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Key Indicators of Climate Change and the Energy Sector in 2022

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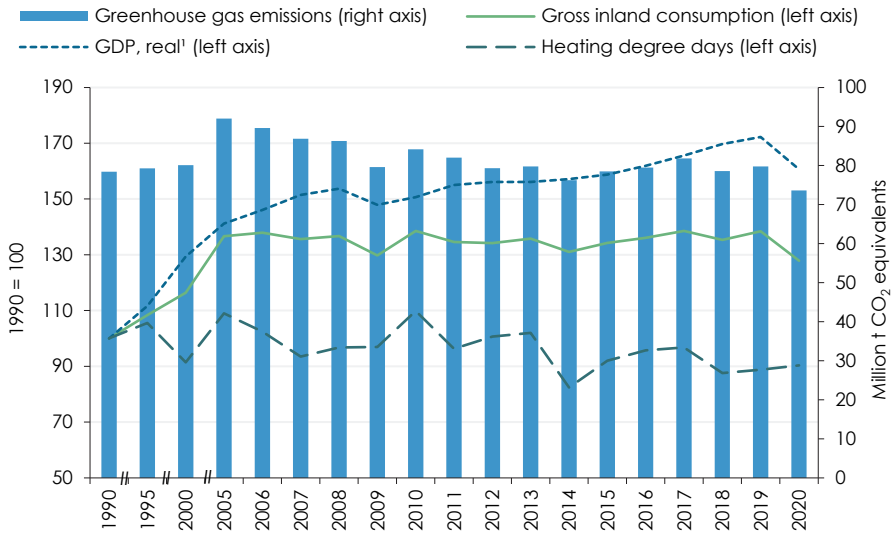
- The COVID-19 crisis caused the gross inland energy consumption of the EU 27 to drop significantly (2020 –8.1 percent compared to the previous year). Economic output shrank by 5.9 percent.
- Energy consumption in the EU 27 thus reached its lowest level since 1990. The consumption of solid fossil fuels decreased particularly strongly (–18 percent), but there were also decreases in oil (–12.6 percent) and natural gas (–2.4 percent) demand. The upward trend in renewable energy continued.
- Austria emitted 7.7 percent less greenhouse gases in 2020 than in the previous year due to the effects of the COVID-19 pandemic (–6.15 million t CO_2 equivalents).
- Transport recorded the strongest reduction in emissions of all sectors. It accounted for more than half of the total reduction.

Greenhouse gas emissions, energy consumption, gross value added and heating degree days in Austria



In 2020, both greenhouse gas emissions (–7.7 percent) and gross inland energy consumption (–7.6 percent) fell sharply in Austria. This is due to the decline in economic output as a result of the COVID-19 pandemic (source: Environment Agency Austria, 2022; Statistics Austria, Energy Balance Austria 1970-2020; WDS – WIFO Data System, Macrobond. – [1] Reference year 2015).

"Renewable energy sources covered 439 PJ of gross inland energy consumption in 2020, up by 0.7 percent or almost 3 PJ compared to 2019. Over the long term, energy supply from renewable sources has more than doubled, with an average increase of 2.5 percent p.a. in the period 1990-2020."

Key Indicators of Climate Change and the Energy Sector in 2022

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August 2022

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As a result of the measures taken to contain the COVID-19 pandemic, Austria's economic output decreased by 6.7 percent in 2020 compared with the previous year. Greenhouse gas emissions fell by 7.7 percent (or 6.1 million t CO_2 equivalents) and reached their lowest level since 1990. The transport sector accounted for more than half of the total decrease in greenhouse gas emissions compared to 2019. However, the emissions reductions do not reflect structural improvements in energy or emissions intensity; rather, they are short-term declines resulting from reduced economic activity and limited private mobility due to COVID-19 related restrictions and increased home-office schemes. Therefore, consistent implementation of measures leading to a sustainable reduction of greenhouse gas emissions is required to achieve the climate policy objectives, in particular the Austrian target of climate neutrality by 2040.

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Scientific referee: Margit Schratzenstaller • **Research assistance:** Susanne Markytan (susanne.markytan@wifo.ac.at), Dietmar Weinberger (dietmar.weinberger@wifo.ac.at), Eva Wretschitsch (eva.wretschitsch@wifo.ac.at) • **Cut-off date:** 2 August 2022

Contact: Claudia Kettner (claudia.kettner@wifo.ac.at), Daniela Kletzan-Slamanig (daniela.kletzan-slamanig@wifo.ac.at), Angela Köppl (angela.koeppl@wifo.ac.at), Ina Meyer (ina.meyer@wifo.ac.at), Franz Sinabell (franz.sinabell@wifo.ac.at), Mark Sommer (mark.sommer@wifo.ac.at)

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This 15th WIFO report on key indicators on climate change and the energy economy documents and analyses their development in 2020, based on current data on greenhouse gas emissions in Austria (Environment Agency Austria, 2022) and energy flows according to the energy balance (Statistics Austria, 2021b, 2022).

As a result of the economic downturn triggered by the COVID-19 pandemic, the increased use of home offices and official traffic restrictions, Austria's greenhouse gas emissions fell by 7.7 percent in 2020 compared to the previous year. The decrease in emissions was stronger than the decline in the GDP (2020 –6.7 percent), mainly due to a reduction in energy intensity. Emissions in the transport sector (–13.6 percent) and in the energy sector (–13.5 percent) fell particularly sharply, while greenhouse gas emissions from industry decreased by about 5 percent. However, the emission reductions do not reflect a structural improvement in energy or emission intensity but rather represent short-term declines as a result of lower economic output and reduced mobility. In order to achieve the climate policy objectives – especially the Austrian target of climate neutrality by 2040 – the consistent implementation of measures for a sustainable reduction of greenhouse gas emissions is therefore required.

This year's special topic, dedicated to agriculture and food security in the context of climate change, appears as a separate contribution in issue 9/2022 of the WIFO-Monatsberichte (monthly reports).

1. Climate and energy indicators

1.1 Gross inland energy consumption of the EU 27 decreased significantly due to COVID-19 pandemic

In 2020, GDP in the EU 27 fell significantly due to the pandemic. Accordingly, energy consumption fell to its lowest level since 1990.

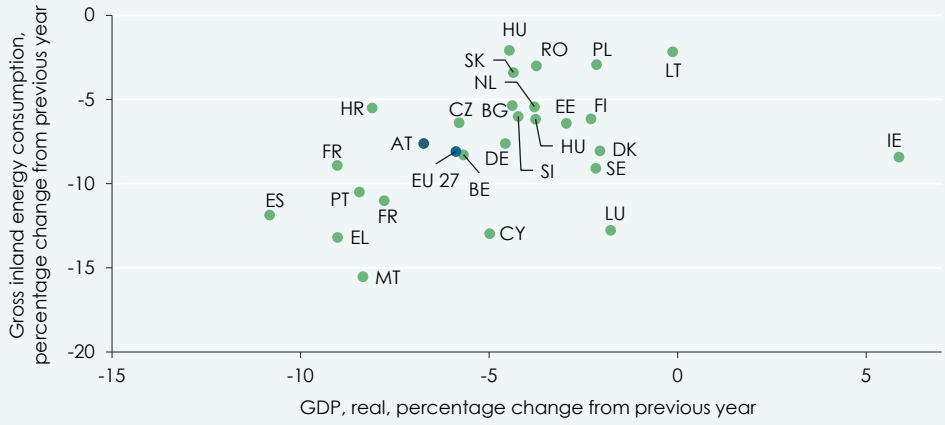
Gross inland energy consumption in the EU 27 fell noticeably in 2020. At –4,932 PJ (–8.1 percent compared to 2019), it fell four times as much as in the previous year, reaching 56,100 PJ, the lowest value since 1990. However, the decline was primarily due to the effects of the COVID-19 pandemic, i.e. significantly reduced economic activity in the member countries. Due to the lockdowns and the associated economic consequences, the GDP of the EU 27 shrank by 5.9 percent. The sharpest declines were recorded in Spain (–10.8 percent), Italy (–9 percent), Greece (–9 percent) and Portugal (–8.4 percent). In Austria, GDP fell by 6.7 percent.

