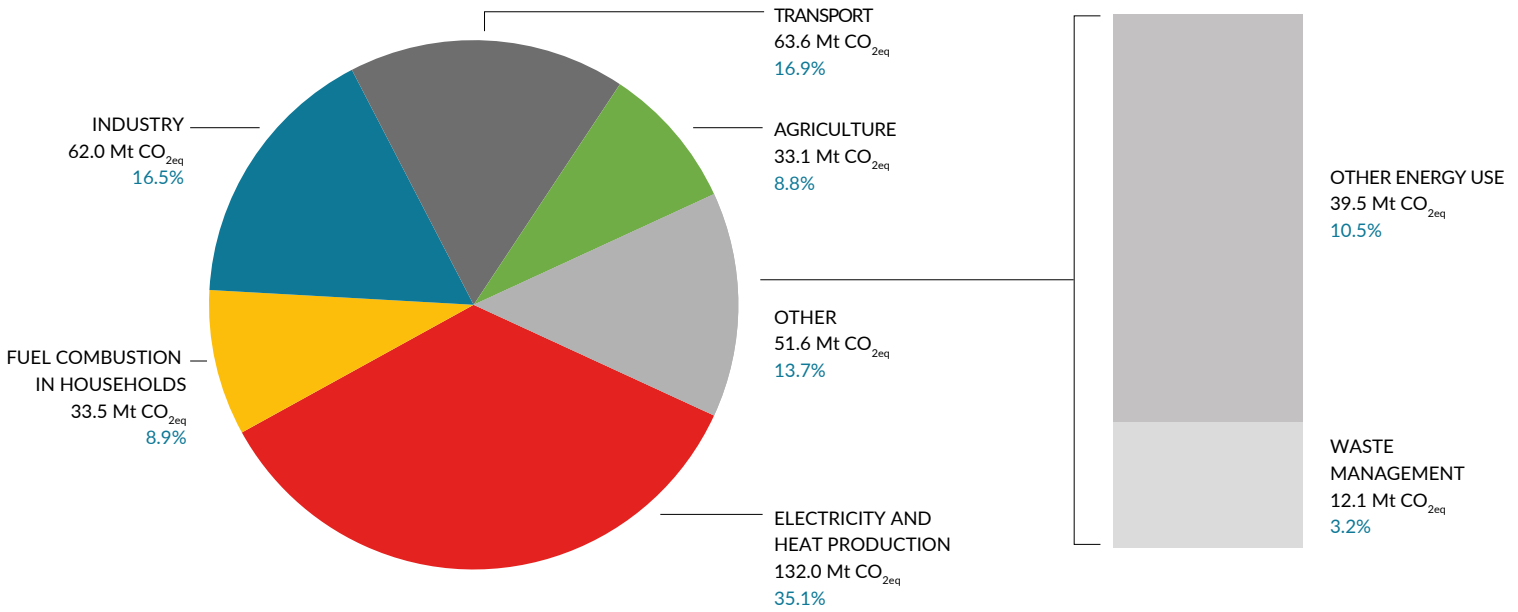
- Carbon intensity of electricity production in 2020 in Poland was about 710 kg CO_2/MWh and was one of the highest in the European Union.
- Such a high carbon intensity has and will continue to impact the industry due to the increasing importance of the carbon footprint in manufacturing and high sensitivity of electricity prices to the price of CO_2 emission allowances, among other factors.



Own elaboration based on EEA data.

Structure of greenhouse gas emissions in Poland

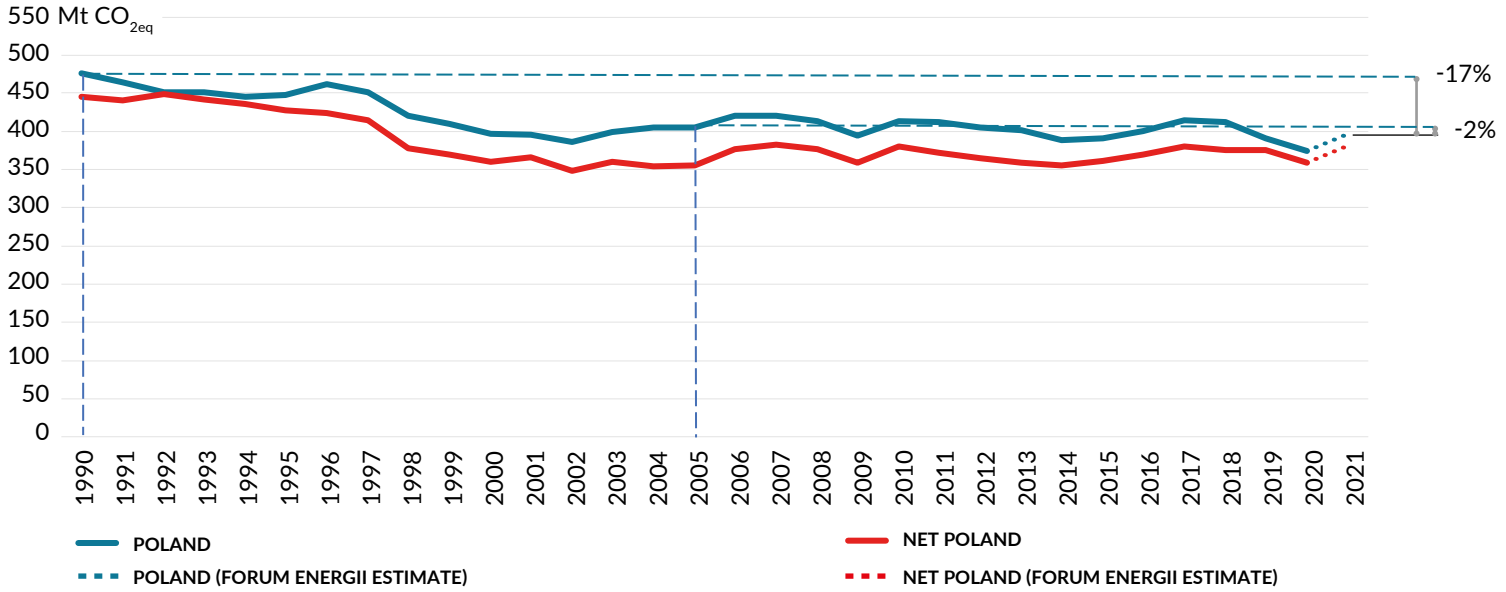
- In 2020, most emissions were from electricity and heat generation - 35.1% of total gross emissions.
- Transportation and industry were responsible for 16.9% and 16.5%, respectively.
- Households emitted 9% of greenhouse gases.



Own elaboration based on EEA data.

Changes in greenhouse gas emissions in Poland

- According to Forum Energii estimates, in 2021 emissions increased by about 6% to about 397 million tonnes of CO_2 equivalent, mainly in transport and electricity production.
- Land use, land use change and forestry (LULUCF) was responsible for absorbing about 15 million tonnes of CO_{2eq}.

