



New
Direction



ENERGY SECTOR OF EU-14

IN CONTEXT OF CLIMATE POLICY AND GREEN DEAL

PIELA BUSINESS ENGINEERING

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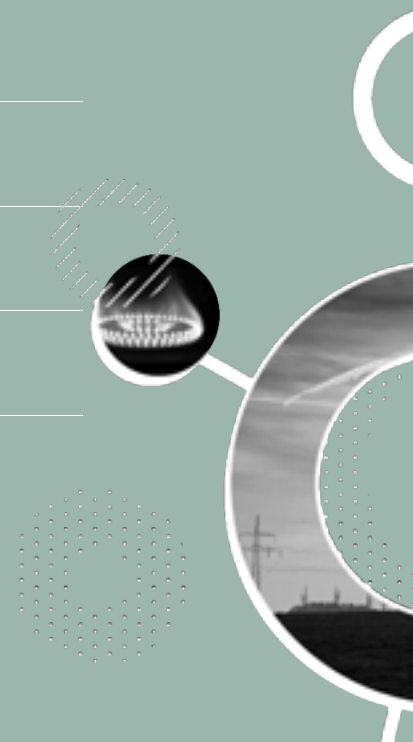


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1 Executive summary

The European Union aims to be the leader of the greenhouse gas emissions reduction in the World. Therefore, the Green Deal Strategy under development by the EU is proposing some ambitious greenhouse gas emissions reduction target for the whole EU for 2030 – 50% or even 55% reduction comparing to year 1990. In practice it translates in repeating the half of the reduction level achieved between 1990 and 2020 or more if the 55% target is retained.

The proposed goals have not been yet defined precisely. It is still under discussions how the EU global target will be translated into national targets. Nevertheless, it is obvious that the effort necessary to tackle the challenging targets is considerable and the level of difficulty faced by countries is different depending on their level of economic development and the current situation of their energy sectors.

GDP of EU-14 countries represents 90% of the EU-27 GDP, whereas they cover only 73% of the total area and they represent 77% of the total population. Their GDP per capita is also higher than for EU-11 countries. Regardless of this general statement the situation of particular countries differs. For some countries it will be much easier to meet the new targets due to their economic strength whereas some will face a challenging situation if the Green Deal Strategy is applied as announced.

Similar situation can be observed in the energy sector. Some countries rely on renewable energy sources (Sweden, Denmark) or nuclear (France) and therefore the level of greenhouse gas emissions is relatively lower. On the other side some countries are still generating significant share of energy from solid fuels, gas and oil (Greece, Ireland, Netherlands). Their situation will be far more challenging if the Green Deal Strategy is approved and the proposed targets are applied. They will have to invest more in energy sector transformation and finance this investment for national budget or by increasing the cost of energy for the final customers.

As a group, the EU-14 is better placed to face the new regulations. The countries are generally wealthier and their energy sector is less dependent on greenhouse gas emitting fuels than it is the case of EU-11. But at the same time there are few countries among EU-14 which will have to do much more efforts than the average to meet the new targets. Therefore, this country specific situation must be considered when the support system is discussed. Both the current economic situation and the current energy production structure needs to be considered when the distribution of support funds and the level of support are decided. Otherwise the cost of the transformation can overwhelm the local economies and the overall results of the strategy can underpinned by difficult economic situation of the countries.



2 Energy sector in EU-14 countries

2.1 General information

EU-14 is named the group of 14 countries formed the European Union or joined it before 1990. The group is composed of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, Spain, and Sweden. In the analysis Cyprus and Malta were omitted. Both countries are small islands without connection to the continent. Their energy systems are therefore, very specific. Luxemburg was also omitted as one-country description for its small scale, but it is included in EU-14 group. The Item 1 and

Item 2 summarized the key information about the group.