A comparison of the development of GDP and gross inland energy consumption in the EU 27 shows a – partly drastic – decline of both key figures (Figure 1): gross inland energy consumption declined in all EU countries in 2020. Likewise, economic output in 26 EU member countries was below the level of the previous year. Only Ireland recorded economic growth in 2020[1]. With regard to energy consumption, the use of fossil fuels in particular declined: consumption of solid fossil fuels fell for the fifth year in a row (–18 percent), but reductions were also recorded for oil (–12.6 percent) and, to a lesser extent, natural gas (–2.4 percent). This is mainly due to transport restrictions and the strong expansion of home office in the pandemic. In contrast, the upward trend in the use of renewable energy sources continued. In 2020, these accounted for a share of 22.1 percent of gross inland energy consumption in the EU 27, exceeding the EU target by 2 percentage points.

Gross inland energy consumption in 2020 declined the most in Malta (–15.5 percent), ahead of Greece, Cyprus, Luxembourg and Spain (–13.2 percent to –11.9 percent). In Austria, the decrease was 7.6 percent. However, this was also a consequence of the COVID-19 pandemic and not the result of structural changes.

Figure 1: **Development of gross inland energy consumption in relation to GDP development in the EU countries**

2020



Source: Eurostat.

1.2 Austria: COVID-19 crisis causes greenhouse gas emissions to drop sharply

Austria's greenhouse gas emissions[2] fell significantly in 2020 compared to the previous year due to the effects of the COVID-19 pandemic (–7.7 percent or –6.15 million t CO_2 equivalents; Figure 2). At 73.6 million t CO_2 equivalents, they reached the lowest level since 1990.

The Austrian Climate Protection Act sets emission caps for those sectors that are not subject to the EU emissions trading system (EU ETS) but to the burden sharing system. For 2020, the corresponding cap was 47.8 million t CO_2 equivalents. The actual

[1] This is probably due, on the one hand, to exports and, on the other, to activities of the branches of large international corporations.

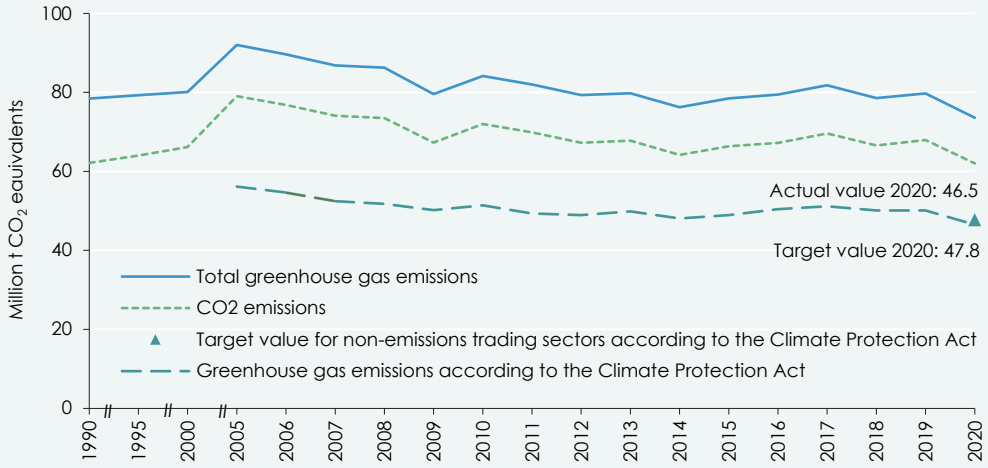
[2] Excluding emissions from land use, land use change and forestry.

Austria's greenhouse gas emissions fell sharply in 2020 (–7.7 percent), both in the area of emissions trading and in the sectors regulated by the Climate Protection Act.

emissions of the sectors not covered by emissions trading were, at 46.5 million t CO_2 equivalents, 1.3 million t (2.7 percent) below the target value and 3.6 million t (7.2 percent) below the value for 2019.

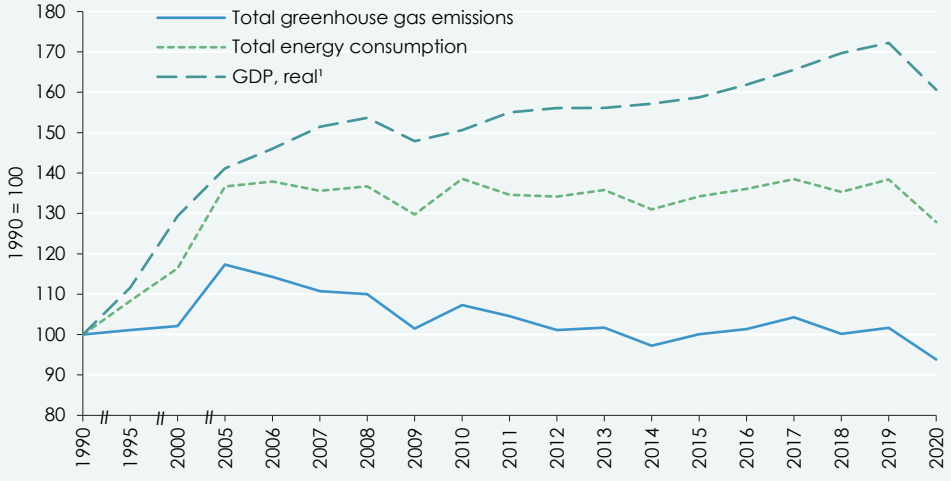
Greenhouse gas emissions in the emissions trading sector were also lower than in 2019 (–2.6 million t CO_2 equivalents or –8.6 percent). Installations covered by the emissions trading scheme emitted[3] 27 million t of greenhouse gases in 2020, of which 7.8 million t were from power generation and 19.2 million t from industry. The reduction in industry (–5.4 percent, –1.1 million t) is mainly due to the pandemic-related lower iron and steel production (about –10 percent crude steel production). Emissions also decreased in energy production (electricity and heat production in large plants, refinery and natural gas compressor stations; –15.6 percent, –1.4 million t CO_2 equivalents). This reflects the decommissioning of the last Austrian coal-fired power plant and lower electricity production in large power plants.

Figure 2: **Greenhouse gas emissions in Austria and Kyoto target**



Source: Environment Agency Austria.

Figure 3: **Greenhouse gas emissions and economic growth in Austria**



Source: Environment Agency Austria; WDS – WIFO Data System, Macrobond. – [1] Reference year 2015.

[3] European Environment Agency (2021). EU Emissions Trading System (ETS) data viewer.

The decrease in energy consumption of –7.6 percent roughly corresponded to that of greenhouse gas emissions. Energy-related greenhouse gas emissions decreased significantly in 2020 (–9 percent compared to the previous year), as the use of fossil fuels decreased, and renewable energy sources were expanded at the same time (see Chapter 1.8). Non-energy emissions from industrial processes, agriculture and waste management, on the other hand, fell by only 4 percent.

As noted above, the emission reductions do not reflect a structural improvement in energy or emission intensity, but rather short-term declines as a result of reduced economic performance. With the recovery of the economy, a renewed increase in greenhouse gas emissions can therefore be anticipated. The WIFO forecast of June 2022 expects a year-on-year increase in emissions of 4.8 percent and 4.3 percent for 2021 and 2022, respectively.

The emission reductions in 2020 do not reflect a structural improvement in energy or emission intensity, but rather short-term declines as a result of reduced economic performance.