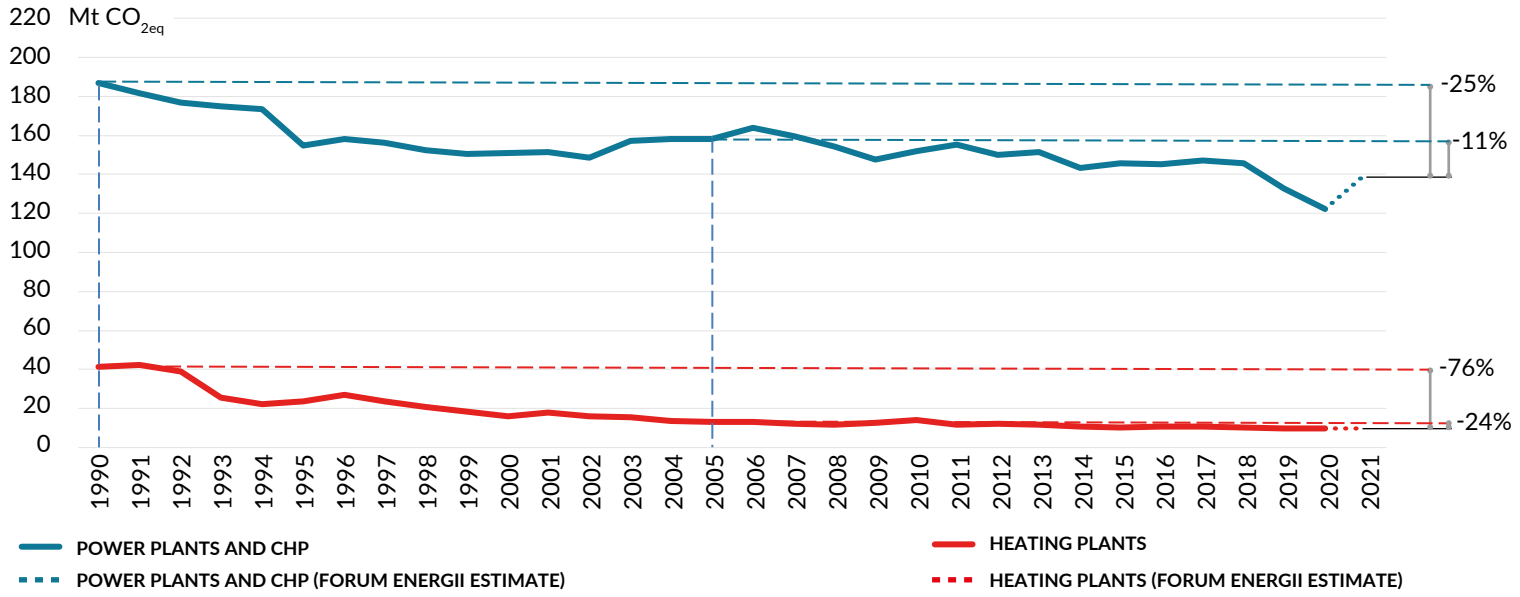


Own elaboration based on EEA, KOBiZE, ARE and GUS data. Greenhouse gases: CO_2, methane, nitrous oxide.

Net greenhouse gas emission is lower than gross emission because it takes into account not only greenhouse gases released into the atmosphere, but also those absorbed by trees, peatlands, or soil (LULUCF – *Land Use, Land Use Change and Forestry*).

Changes in greenhouse gas emissions from electricity and heat production

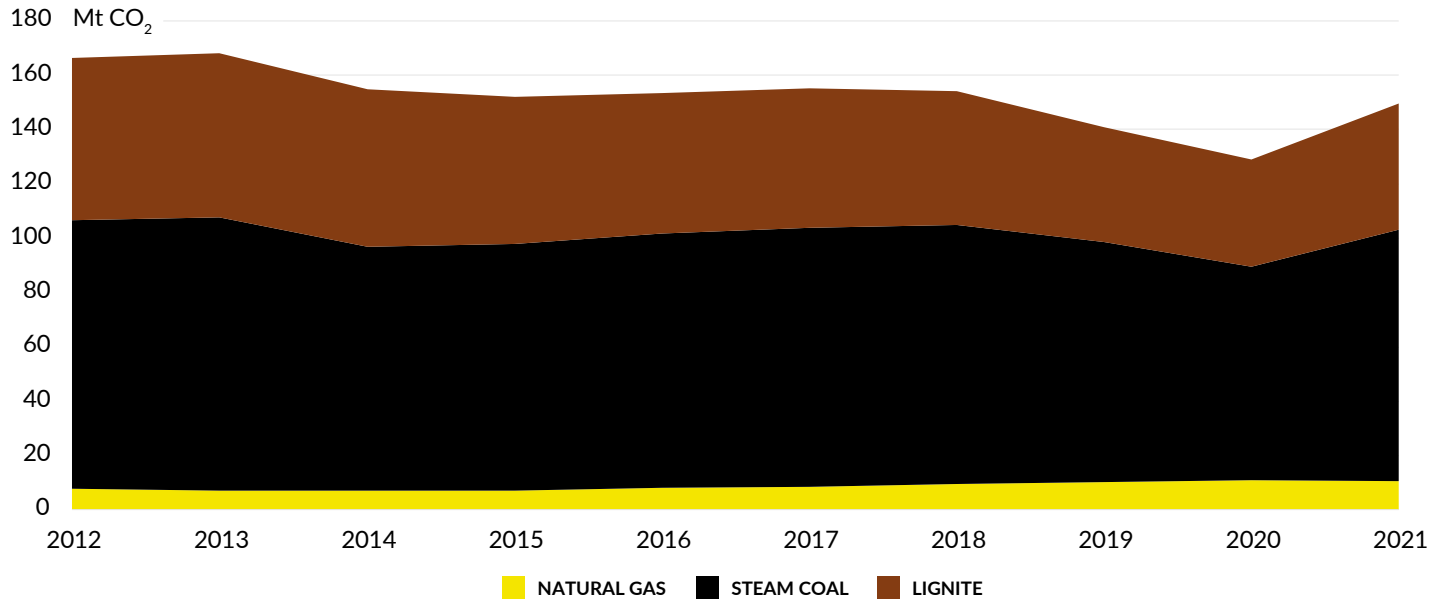
- In 2021, emissions from power and CHP plants are estimated to have increased by 15% to 140 million tonnes of CO_{2eq}.
- No significant changes in emissions from the heating plant are expected.



Own elaboration based on EEA, KOBiZE, ARE and GUS data. Greenhouse gases: CO_2 , methane, nitrous oxide.

Emissions from electricity and heat production, by fuel

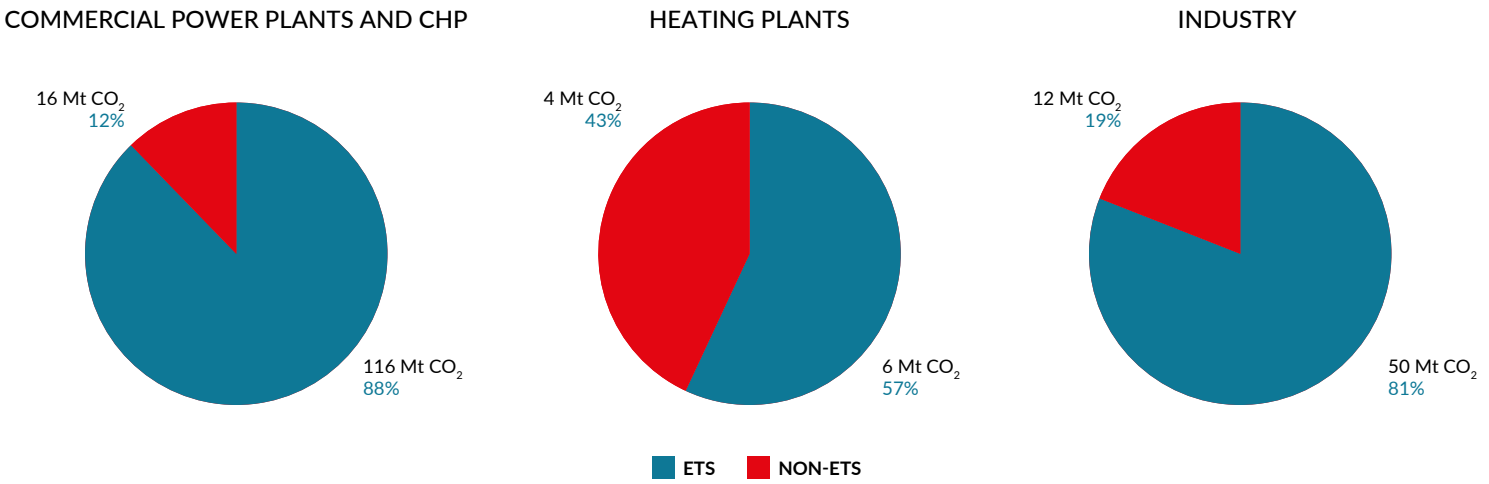
- Hard coal was responsible for 62% of greenhouse gas emissions from the power industry in 2021 (93 million tonnes CO_2 , +18% y/y).
- Lignite was responsible for 31% of emissions (7 million tonnes CO_2 , +18% y/y).
- The production of electricity and heat from natural gas fuels was associated with emissions of 10 million tonnes of CO_2 (-4.7% y/y).