Item 1: EU map



Source: EU website

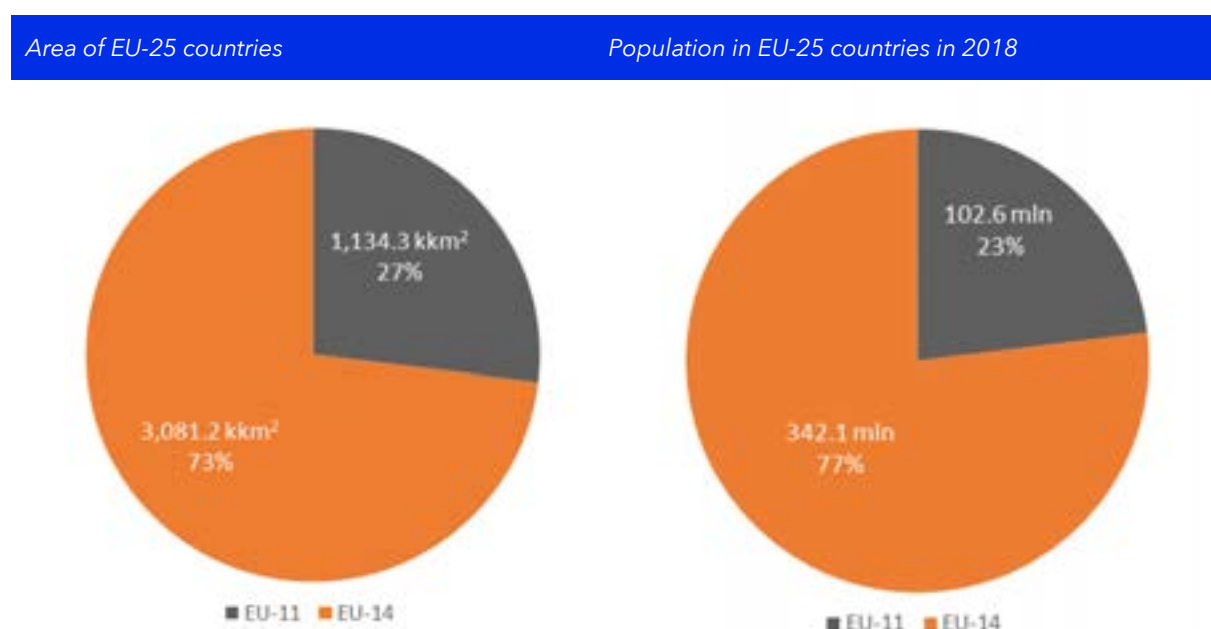
Item 2: EU-14 - key data

| Key data | |
|------------------------------------------------------|--------|
| Population (M) | 342.1 |
| GDP per capita (EUR, nominal) | 36,175 |
| GDP per capita (EUR, PPS) | 33,459 |
| GDP as share of EU-27 | 90% |
| Energy intensity of the economy (kgoe per 1,000 EUR) | 110.1 |
| Greenhouse gas emissions (Mg per capita) | 8.5 |

Source: Eurostat data for 2018, extracted in 2020

EU-14 countries are 14 of 27 EU member states (about 52% of member states). At the same time, the area of these countries is about 3,081.2 kkm² which is 73% of the total EU area. The population of EU-14 is about 342.1 M which is only 77% of EU total population.

Item 3: Area and population in EU-25 countries



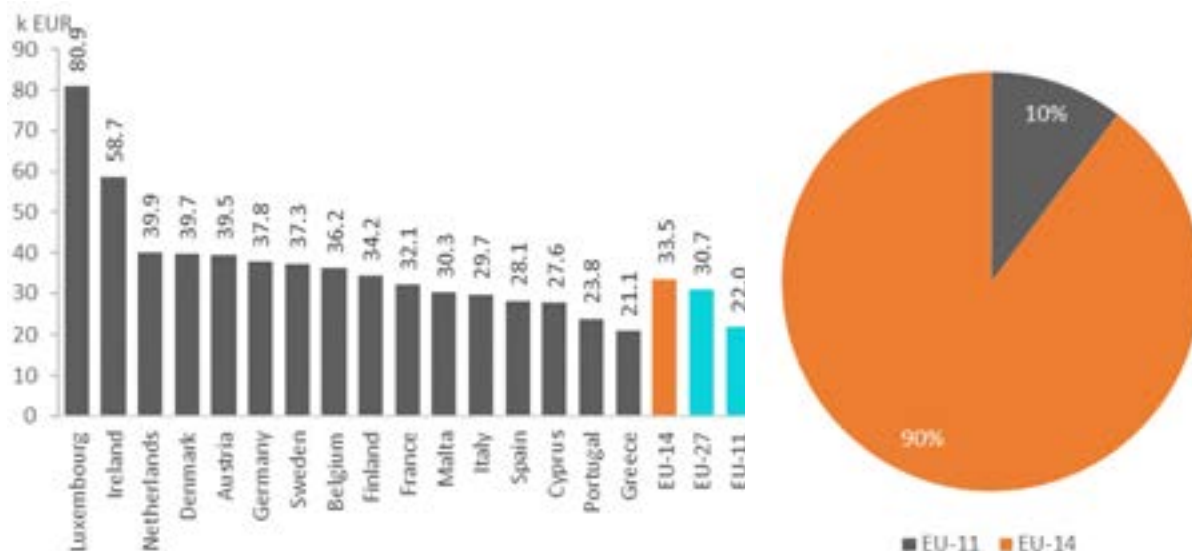
Source: Eurostat data for 2018, extracted in 2020. Errors in summation to 100% are due to rounding