1.3 Greenhouse gas emissions from transport and energy supply to decrease most in 2020

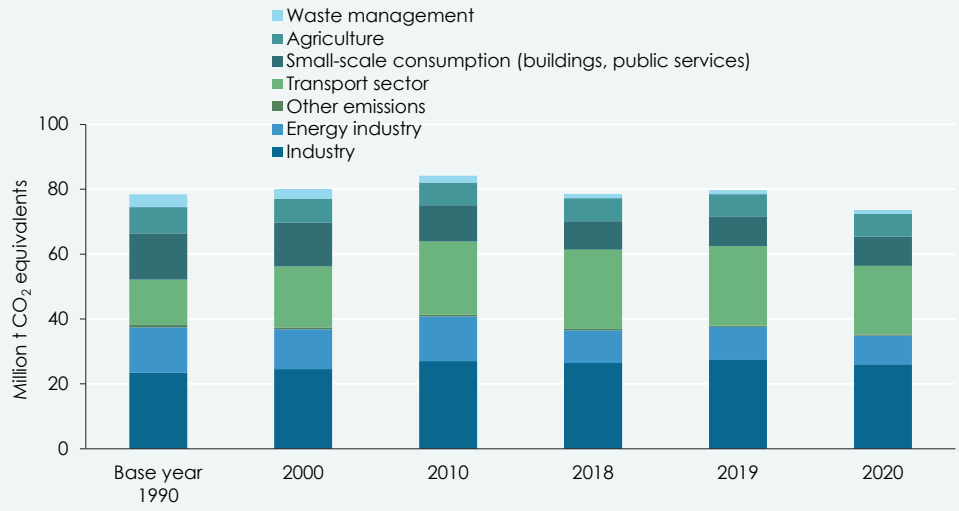
A look at the development of Austrian greenhouse gas emissions in 2020 by sector (Figure 4) shows the highest absolute reductions in the sectors transport (–3.3 million t CO_2 equivalents), energy (–1.4 million t CO_2 equivalents) and industry (–1.3 million t CO_2 equivalents) in comparison with the previous year. In relative terms, transport (–13.6 percent) and energy supply (–13.5 percent) also showed the most pronounced reductions.

In 2020, industry continued to be the largest emitter of greenhouse gases in Austria, with a share of 35.4 percent or 26 million t of CO_2 equivalents. The sector's share of total greenhouse gas emissions increased by more than 1 percentage point compared to 2019. The second highest share accrued again to the transport sector with 21.2 million t CO_2 equivalents or 28.8 percent, even though it was almost 2 percentage points lower than in 2019. In 2020, the share of small-scale consumption in Austrian greenhouse gas emissions exceeded that of the energy sector (12 percent or 8.8 million t CO_2 equivalents) for the first time since 2002, with 12.3 percent (9 million t CO_2 equivalents). Agriculture accounted for 9.5 percent (7 million t CO_2 equivalents) and waste management contributed 1.6 percent (1.2 million t CO_2 equivalents) to the total greenhouse gas emissions.

Even in the crisis year 2020, greenhouse gas emissions from the transport sector were still more than 50 percent above the 1990 levels; in industry they were more than 10 percent higher. In the other sectors, emissions have been significantly reduced since 1990, especially in waste management (–70 percent) and in the energy sector (–37 percent).

Transport and energy supply recorded a decrease in greenhouse gas emissions of more than 13 percent in 2020.

Figure 4: **Source sectors of greenhouse gas emissions in Austria**



Source: Environment Agency Austria.

1.4 Reduction of industrial emissions through lower steel production

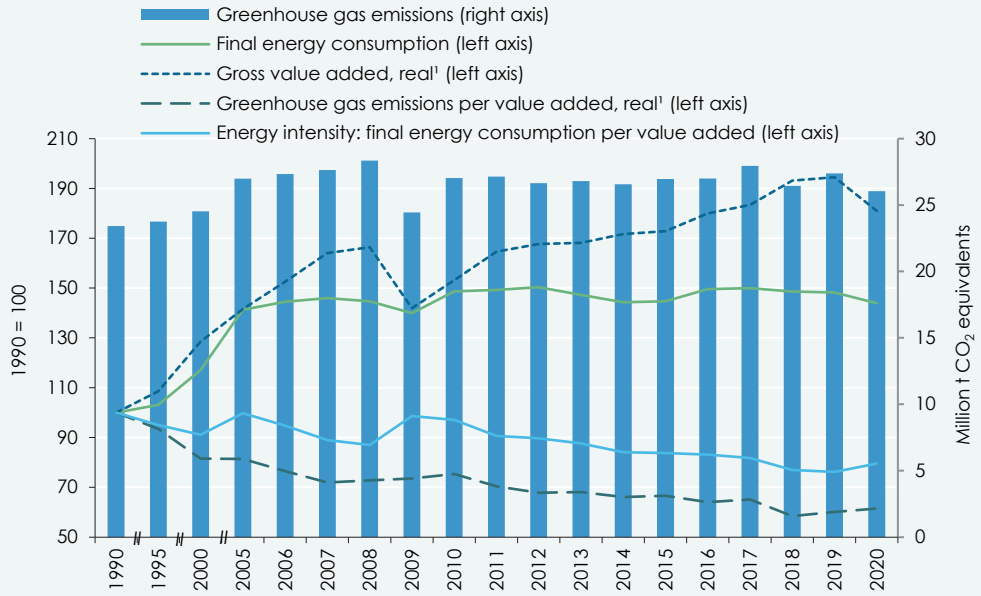
Industry accounted for a good third of greenhouse gas emissions in Austria in 2020. The reduction in industrial emissions (–4.9 percent to 26 million t CO_2 equivalents; Figure 5) was mainly caused by the pandemic-related reduction in steel production and the lower emission of fluorinated greenhouse gases.

Gross value added of industry decreased by 7 percent year-on-year as a result of the

Greenhouse gas emissions from manufacturing fell by around 5 percent in 2020 compared to the previous year due to reduced steel production.

COVID-19 pandemic, while energy consumption decreased by only 2.9 percent. Accordingly, the energy intensity of the domestic industrial sector (measured by final energy consumption per gross value added) rose by 4.4 percent in 2020. The emissions intensity (emissions per gross value added) also increased (+2.2 percent).

Figure 5: **Greenhouse gas emissions, energy consumption and gross value added of industry**



Source: Environment Agency Austria; Statistics Austria, Energy Balance Austria 1970-2020; WDS – WIFO Data System, Macrobond. – [1] Production of material goods including mining, at basic prices, reference year 2015.

1.5 Greenhouse gas emissions from the transport sector decreased at an above-average rate

In 2020, transport recorded the strongest emission reduction of all sectors and contributed more than half of the total reduction.

In transport[4], emissions[5] declined for the first time since 2014 (2020 –13.6 percent compared to 2019) and reached a level last observed in 2012. Emission reductions in the transport sector accounted for more than half of the total decrease in greenhouse gas emissions in 2020 (–6.1 million t CO_2 equivalent compared to 2019).

By fuel type, petrol sales (–17 percent) fell more sharply than diesel sales (–11 percent)[6]. This is probably due to the moderate decline in truck traffic[7], which was only 4.6 percent lower in 2020 than in the previous year. The direct CO_2 emission savings in the transport sector achieved through the use of biofuels declined at a similar rate as fuel sales (–15 percent) and amounted to 1.33 million t CO_2 equivalents in 2020 (Aichmayer et al., 2021).

Final energy consumption in the transport sector fell by 18 percent to 336 PJ in 2020, thus reaching the level of 2002. The discrepancy between the development of emissions (–13.6 percent) and that of final energy consumption (–18 percent) is due to the fact that the energy consumption data includes international air traffic, while the emissions data does not. As a result, the slump in final energy consumption in aviation (2020 –27 PJ or –66 percent compared to 2019) is not reflected in the development of emissions (Statistics Austria, 2021b).

Even though greenhouse gas emissions and final energy consumption from transport fell much more sharply than real GDP in 2020 (–6.7 percent), this does not yet indicate a trend reversal (Figure 6). Overall, greenhouse gas emissions from transport have increased by half since 1990 (from 14.0 to 21.2 million t CO_2 equivalents).