Own elaboration based on KOBiZE, ARE and GUS data. Greenhouse gases: CO_2.

Carbon dioxide emissions covered by the ETS

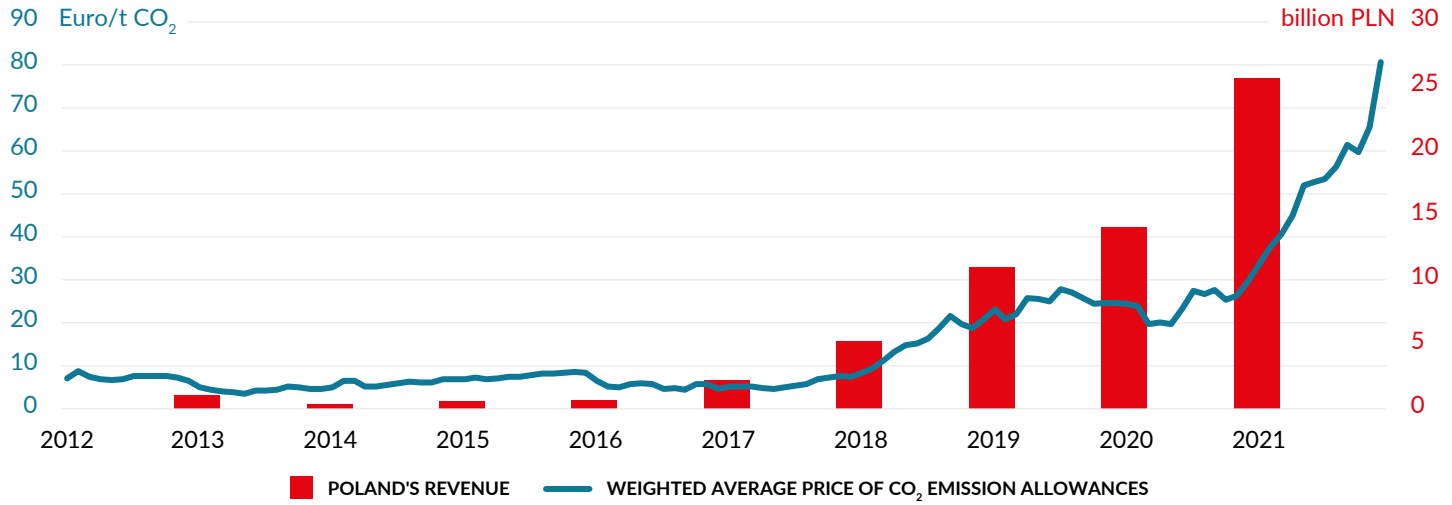
- Poland's total CO_2 emissions in 2020 were 374 million tonnes; 46% was covered by the European Emissions Trading System (EU ETS).
- Among commercial power plants and combined heat and power plants, 116 million tonnes of CO_2 (88% of all emissions from this sector) were covered by the ETS. For heat plants, the figure is 57%, with 6 million tonnes of CO_2 covered by the ETS in 2020.
- 81% of industry was covered by the ETS - 50 million tons of CO_2.



Own elaboration based on EEA and KOBiZE data.

CO_2 emission allowance prices; Poland's income from their sale

- 80.64 euro/t CO_2 was the weighted average price of CO_2 emission allowances on the primary market (EEX, at the end of 2021).
- A dynamic increase in EUA prices was observed in 2021 by 51 euro/t CO_2 (+272% y/y).
- The Polish budget gained PLN 25.56 bln from auctions of CO_2 emission allowances (EUA and EUAA). This is PLN 11.5 billion more than in 2020.
- PLN 60.37 billion – total budget revenue in Poland's 10 years of activity on the primary CO_2 market.

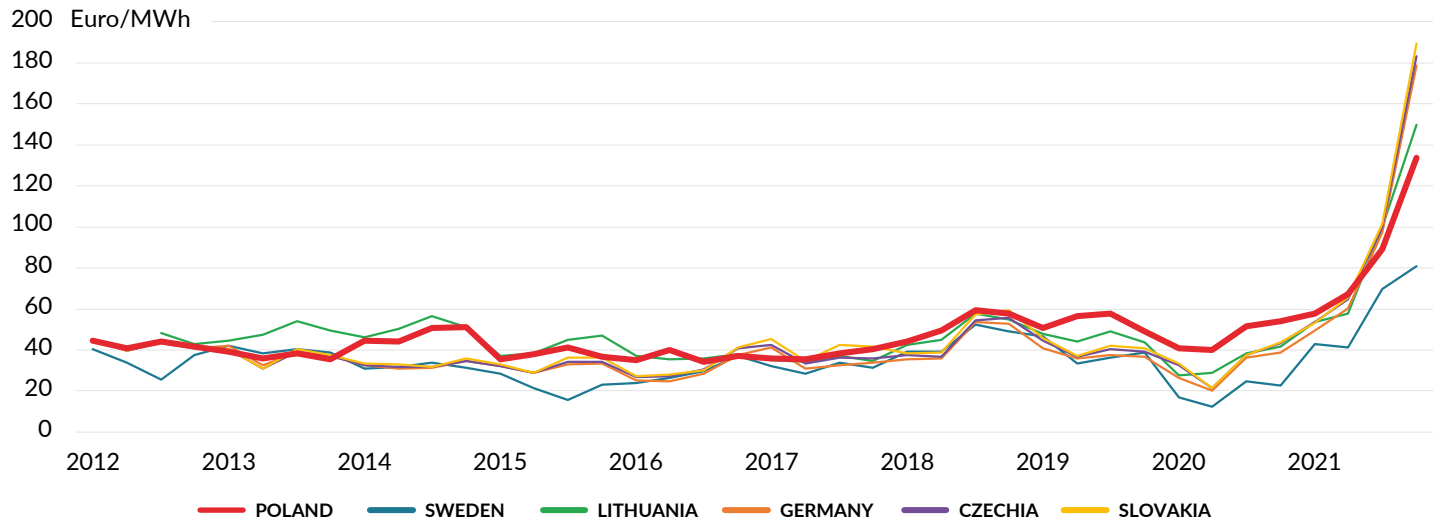


Own elaboration based on EEX data.