EU-14 countries are among the most developed ones in the European Union. The average GDP per capita of EU-14 countries was above EU-27 and EU-11 level in 2018. Only six of EU-14 countries had a CGD per capita lower than EU-27 average. In absolute terms EU-14 was producing 90% of EU GDP, compared to 77% of the population which was living there and 73% of the total EU area.

Item 4: GDP per capita in EU-14 countries for 1995-2018 in comparison with EU-14 and EU-27 averages in 2018 (kEUR, PPS)

GDP per capita in EU-14 countries for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in 2018 (kEUR, PPS)

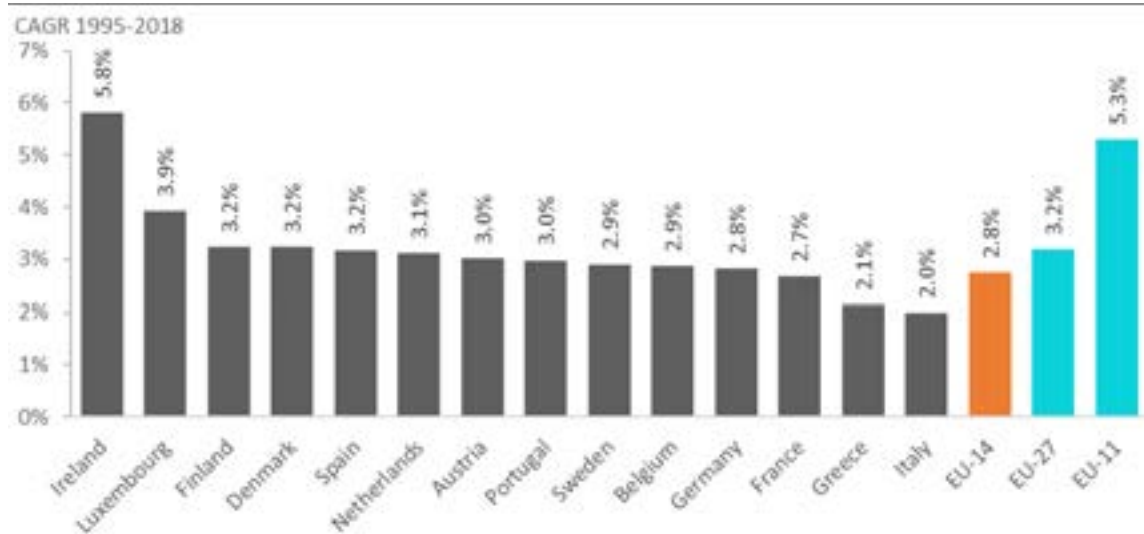
Comparison of GDP in EU-25 countries



Source: Eurostat data for 2018, extracted in 2020. Errors in summation to 100% are due to rounding

Despite higher GDP per capita EU-14 countries were developing slower in past 23 years than EU-11. The average GDP grow rate was CAGR 2.8%, whereas EU-27 and EU-11 averages were CAGR 3.2% and CAGR 5.3% respectively. Only one country of EU-14 group was developing faster than EU-11 average - Ireland with GDP per capita grow CAGR 5.8% versus 5.3% for EU-11