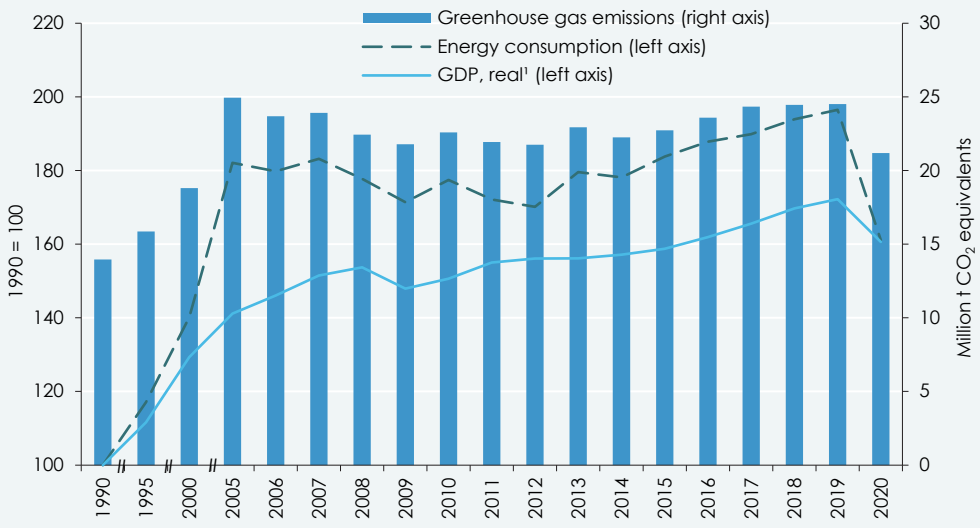
[4] The energy consumption and emissions of the transport sector are generally calculated on the basis of the quantities of fuel sold in Austria.
[5] Emissions according to the Environment Agency Austria excluding international air traffic and including transport in pipelines (around 0.05 million t CO_2 equivalents).
[6] The data on fuel sales were taken from the monthly communications on consumption statistics for petroleum products from the Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology, see https://www.wko.at/branchen/industrie/mineraloelindustrie/verbrauchsstatistik.html.
[7] According to ASFINAG traffic count, based on truck mileage in the high-level road network (all corridors – total).

In 2020, road transport still accounted for just under 97 percent of greenhouse gas emissions in the domestic transport sector, around 57 percent of which were from passenger cars (petrol and diesel cars), 7 percent from light commercial vehicles, 35 percent from the operation of heavy goods vehicles and buses, and 1 percent from motorbikes (Environment Agency Austria, 2022). In absolute terms, greenhouse gas emissions from domestic passenger car transport increased from 9 million t to 11.8 million t of CO_2 equivalents between 1990 and 2020.

Emissions from heavy goods vehicles increased by 115 percent over the same period (from 3.3 to 7.2 million t CO_2 equivalents). Between 2005 and 2012, emissions from heavy road transport declined slightly, since then they have tended to increase again until 2020, when there was a pandemic-related decline of 3.5 percent compared to 2019. Fuel exports in the tank are also relevant here: part of the fuel sold in Austria is consumed abroad. Due to lower taxation, fuel prices in Austria were lower in 2020 than in neighbouring countries. Fuel export in the tank was lower in 2020 than in the previous year (passenger cars and heavy commercial vehicles: –0.4 million t to 4.9 million t CO_2 equivalents) and contributed around 24 percent to road transport emissions[8]. At –7 percent, however, it fell only about half as strong as transport emissions overall (–13.6 percent).

On average for 2020, Austria ranked 27th and last in the EU in terms of the price of diesel fuel, at 1.07 € per litre. Diesel fuel cost 0.12 € less than the EU average, 0.05 € less than in Germany and 0.25 € less than in Italy. At 1.09 € per litre (rank 23), premium petrol was 0.18 € cheaper in Austria than the EU average[9].

Figure 6: **Greenhouse gas emissions, energy consumption of the transport sector and economic growth in Austria**



Source: Environment Agency Austria; Statistics Austria, Energy Balance Austria 1970-2020. – [1] Reference year 2015.

1.6 Greenhouse gas emissions from small-scale consumption slightly declining

In the household, services and agriculture sectors, both final energy consumption and greenhouse gas emissions decreased slightly in 2020: at 409.4 PJ, final energy consumption was 0.8 percent lower than in the previous year, while greenhouse gas emissions from small-scale consumption fell by 0.3 percent (Figure 7).

With regard to energy consumption, two opposing effects were observed in 2020: on the one hand, an increase in the energy demand of private households for heating purposes (+1 PJ), which can primarily be attributed to the slightly higher number of heating degree days (+1.8 percent); on the other hand, a cyclical decline in the energy demand of the service sector (–3.3 PJ) and agriculture (–0.4 PJ). This is mainly due to the lower demand for electrical energy in the

Due to the higher number of heating degree days, energy consumption for heating purposes increased in 2020, while it decreased in services and agriculture due to the economic cycle.

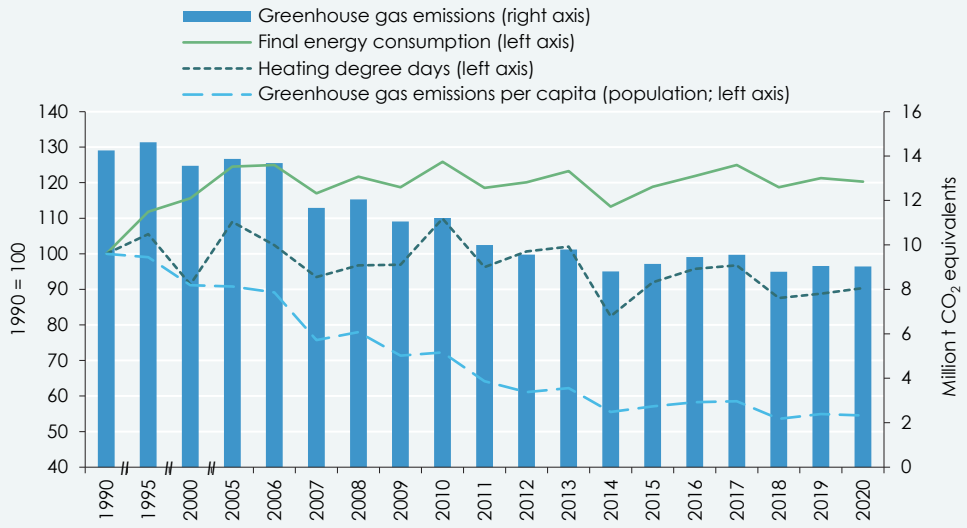
[8] Data according to Environment Agency Austria (2022, Table 77).
[9] Fuel prices based on the European Commission's Weekly Oil Bulletin, https://ec.europa.eu/energy/data-analysis/weekly-oil-bulletin_en (retrieved 25. 7. 2022).

services sector (–3.3 PJ) and for biogenic fuels in agriculture (–0.2 PJ). The electricity demand of private households also diminished in 2020 (–1.2 PJ).

Overall, the slight decrease in small-scale consumption (–0.8 percent) results from the cyclically lower consumption of electrical energy (–4.6 PJ) and natural gas (–1 PJ), which is offset by a weather-related increase in the demand for gas oil for heating purposes (+0.7 PJ), ambient heat (+1.3 PJ) and district heating (+0.4 PJ). Due to the opposing development of consumption of gas oil and natural gas, greenhouse gas emissions from small-scale consumption fell only slightly (–0.3 percent; Statistics Austria, 2021a).