Electricity prices

Comparison of SPOT electricity prices in neighbouring markets

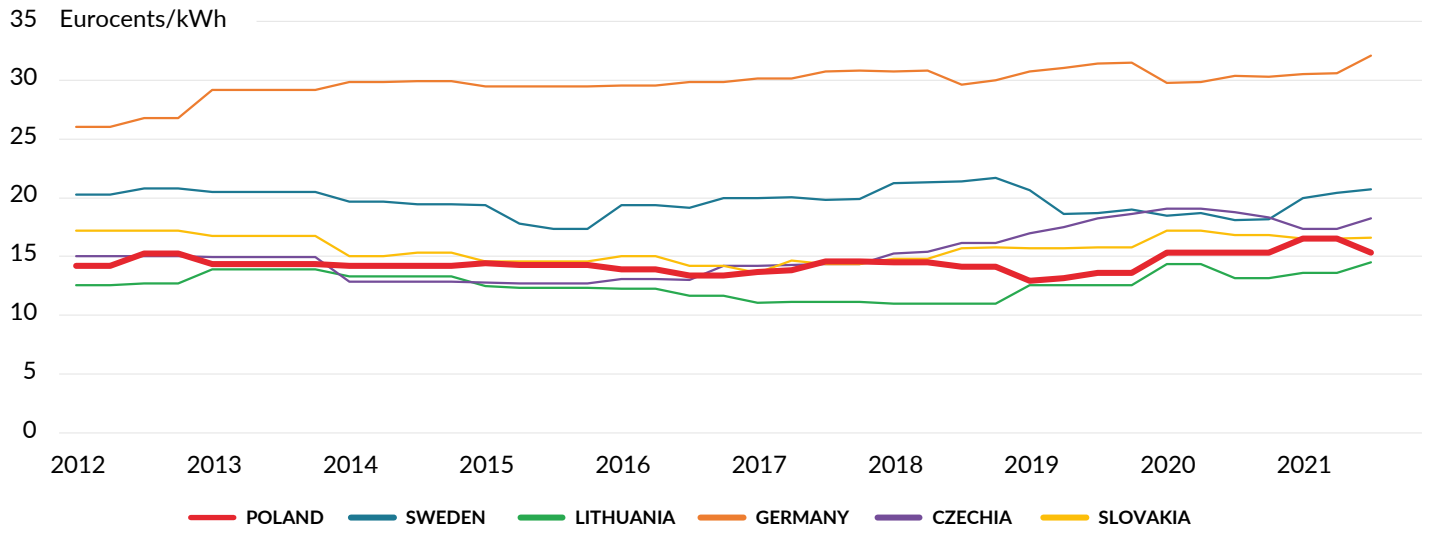
- At the end of 2021, for the first time in years, the wholesale price of electricity in Poland was not among the highest in the region. Only in Sweden in the second half of the year was it cheaper.
- The post-pandemic rebound has pushed natural gas prices to record levels, affecting the wholesale price of electricity in many European Union countries.
- Despite the high prices of CO_2 emission allowances, the cost of electricity production in Polish units was lower than in foreign ones. This resulted in the highest electricity exports in years.



Own elaboration based on European Commission (Quarterly Report on Energy Markets) and ENTSO-E data.

Comparison of electricity prices in neighbouring markets – prices for households

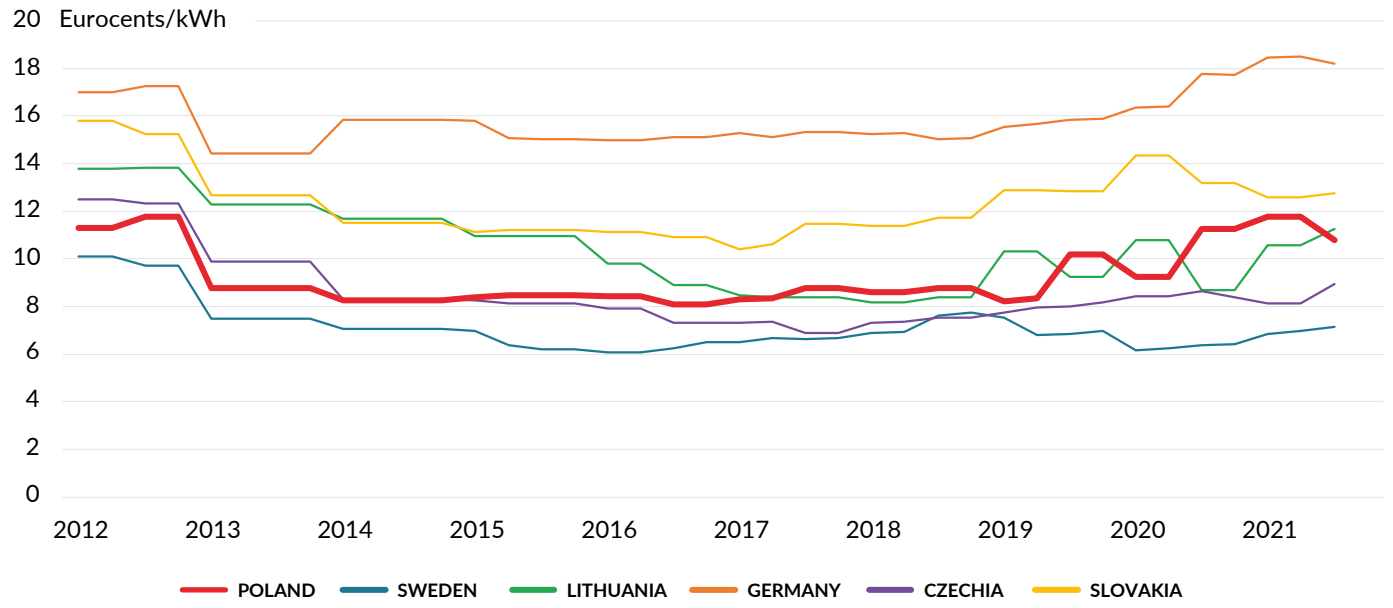
- For years, electricity prices for households in Poland have been among the lowest of the neighbouring countries.
- Including all taxes and levies, the price of electricity in Poland in the third quarter of 2021 was 15.3 eurocents/kWh.
- The price of electricity for households is shaped by many factors, most notably government tax and regulatory policies. It is not a simple reflection of wholesale energy prices on the exchange.



Own elaboration based on European Commission (Quarterly Report on Energy Markets) data.

Comparison of electricity prices in neighbouring markets - industrial prices

- After deducting VAT and all recoverable taxes and levies, the price of electricity for industry in Poland was 10.79 eurocents/kWh.



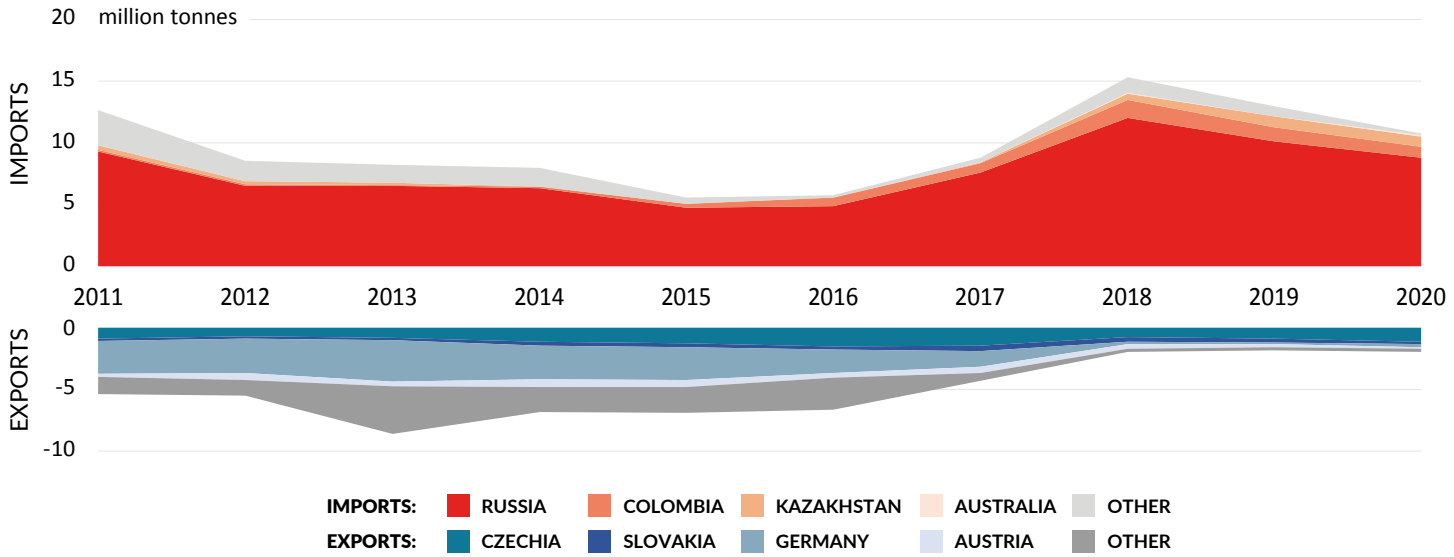
Own elaboration based on European Commission (Quarterly Report on Energy Markets) data.

Power sector fuels*

* Most data ends in 2020 due to the late publication of GUS reports for the previous year.