Item 5: GDP per capita change in EU-14 countries for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in years 1995-2018 (kEUR, PPS)



Source: Eurostat data for 2018, extracted in 2020. Detail references: GDP per capita - Gross domestic product at market prices (B1GQ), Current prices, purchasing power standard per capita (CP_PPS_HAB)

The energy intensity of EU-14 economy remained lower than EU-11 and EU-27 averages. Only five countries were characterized by higher energy intensity than EU-11. At the same time only five EU-14 countries reduced the energy intensity of their economy by a CAGR higher than the average for EU-27 countries.

Item 6: Energy intensity of the economy in EU-14

Energy intensity of the economy in EU-14 countries in 2018 in comparison with EU-11, EU-14 and EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)

Change of energy intensity of the economy in EU-14 countries in 1995-2018 in comparison with EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)



Source: Eurostat data for 2018, extracted in 2020. Values for EU-25 were recalculated based on energy intensity and GDP data from Eurostat. Detail references: Energy intensity of GDP in purchasing power standards (PPS) - EI_GDP_PPS

Conclusions

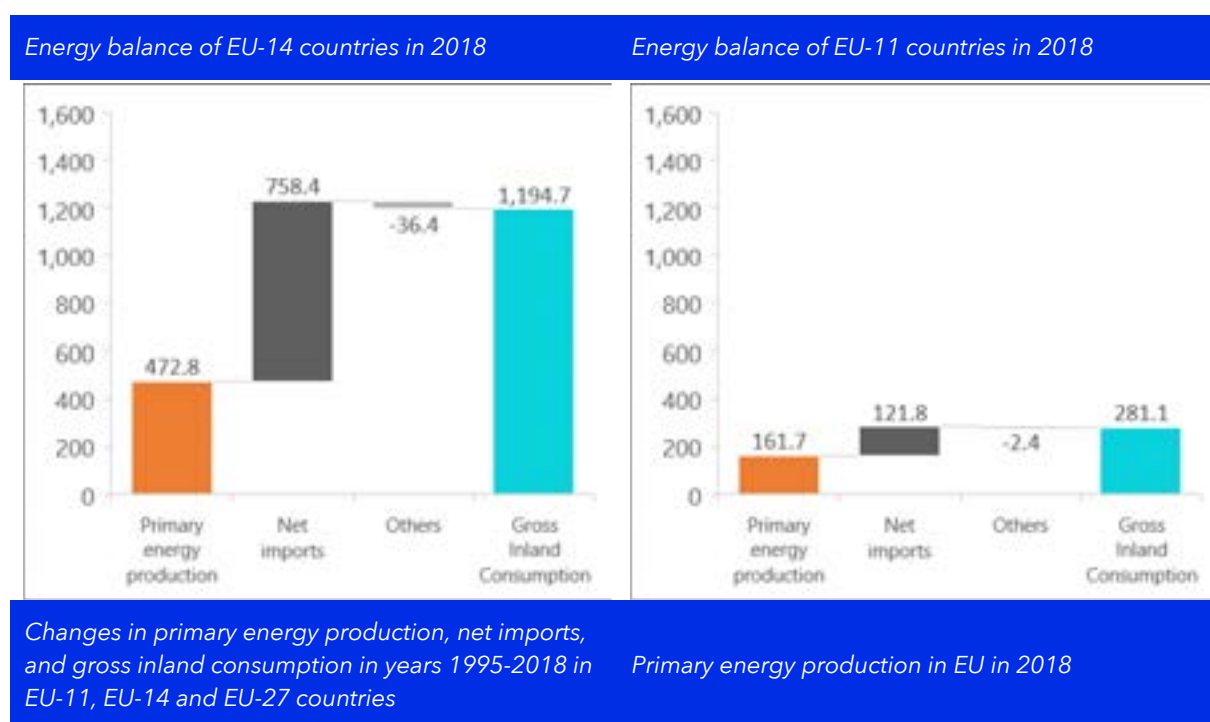
- EU-14 countries represented in 2018 73% of area, 77% of population and 90% of the total GDP of European Union.
- Their GDP per capita was higher than EU-11 and EU-27 averages but it was increasing for past 23 years slower than the GDP per capita of EU-11 and EU-27 countries.
- EU-14 countries reduced the energy intensity of economy less than EU-27 average decrease of energy intensity but they were still consuming less energy for producing the GDP.