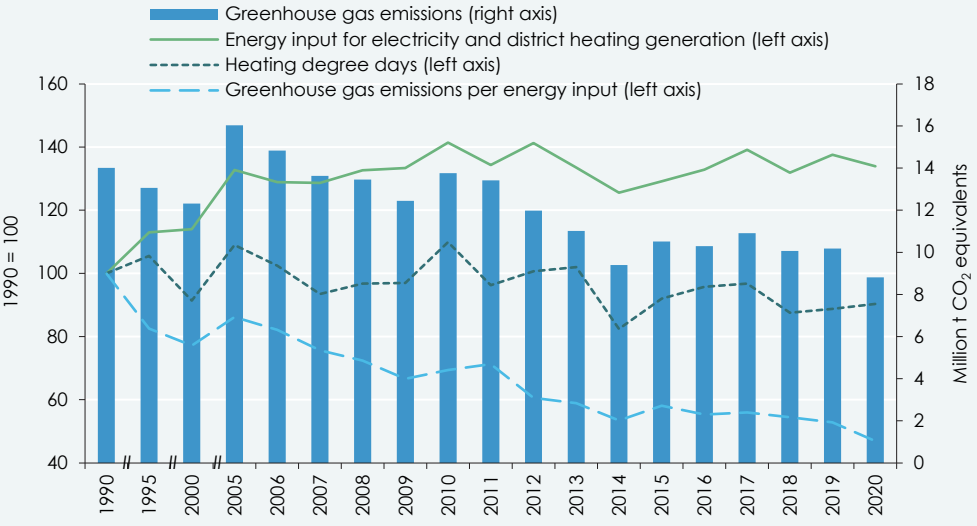
The useful energy category "indoor climate and hot water" accounted for 78 percent of final energy consumption in the private household, services and agriculture sectors (excluding transport) in 2020.

Figure 7: **Greenhouse gas emissions of buildings, energy consumption of households, services and agriculture and number of heating degree days**



Source: Environment Agency Austria; Statistics Austria, Energy Balance Austria 1970-2020; WDS – WIFO Data System, Macrobond.

Figure 8: **Greenhouse gas emissions and energy use for electricity and district heating generation by energy utilities**



Source: Environment Agency Austria; Statistics Austria, Energy Balance Austria 1970-2020; WDS – WIFO Data System, Macrobond.

1.7 Decrease in greenhouse gas emissions from the provision of electricity and district heating

After the slight increase in the previous year, greenhouse gas emissions in the provision of electricity and district heating fell significantly in 2020 (–13.5 percent from 10.2 million t to 8.8 million t of CO_2 equivalents), but the energy input used for this shrank much more slowly at –2.7 percent (Figure 8).

The most important driver of this discrepancy is the use of natural gas and hard coal. While 5.9 PJ less electrical energy was generated in 2020 than in the previous year due to falling demand (–2.3 percent to 249 PJ) and district heating remained relatively constant at 84.3 PJ (+0.6 percent), the use of natural gas (–4.9 PJ) and hard coal (–3.4 PJ) for electricity and heat generation decreased relatively strongly. Electricity from hydropower recorded an increase of 4.2 PJ (+2.9 percent), electricity from photovoltaics an increase of 1.2 PJ (+20 percent), whereas electricity generation from wind declined for the first time (–2.4 PJ to 24.5 PJ). The decrease in the share of fossil energy sources in the generation of electricity and district heating led to a relatively strong reduction in emissions, while the energy input declined only slightly. In total, the emission intensity of electricity and district heating production decreased significantly (–11.1 percent compared to the previous year).

1.8 Strong decline in the use of fossil fuels led to an increase in the share of renewable energy in gross domestic energy consumption

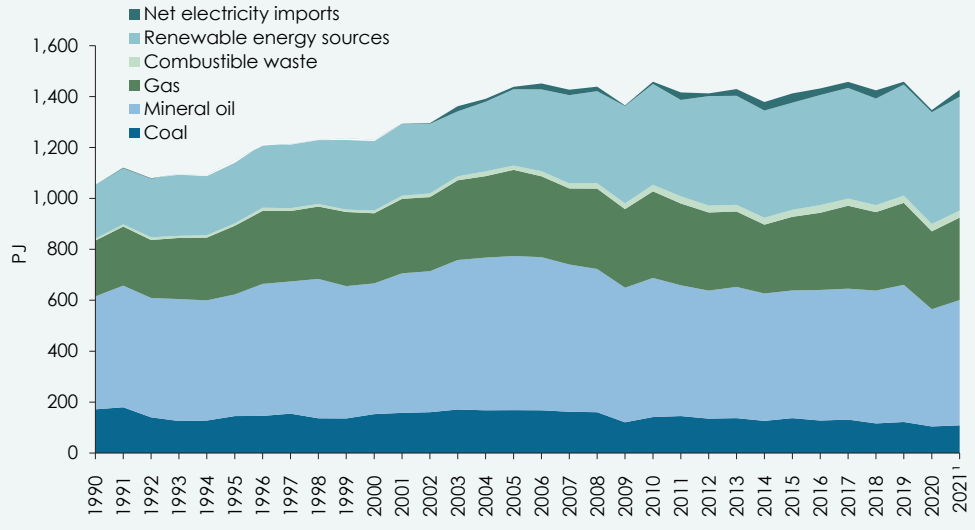
Electricity generation declined in 2020 (–2 percent), most significantly from hard coal, natural gas and wind power. By contrast, he provision of district heating remained roughly constant (+0.6 percent).

Two influencing factors are highly relevant for overall economic energy use, expressed as gross inland consumption: on the one hand, economic development and, on the other, weather conditions. Economic development essentially determines energy use in industry, while weather conditions influences the amount of energy used for heating and cooling. A decline in gross inland energy consumption in one year can therefore be due to a slowdown in economic growth or a particularly mild winter, while the underlying structures of energy demand have not changed.

Gross domestic energy consumption in 2020 was affected by the COVID-19 pandemic and declining economic output.

In 2020, 1,347 PJ of energy were used in Austria, 112 PJ (–7.6 percent) less than in 2019. Gross inland energy consumption thus fell slightly more than real GDP (–6.7 percent), which was due to differenences which sectors were affected by the COVID-19 measures. The lower gross inland consumption in 2020 also depresses the long-term growth rate: in the period 1990-2019 this averaged +1.1 percent p.a. Taking the crisis year 2020 also into account, it drops to +0.8 percent p.a.

Figure 9: **Gross inland consumption by energy source in Austria**



Source: Statistics Austria, Energy Balance Austria 1970-2020. – [1] Preliminary Energy Balance Austria 2021.

Renewable energy sources covered 439 PJ of gross inland consumption in 2020, 0.7 percent or just under 3 PJ more than in 2019. In the long term, the energy supply from renewable sources has more than doubled, with an average increase of 2.5 percent p.a. in the period 1990-2020. Energy consumption from fossil sources was significantly lower in 2020 than in the previous year (–11.4 percent or –112 PJ to 870 PJ), mainly due to the underconsumption of oil (–78 PJ). This also reflects the weaker transport demand due to the pandemic and the lockdowns imposed. For natural gas

and coal, the decreases amounted to 17 and 18 PJ, respectively. Despite this lower use of fossil fuels in 2020, their share of gross domestic consumption was only 2.7 percentage points lower than in the pre-crisis year 2019, still accounting for just over two-thirds, with the remainder coming from renewable energy sources. This shows that there is still a great need for action: in order to achieve the EU climate goals and the Austrian goal of climate neutrality by 2040, far-reaching structural changes are necessary. The developments in 2020, on the other hand, were largely caused by the COVID-19 pandemic and the health policy measures to contain it. In a longer-term perspective (Figure 9), 2020 is characterised by a short-term, significant decline in gross inland consumption, as was already observable during the financial market and economic crisis of 2008-09.

Austria has consistently been a net importer of electricity since 2001; in 2020, imports exceeded exports by just under 8 PJ. Compared to 2019, this corresponds to a decrease in net imports of 3.4 PJ. In total, Austria consumed 220 PJ of electricity in 2020. Accordingly, net imports covered 3.6 percent of demand in 2020, more than 1 percentage point less than in the previous year. In 2020, both electricity exports (–2.6 percent) and electricity imports (–5.9 percent) fell. The significantly stronger reduction in import demand improved the balance in foreign trade in electricity (Table 1). In 2021, however, the net import volume of electricity is expected to have grown significantly to 27 PJ (according to the preliminary energy balance).