Trade balance of steam coal

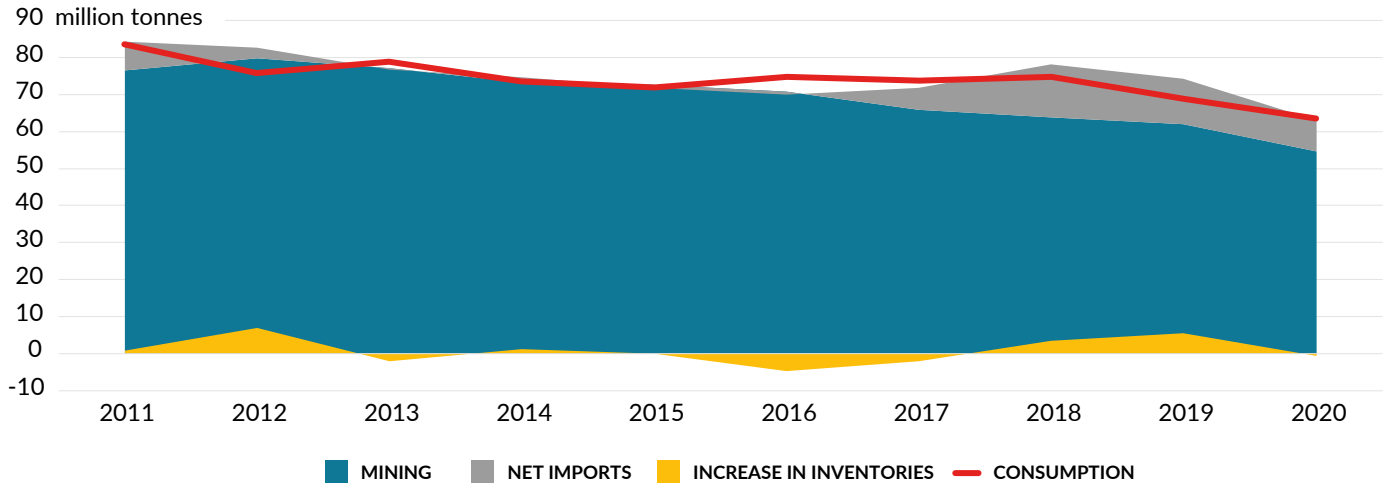
- In 2020, steam coal imports totalled 11 million tonnes - 2.2 million tonnes less than in 2019.
- 82% of imported steam coal came from Russia. Other import destinations were Colombia (8%), Kazakhstan (8%), and Australia (1%).
- In 2020, 2 million tonnes of steam coal were exported. The main customers were Czechia (59%), Slovakia (11%), Germany (11%), and Austria (9%).



Own elaboration based on GUS and Eurostat data.

Hard coal balance in Poland

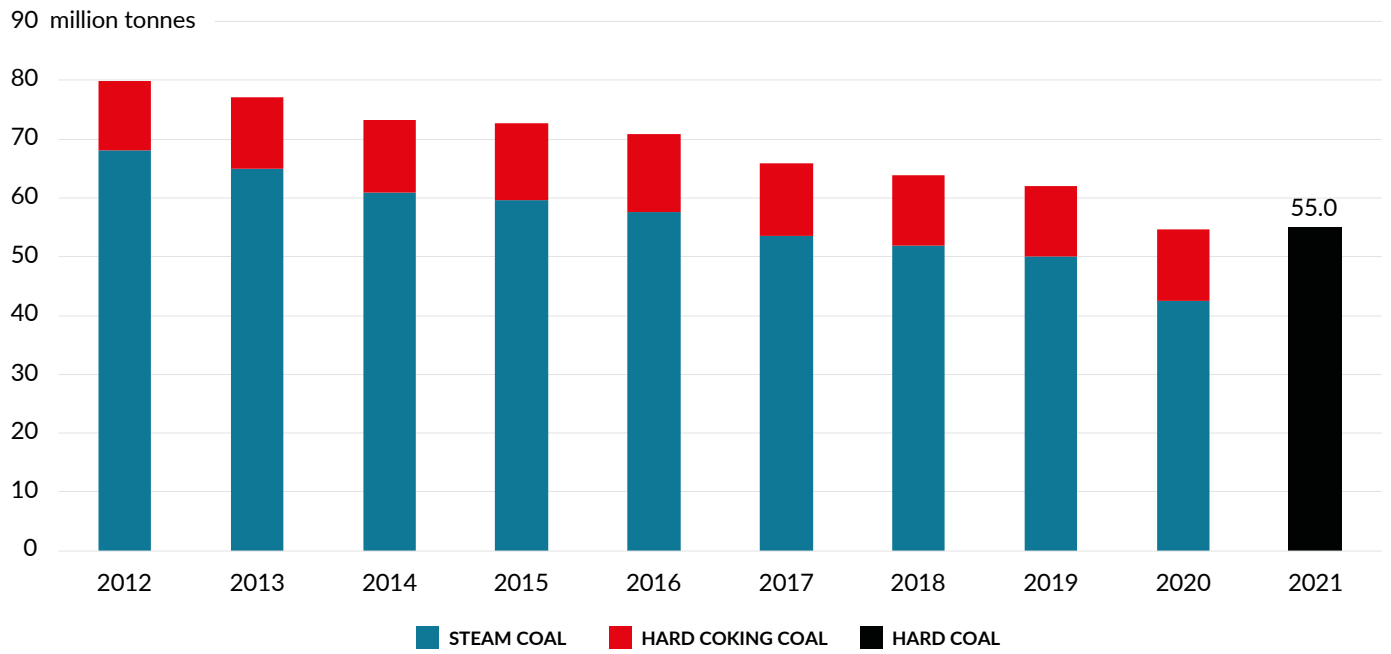
- In 2020, both coal production and consumption were lower than in previous years.
- Consumption was 63.5 million tonnes (5.3 million tonnes less than in the previous year), domestic production was 54.7 million tonnes (7.4 million tonnes less), and net imports were 8.2 million tonnes (4.1 million tonnes less).
- In contrast to previous years, domestic production and net imports were approximately equal to consumption in 2020.
- In previous years (2018 and 2019), coal (mostly domestic) was stockpiled.



Own elaboration based on GUS data.

Domestic hard coal production

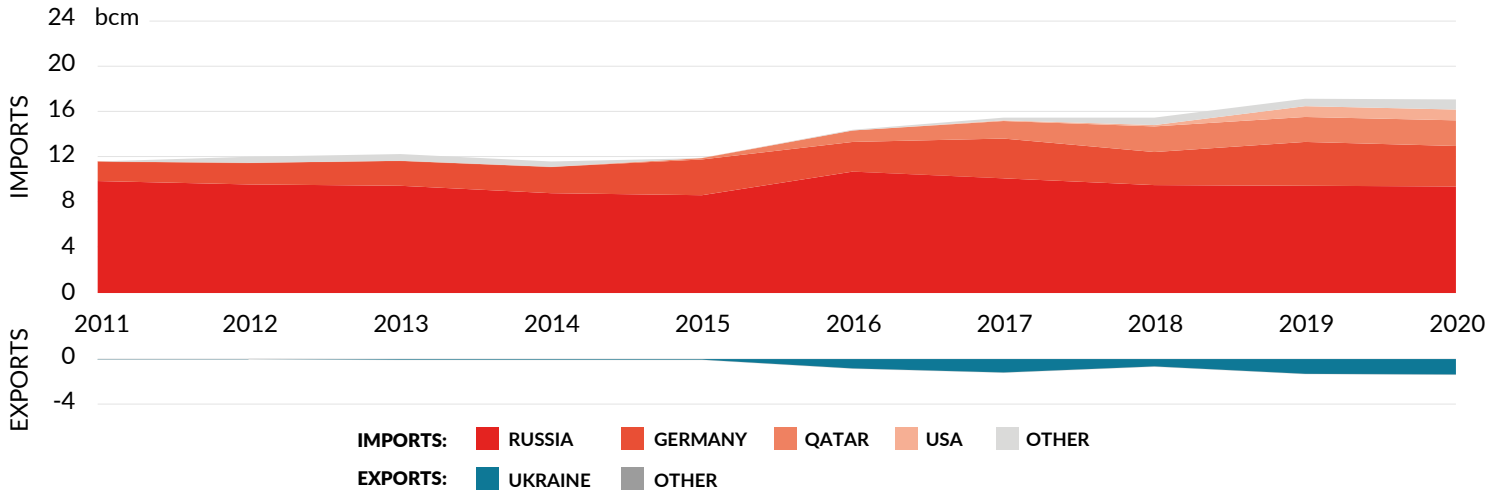
- 55 million tonnes of hard coal was mined domestically in 2021.
- Compared to last year, production increased by 0.3 million tonnes.