2.2 Energy balance of EU-14 countries

The average production of energy in EU-14 countries represented 75% of the total EU primary energy production. Net import of energy was higher in EU-14 countries than EU-11 in absolute terms (758.4 Mtoe versus 121.8 Mtoe) and net import of EU-14 countries represented 86.3% of EU-27 imports. Gross inland consumption of EU-14 countries remained higher than EU-11 (only 81% of EU-27).

At the same time EU-14 countries were increasing their primary energy production and reducing gross inland consumption of energy in years 1995-2018 in opposition to EU-11 countries which were reducing both values (see Item 7). Net imports of energy in EU-14 countries were increasing by CAGR 0.26% in past 23 years whereas EU-14 imports have increased by larger CAGR 2.08%.

Item 7: Energy balances of EU-25

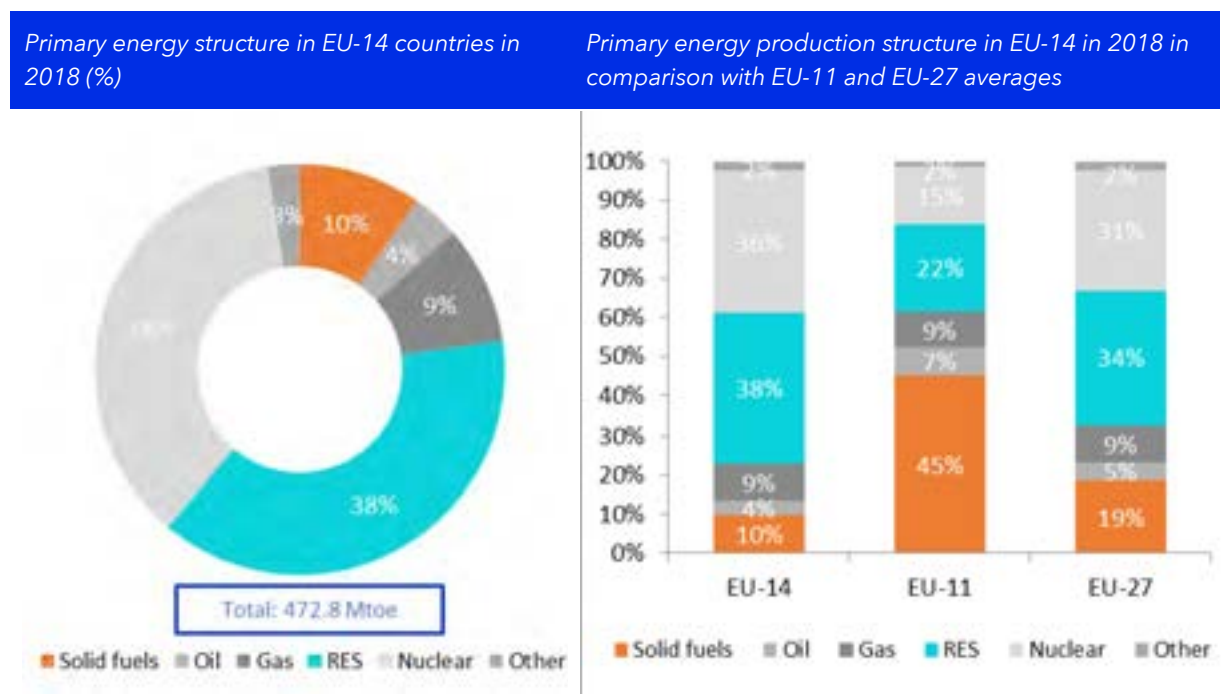


Source: Eurostat data for 2018, extracted in 2020. Errors in summation to 100% are due to rounding

2.2.1 Primary energy production

The primary energy production structure was dominated in 2018 in EU-14 countries by renewable energy sources (38% share) and nuclear (36% share). It differed from EU-11 where the solid fuels were dominating the primary energy production structure. Oil use was lower in EU-14 countries than in EU-11 (respectively 4% versus 7%), but gas share of primary energy production was the same - 9%. EU-11 countries relies less on renewable energy sources (22%) and nuclear energy (15%).