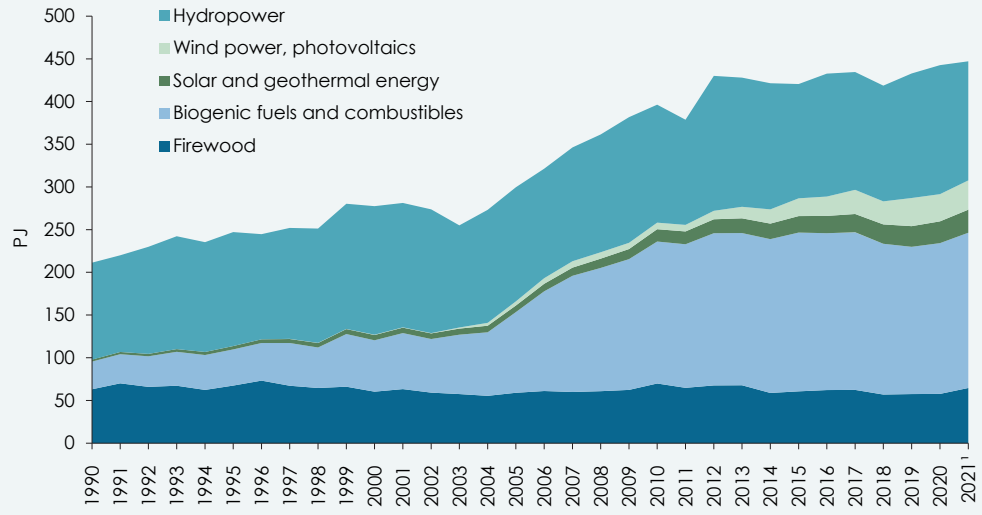
1.9 Selected developments according to the preliminary energy balance 2021

Despite the persistence of the pandemic, there was an economic recovery in 2021, which is also reflected in the energy sector and thus in the preliminary energy balance published by Statistics Austria by the end of May 2022. In addition to the economic recovery, the cold winter is also likely to have contributed to the increase in domestic gross inland consumption. According to the preliminary data, this amounted to 1,426 PJ in 2021, almost 80 PJ or 6 percent more than in 2020.

Although energy consumption from renewable sources increased slightly more in 2021 than in the previous year (+1.8 percent compared to +0.7 percent in 2020), the increase was significantly weaker than the use of fossil fuels, which is expected to have increased strongly again (+6.2 percent), especially in the second half of the year, despite the price rise. The increase was much more pronounced for oil (+6.8 percent) and natural gas (+6.2 percent) than for coal (+3.8 percent; Figure 10).

The preliminary energy balance for 2021 shows energy production from renewable sources of 447 PJ. As a long-term comparison shows, it only grew by about 1.0 percent p.a. in the period 2010-2020, whereas in the previous period it grew more than three times as fast (2000-2010 +3.6 percent p.a.).

Figure 10: **Gross inland consumption of renewable energy sources**



Source: Statistics Austria, Energy Balance Austria 1970-2020. – [1] Preliminary Energy Balance Austria 2021.

While the share of fossil energy sources in gross inland consumption increased in the course of the economic recovery in 2021 (by an expected 0.2 percentage points to just under 65 percent), that of renewable energy sources declined by 1.3 percentage

points. In view of the climate and energy policy goals and the new EU targets for 2030, structural changes in the energy system and a sustainable trend reversal are becoming increasingly urgent. The Ukraine war also made the issue of energy security a high priority. The economic costs of a strong dependence on – largely imported – fossil fuels are becoming increasingly visible, not least in the form of high energy prices.

At the same time, Austria has benefitted since a long time from its good endowment with renewable resources, especially hydropower and firewood. In recent decades, great efforts have been made, not only in Austria but worldwide, to advance the use of other renewable forms of energy, such as photovoltaics, wind power or geothermal energy. Accordingly, the structure of renewable energy resources is also changing in Austria.

In the period 2010-2020, biogenic fuels have become the most important renewable energy resource in Austria. These include pellets, wood waste, landfill gas and biogas or biodiesel. The share of biogenic fuels in renewable energy supply was 42 percent on average in the period 2010-2020 (+24 percentage points compared to 1990-2000). The second most important renewable energy resource in Austria is hydropower with an average share of one third (average 2010-2020), which decreased by 19.7 percentage points compared to the previous period 1990-2000. With an average share of just under 15 percent, firewood is also an important renewable energy resource. In the long term, however, firewood has lost relative importance.

Within renewable energy sources, major shifts in shares can be observed since 1990.

1.10 Expenditure on energy imports up sharply in 2021

Austria's high dependence on fossil fuels is also reflected in its high dependence on imports. The associated vulnerability of the economy and society is visible in the current energy crisis. On the one hand, energy prices have risen drastically, especially for natural gas, but also for fuels; on the other hand, supply bottlenecks cannot be ruled out, especially for natural gas. In addition to climate protection, security of supply is therefore another pressing argument for reducing dependence on fossil energy imports. To achieve this, on the one hand, stronger attention needs to be paid to an improvement in energy efficiency in order to provide desired energy services with significantly less energy input. On the other hand, the capacity of energy production from renewable sources must be expanded rapidly. The improvement of energy efficiency and the shift towards renewable energy resources are course-setting measures that are of central importance both for achieving the energy and climate goals and for ensuring security of supply.

Austria spent significantly more on energy imports in 2021 than in the previous year. The increase in expenditure was price-driven, while volumes declined slightly.

Table 1: **Foreign trade in energy sources**

	Exports					Imports					Balance			
	2010	2015	2019	2020	2021	2010	2015	2019	2020	2021	2010	2015	2020	2021
	Million €													
Coal	3	2	2	1	2	719	476	536	457	496	– 716	– 475	– 456	– 494
Crude oil	0	745	0	0	0	3,049	3,097	3,777	2,174	3,434	– 3,049	– 2,352	– 2,174	– 3,434
Heating oil	76	121	127	0	0	111	33	45	15	22	– 36	+ 88	– 15	– 22
Petrol	376	476	534	370	596	689	499	392	244	396	– 313	– 23	+ 125	+ 201
Diesel fuel	570	478	716	453	792	3,342	2,177	3,159	2,030	2,927	– 2,771	– 1,699	– 1,577	– 2,136
Natural gas	813	315	375	348	438	2,867	2,701	2,544	1,995	4,131	– 2,055	– 2,387	– 1,647	– 3,693
Electricity	1,289	857	1,200	1,121	1,620	810	1,103	1,069	884	1,935	+ 479	– 246	+ 238	– 315
Total	3,126	2,994	2,953	2,294	3,448	11,586	10,086	11,521	7,800	13,341	– 8,460	– 7,093	– 5,506	– 9,894
	PJ													
Coal	0.2	0.3	0.0	0.0	0.0	141.2	119.4	118.1	102.3	108.0	– 141.0	– 119.1	– 102.3	– 108.0
Crude oil	0.0	0.0	0.0	0.0	0.0	288.8	344.6	365.2	316.2	321.6	– 288.8	– 344.6	– 316.2	– 321.6
Heating oil	9.9	21.6	18.7	19.5	15.4	7.1	0.5	1.8	2.8	1.3	+ 2.8	+ 21.1	+ 16.7	+ 14.0
Petrol	26.6	38.6	38.8	39.0	39.0	34.5	33.3	26.6	22.1	22.5	– 7.9	+ 5.3	+ 17.0	+ 16.5
Diesel fuel	34.9	34.0	41.9	39.5	48.6	177.9	155.6	180.3	165.5	167.7	– 143.0	– 121.6	– 126.0	– 119.1
Natural gas[1]	170.6	201.2	97.6	349.3	69.8	426.6	411.2	492.5	572.6	524.6	– 256.0	– 210.0	– 223.3	– 454.9
Electricity	62.9	69.6	82.5	80.4	68.0	71.7	105.8	93.8	88.3	95.2	– 8.8	– 36.2	– 7.9	– 27.2
Total	305.1	365.2	279.6	527.6	240.8	1,147.8	1,170.4	1,278.4	1,269.8	1,241.0	– 842.7	– 805.2	– 742.1	– 1,000.1

Source: Statistics Austria, Energy Balance Austria 1970-2020, preliminary Energy Balance 2021, Foreign Trade Statistics; WDS – WIFO Data System. – [1] Due to a methodological change, data from the energy balance of Statistics Austria are used for natural gas up to and including 2020, and data from foreign trade statistics from 2021 onwards.