Own elaboration based on GUS and Polski Rynek Węgla data.

Trade balance of natural gas

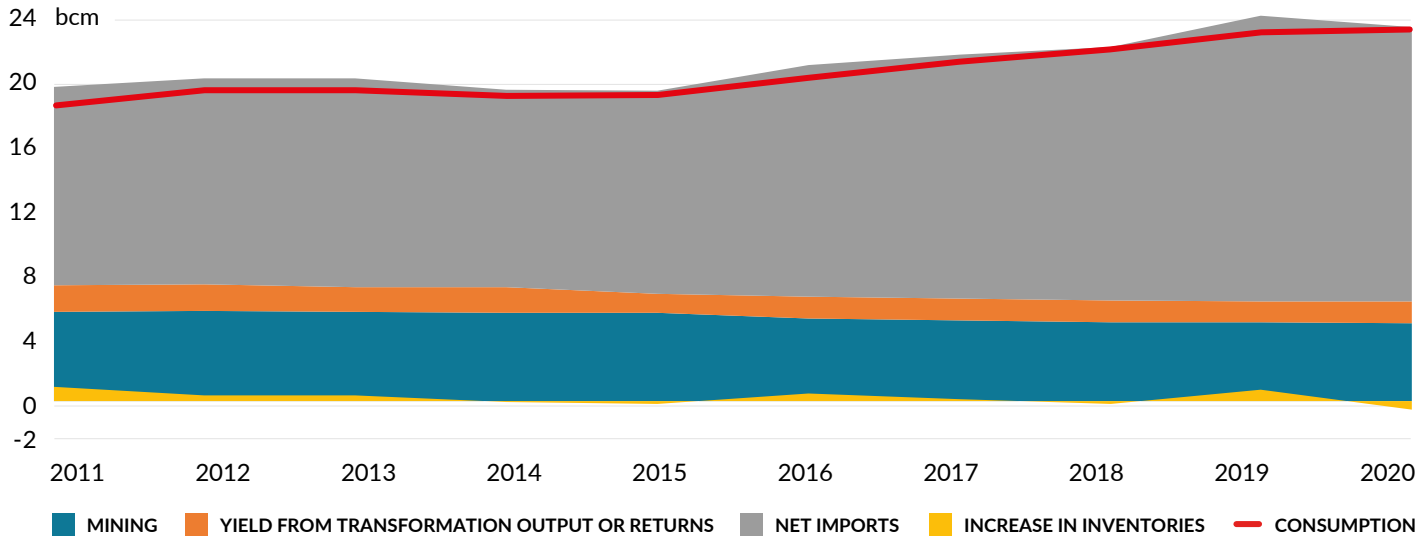
- In 2020, natural gas imports (both pipeline and LNG) totalled 17.4 bcm, the same as in the previous year.
- About 55% of the imported natural gas came from Russia. Other import destinations were Germany (21%), Qatar (13%), and the USA (6%).
- In 2020, 1.4 bcm of natural gas was exported. Practically the only customer was Ukraine (98%). The remaining 2% of exported gas went to Germany.
- LNG imports accounted for 22% (3.8 bcm after regasification) of all imported gas fuel. The main suppliers were Qatar (60%) and the USA (26%).



Own elaboration based on GUS and Eurostat data.

Natural gas balance in Poland

- In 2020, the upward trend in natural gas consumption continued, with high-methane gas responsible for the increase. Nitrogen-rich natural gas consumption remains stable at 3.7-3.8 bcm.
- Total natural gas consumption was 20.9 bcm, of which high-methane gas was responsible for 18.4 bcm.
- The increased consumption was not associated with an increase in production or net imports (which fell by 0.6 bcm to 15.5 bcm), so inventories had to be reduced by 0.5 bcm to close the balance.

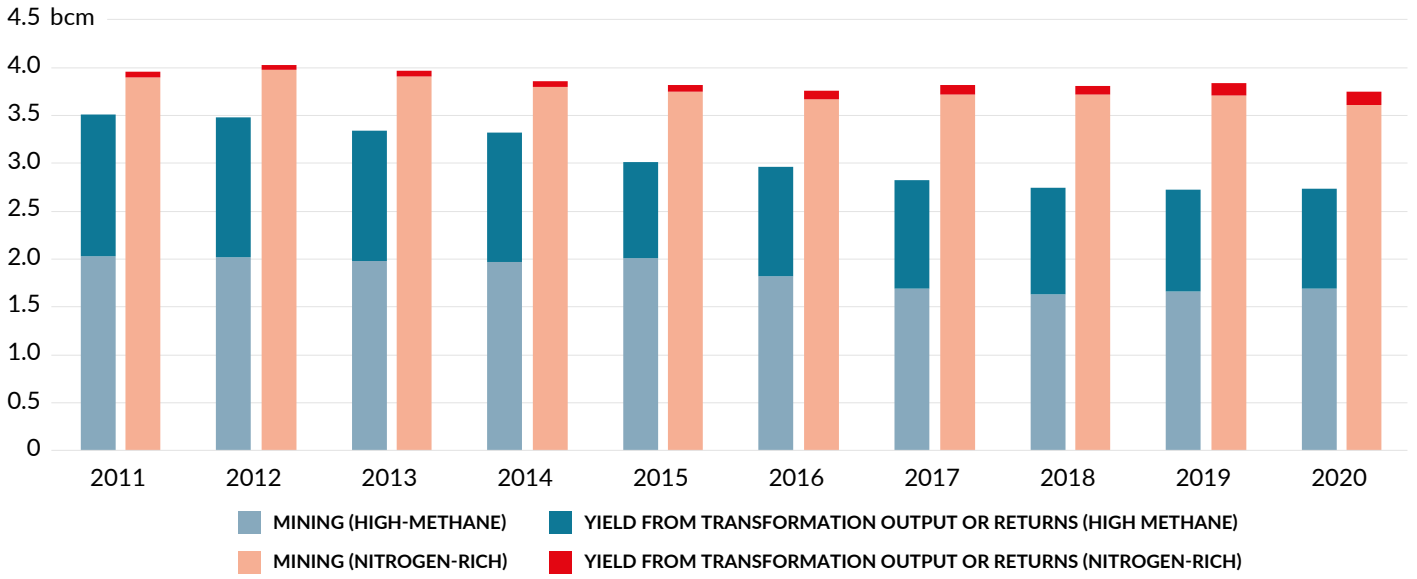


Own elaboration based on GUS data.

Nitrogen-rich natural gas has been converted to the equivalent of high-methane natural gas.

Domestic natural gas production

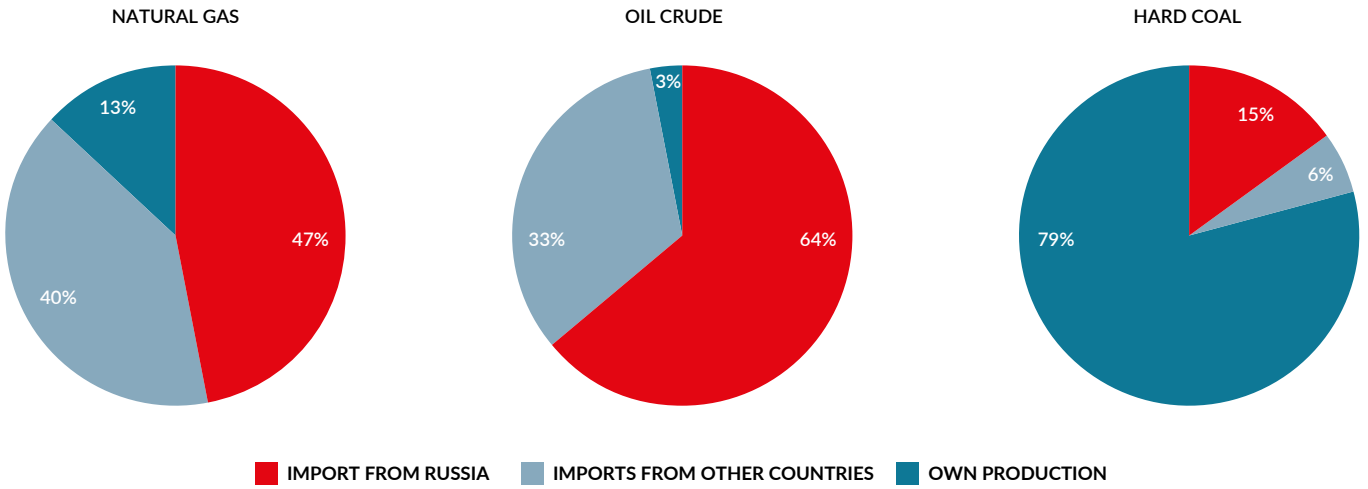
- Domestic production of high-methane gas is declining slightly. In 2020, 2.7 bcm were extracted, with 62% coming from minig and the remaining 38% from transformation output or returns.
- Domestic production of nitrogen-rich natural gas did not deviate from the long-term trend. In 2020, 3.7 bcm were produced, with 96% coming from mining and 4% from transformation output or returns.



Own elaboration based on ARE data.

Share of imports of energy resources from Russia

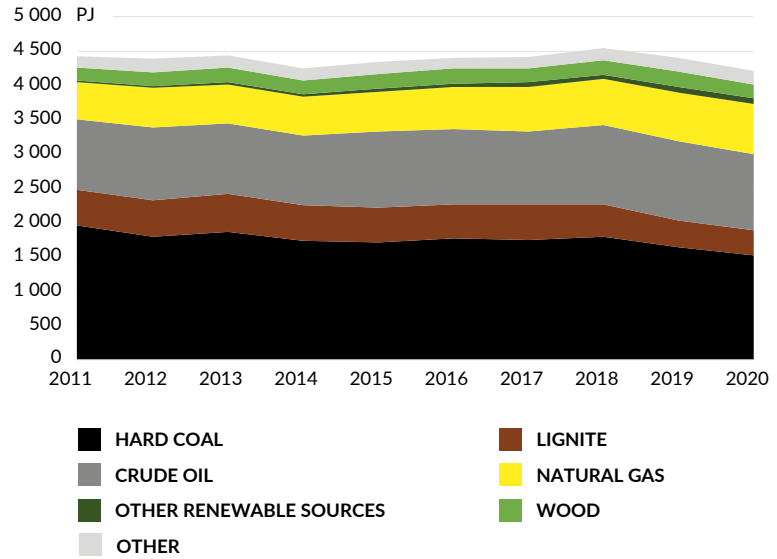
- In 2020, the energy resource Poland imported the most from Russia was oil (64%).
- The smallest share of energy imports from Russia was recorded in hard coal (15%).
- About half of the natural gas (47%) came from Russia.

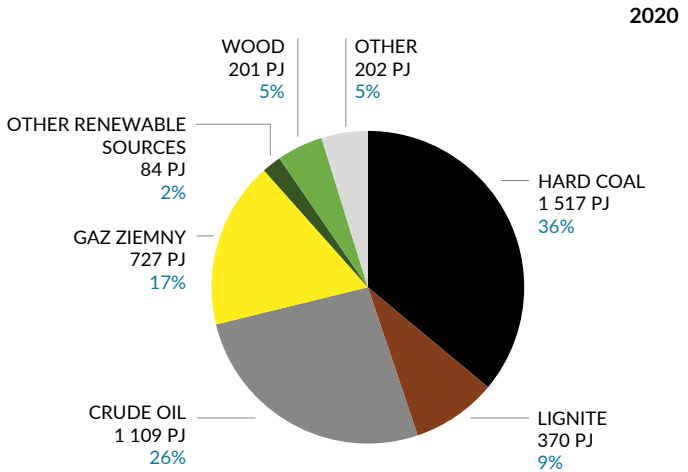


Own elaboration based on ARP, marketwatch.com, wnp.pl data.

Structure of primary energy consumption

- 45% of the energy consumed in Poland comes from coal: 36% from hard coal and 9% from lignite.
- 88% of final energy consumption is covered by fossil fuels.
- Renewable sources provided 7% of energy, with as much as 5% from biomass (wood). Water energy, photovoltaic, wind energy, geothermal, and ambient heat covered 2% of energy needs.
- Over the decade, there is a decrease in the share of coal (-8 p.p.), an increase in the share of oil (+3 p.p.) and natural gas (+5 p.p.). The share of wood remains stable.

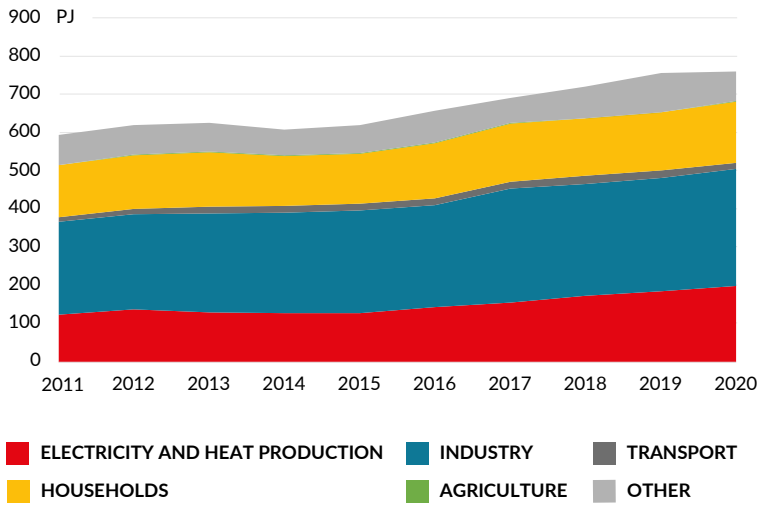


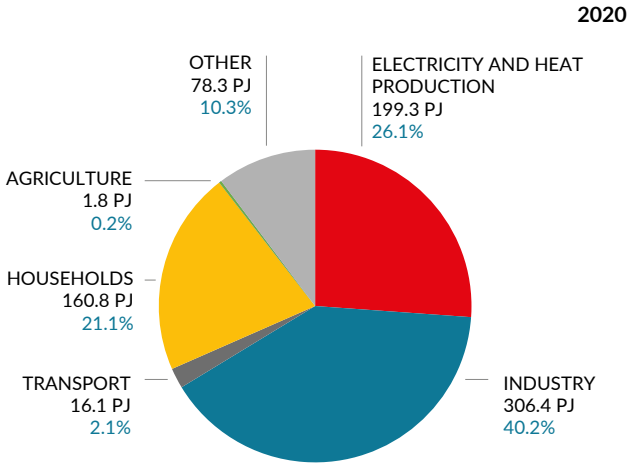


Own elaboration based on ARE data.

Structure of natural gas consumption

- The largest consumer of gas in Poland is industry, which in 2020 was responsible for 40.2% of domestic consumption. For years, this sector has been responsible for 40-43% of demand.
- A decrease in the share of gas in final consumption was recorded only in transport (-11% y/y) and among other customers (-23% y/y).
- The largest increases in the share of gas were recorded in agriculture (+16% y/y), electricity and heat production (+8% y/y), and households (+6% y/y).