The present analysis of energy imports and exports (Table 1) refers to the period up to 2021. The latest developments on the energy markets as a result of the Ukraine war are therefore not yet reflected in the data, even though nominal expenditure on energy imports already jumped in the second half of 2021 (from 11.5 billion € in 2019 to 13.3 billion € in 2021; +16 percent). The strongest growth in nominal import expenditure was recorded for natural gas in 2021 (+2.1 billion € or +107 percent year-on-year), followed by oil (+1.3 billion € or +58 percent). Expenditure on electricity imports also increased strongly (+1.1 billion € or +120 percent). The increases in expenditure do not correspond to an increase in volume, which suggests that they are exclusively due to price effects. The import volumes of crude oil grew very moderately by 2 percent in 2021, natural gas imports were even 8.4 percent lower in volume than in 2020. The volume of imported coal increased by 5.6 percent, that of electricity by 7.8 percent. Overall, the amount of imported energy decreased by 2.3 percent in 2021, whereas expenditure on energy imports increased by 71 percent.

Austria's revenues from energy exports were 3.4 billion € in 2021 – a strong increase of 50 percent compared to 2020, which resulted in particular from higher export revenues for diesel, petrol and electricity. The higher prices also had an impact on revenues from energy exports, while the exported volumes declined by almost 287 PJ, mainly due to the sharp drop in natural gas exports.

The implicit import price calculated from quantities and expenditures for a fictitious imported quantity of energy quantity in 2021 was 10.8 million € per PJ, 4.6 million € higher than in 2020. The implicit export price was even three times higher in 2021 than in the previous year at 14.3 million € per PJ, which in turn is mainly due to natural gas, petrol and heating oil.

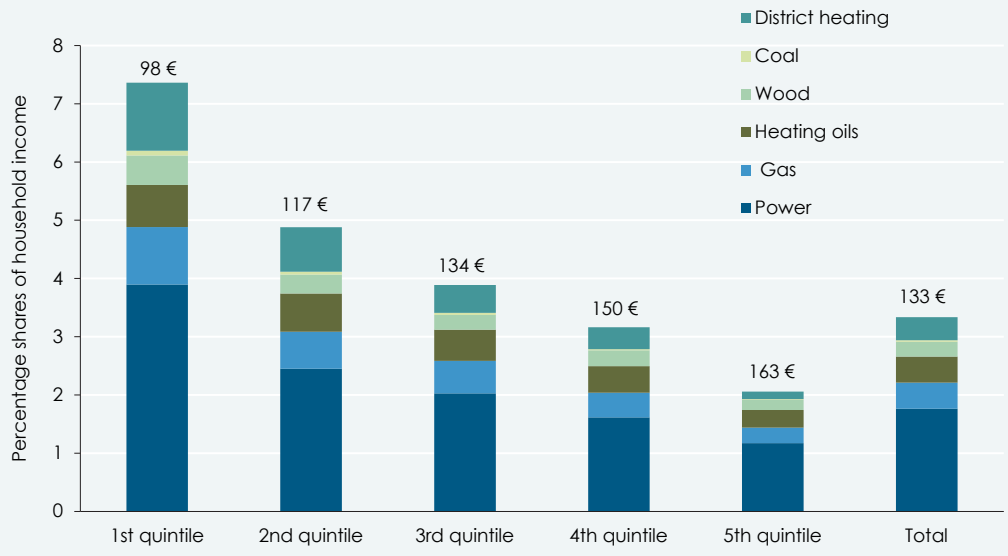
The nominal foreign trade balance for energy deteriorated by about 4.4 billion € in 2021 to –9.9 billion €, while the quantitative balance improved by about 260 PJ.

1.11 Energy expenditures burden low-income households in particular

Lower-income households are significantly more burdened by energy expenditure. Accordingly, they will be hit harder by the current energy crisis.

Energy expenditure burdens lower-income households significantly more than households with higher incomes. This was also evident in 2020. On average across all income groups, energy expenditure for housing (mainly for space heating, hot water, cooking) amounted to 133 € per month; it was thus similar to the level in 2019 (Figure 11). The lowest income fifth spent 98 € per month on household energy, the top income fifth 163 €. The relative burden of energy expenditure on the income groups also remained stable over time. The lowest-income households (first quintile) spent 7.4 percent of their income on household energy in 2020, more than three times as much as the highest-income households (2.1 percent). The gap to the second fifth of income is already considerable: in the second quintile, an average of 4.9 percent of income was spent on household energy in 2020, 2.5 percentage points less than in the first quintile.

Figure 11: **Share of energy expenditure for housing in household income 2020**



Source: EU-SILC.

Electricity and gas are the dominant expenditure categories in all income groups. In the first quintile, electricity accounted for 52 € and gas for 13 € of the 98 € per month spent on household energy. On average across all quintiles, a household spent 70 € per month on electricity and 18 € on gas.

In the meantime, the burden of energy expenditure is likely to be significantly higher than in 2020 (Baumgartner et al., 2022). The strong rise in energy prices increases the share of energy expenditure in household income in all income groups. This poses major challenges for low-income households in particular, as they already spend a high proportion of their income on energy. While some characteristics that influence expenditure such as the size of the flat, the thermal quality of the building or the heating system cannot be changed in the short term, changes in behaviour can reduce energy expenditure even in the short term.

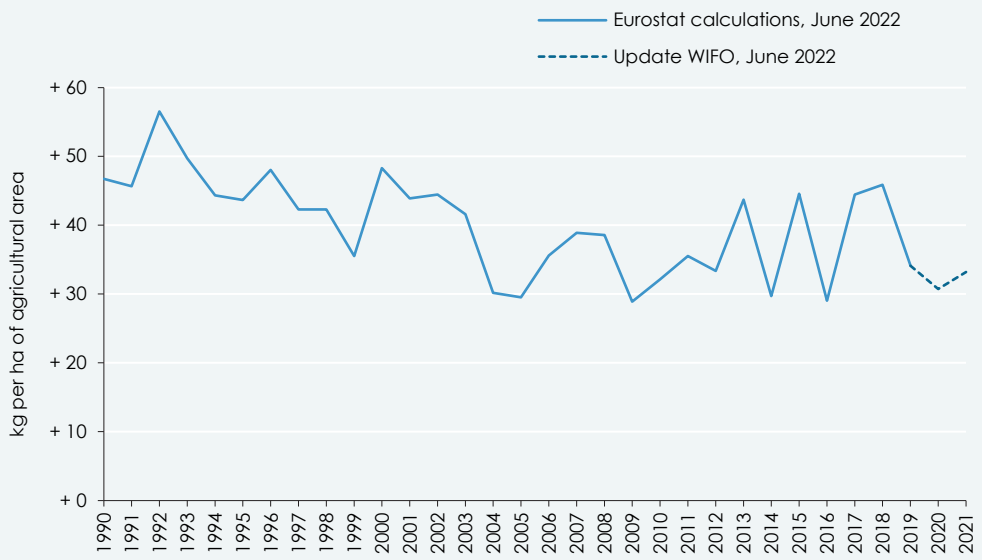
2. Nitrogen balance and biomass production in Austrian agriculture

Nitrogen fertiliser is necessary for the production of biomass, but at the same time it is also a source of greenhouse gases.

The production of biomass for further utilisation as food or feed or as a raw material for a wide variety of applications is closely related to the nitrogen cycle. As an important component of proteins, nitrogen is essential. A sufficient supply of this nutrient to the soil in soluble form is a prerequisite for high crop yields. At the same time, however, nitrogen fertiliser is also a source of greenhouse gases. The most important types of fertiliser in agriculture besides nitrogen are phosphorus and potassium, as these are essential plant nutrients. If nutrients are not absorbed by plants, they remain in the environment and then often pollute groundwater and surface water in addition to the air.