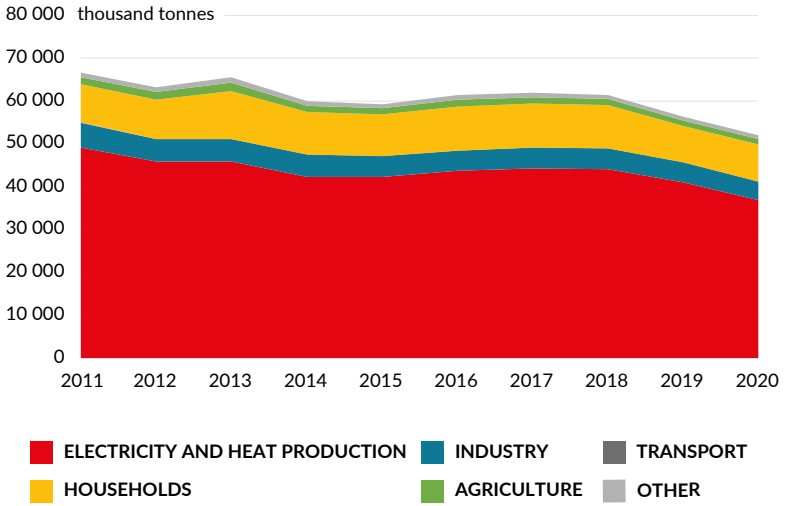


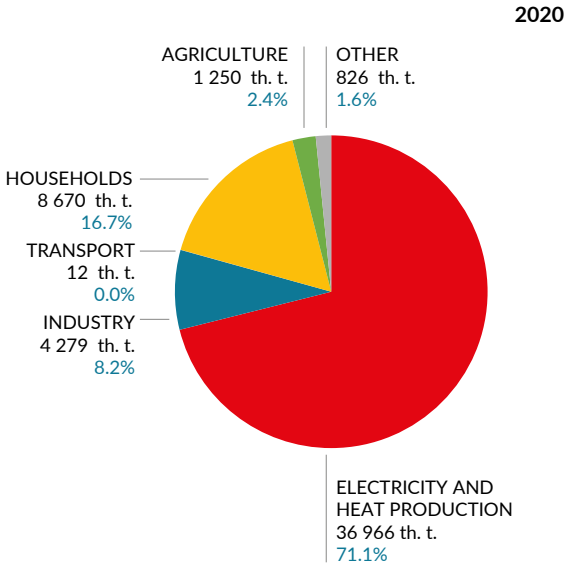


Own elaboration based on GUS data.

Structure of steam coal consumption

- The largest consumer of steam coal is the electricity and heat production industry, which was responsible for 71.1% of domestic consumption in 2020. For years, this sector has been responsible for 70-74% of total demand.
- Transport (-25% y/y), electricity and heat (-10% y/y), and industry (-10% y/y) saw the largest declines in their share of final consumption.
- Only households and agriculture (+2% y/y each) saw an increased share.

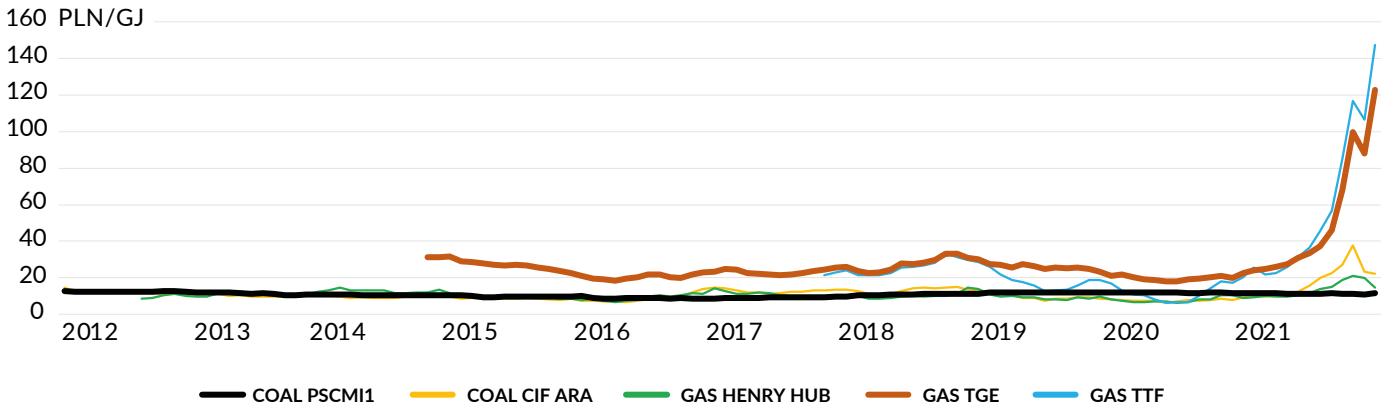




Own elaboration based on GUS data.

Coal and natural gas prices

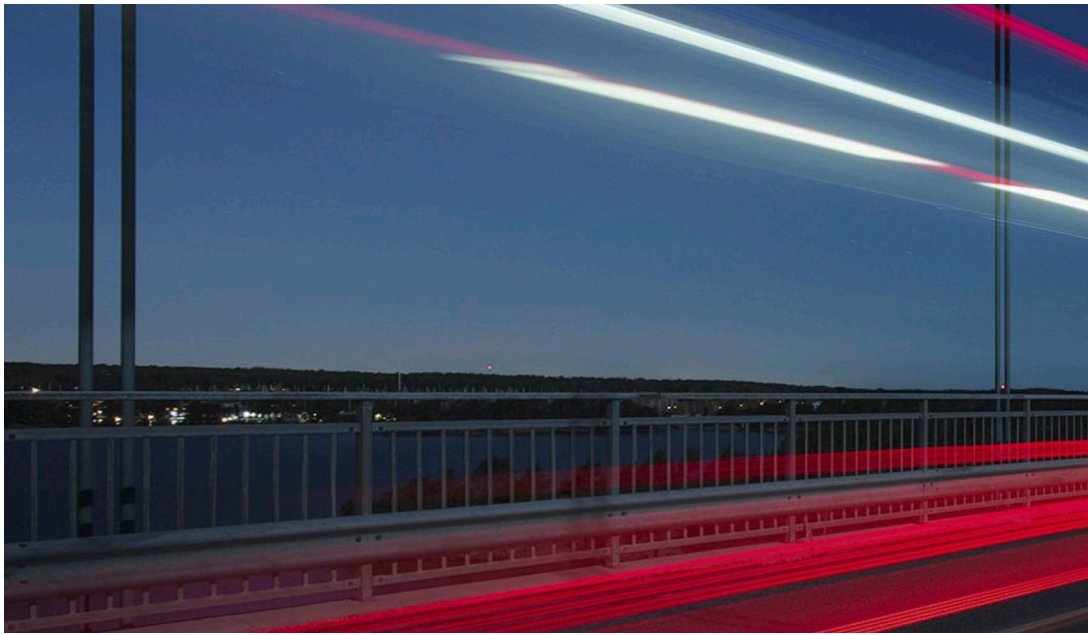
- Since mid-2021, an historically unprecedented rise in energy commodity prices, especially natural gas, has been observed.
- Natural gas futures contracts rose by more than 500% y/y on the Polish exchange, while the European TTF index rose by more than 570% y/y.
- Strong increases in natural gas prices were felt most strongly in Europe. The U.S. Henry Hub index also rose, but on a very limited basis.
- Coal became more expensive on the broader European market, while it became cheaper on the Polish market. ARA API2 recorded a dynamic increase (to 38 PLN/GJ). The Polish index in 2021 was on average PLN 0.5/GJ cheaper than in 2020.



Own elaboration based on monthly averages: ARP, TGE, NBP, Natural gas TTF - Dutch TTF Natural Gas Calendar index (TTF=F), Coal CIF ARA - index Coal (API2) CIF ARA (ARGUS-McCloskey) Futures (MTFc1), Gas Henry Hub - natural gas futures.

Notes

Energy transition in Poland 2022 Edition



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