Irrespective of environmental concerns, a thrifty use of nitrogen is appropriate, as inefficient use increases production costs in agriculture. Since 2021, this aspect has become even more important than before, as fertiliser prices have risen sharply[10]. Farms with livestock can recycle the nutrients contained in farm manure in crop production and thus optimise material turnover.

Figure 12: **Nitrogen balance**



Source: Eurostat, Gross Nutrient Balance 1990-2019 (data retrieved on 1 July 2022); WIFO calculations. Until 2012, the data were determined by the Environment Agency Austria using the OECD method. The Eurostat and OECD methods differ with regard to the areas and sources covered (e.g. atmospheric deposition). Explanatory notes are provided by Kletzan-Slamanig et al. (2014).

In organic farming, easily soluble mineral nitrogen fertilisers are not used. In this farming system, the necessary plant supply is ensured primarily from two sources: firstly, nutrients are deposited on the soil via the atmosphere. These come in part from emissions from the transport sector, households, agriculture and industry. Secondly, certain plants can synthesise nutrients from atmospheric nitrogen in their root systems. Through clever choice of crop rotation and catch

[10] See https://www.landnutzung.at/preise_duengemittel.html.

crops, part of this depot is also available for other plants.

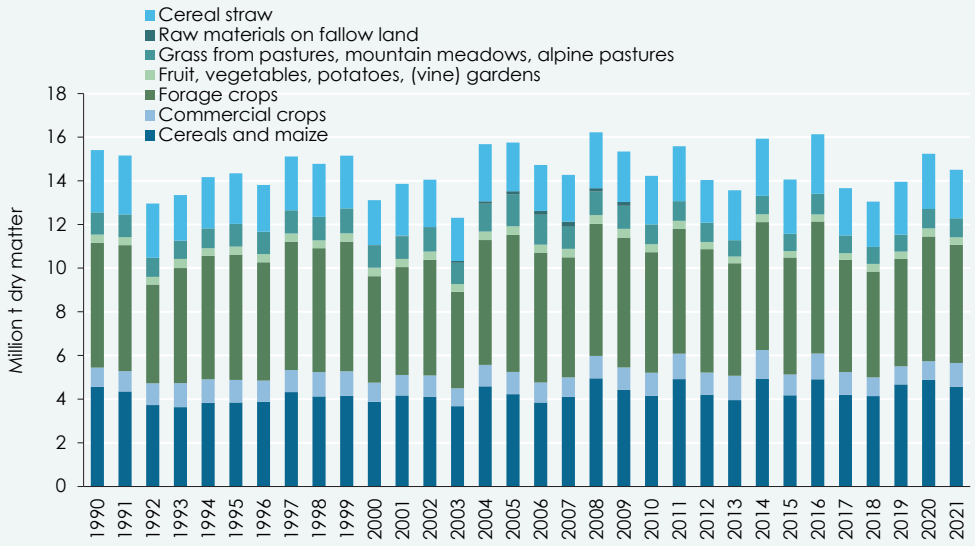
The nitrogen balance according to the method originally developed by the OECD and now modified by Eurostat takes these interrelationships into account (Figure 12). The quantities of nutrients from all sources of nitrogen are added together and compared with the removal by plants in the harvested crop. A positive balance indicates that more nutrients were introduced into the agricultural cycle than were withdrawn. The higher the balance surplus, the greater the risk of undesirable shifts with potentially negative effects on groundwater. However, a surplus in the nitrogen balance does not allow any exact conclusions to be drawn about the contamination of groundwater, since in addition to nitrogen, the water balance also has a major influence on groundwater quality (Federal Ministry of Sustainability and Tourism, 2019). The comparatively high nitrogen balance surpluses in 2013, 2015, 2017 and 2018 were primarily due to the lower removal of nutrients by the crop.

The decision on fertiliser intensity is made at a time when it is not yet foreseeable whether the nutrients applied will actually be needed or not. Even though the nitrogen surplus has been following an increasing trend for about ten years, it was recently much lower than the average of the 1990s (about 46 kg per ha of agricultural land). The strong fluctuations between individual years are due to statistical factors in addition to the removal by the harvested crop: the calculation does not take into account the amount of mineral fertiliser actually applied, but the amount sold on the market. Whether this quantity is also applied in the respective year is not known, as stockpiling is not checked.

In 2021, the amount of biomass produced was in line with the long-term average, although production has been stagnating for decades. One reason for this is the high soil consumption.

In 2021, the harvested volume of agricultural raw materials corresponded to the average of the last decades (Figure 13). According to Statistics Austria (2022a), the production volume in crop production in 2021 was 1.4 percent lower than in the previous year.

Figure 13: **Production of economically usable biomass by agriculture in Austria**

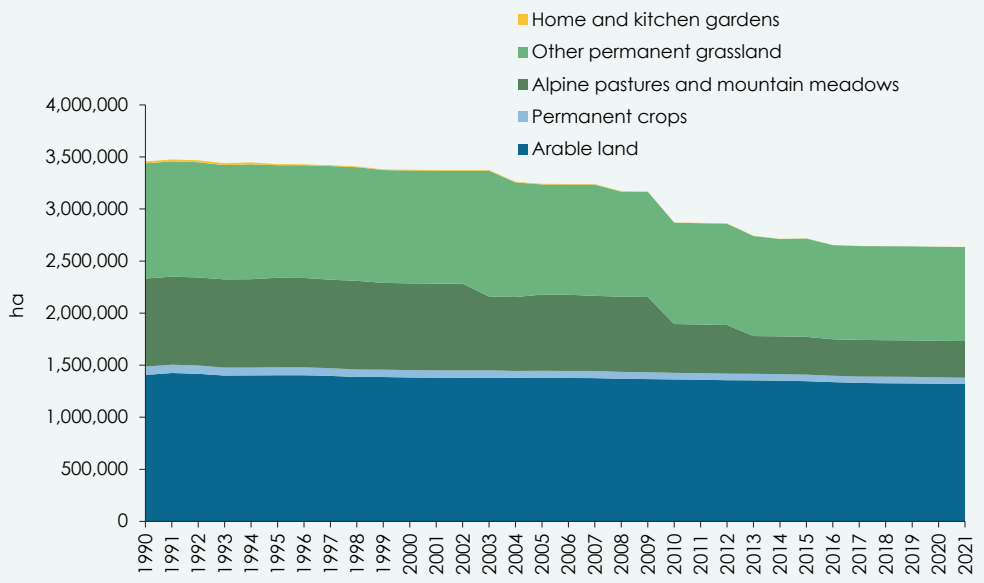


Source: WIFO calculations based on Buchgraber et al. (2003); DLG feed value table; Resch (2007). Straw is a by-product of cereal production (excluding maize); a uniform grain-straw ratio of 1 : 0.9 is assumed. Loss factors for fodder production according to Buchgraber et al. (2003), supply balances according to Statistics Austria.

The physical output of biomass fluctuates considerably from year to year and does not follow an increasing trend. Agricultural biomass production has been stagnating for decades. Against the backdrop of increasing demand from a growing population, domestic agriculture is thus contributing less and less to securing the supply of food and agricultural raw materials. The stagnation of biomass production is mainly a consequence of the constant loss of agricultural land through construction and afforestation.

Between 1990 and 2020, arable land shrank by more than 85,000 ha and grassland (excluding alpine pastures) by more than 205,000 ha. At 39 km², sealed areas exceeded the maximum value of 9.1 km² strived for by the federal government as sustainable by the factor three in 2020 (Environment Agency Austria, 2021a). In 2020, only 2,957 m² of agricultural land was available per person – compared to more than 4,200 m² in 1999 and over 4,500 m² in 1990.

Figure 14: **Agricultural land use**



Source: Statistics Austria, Cultivation on arable land and land use in Austria.

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