Item 8: Primary energy structure in EU in 2018



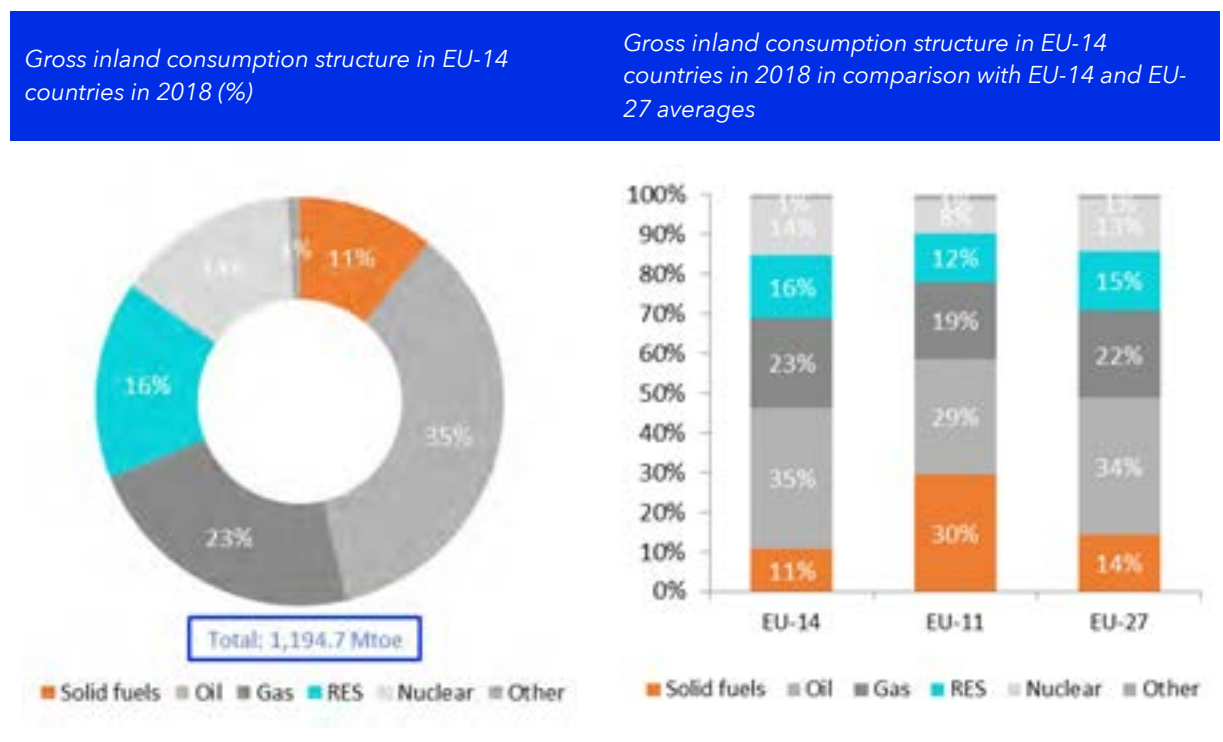
Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H) , Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

2.2.2 Gross inland consumption

Gross inland consumptions of energy in EU-14 countries was equal to 1,194.7 Mtoe in 2018 which represented only 81% of the total EU gross inland energy consumption.

Gross inland consumption of energy in EU-14 countries was dominated by oil (35% share) and it was more than the share of oil in EU-11 countries (29%). The share of solid fuels in EU-14 countries was lower than in EU-11 (11% versus 30%). The share of gas in gross inland energy consumption structure of EU-14 countries was higher (23%) than in EU-11 countries (19%). The situation repeated in case of RES (16% in EU-14 versus 12% in EU-11) and in case of nuclear energy (14% in EU-14 versus 8% in EU-11).

Item 9: Gross inland consumption structure in EU-14 countries



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gross inland consumption – GIC, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion)(O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear – Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

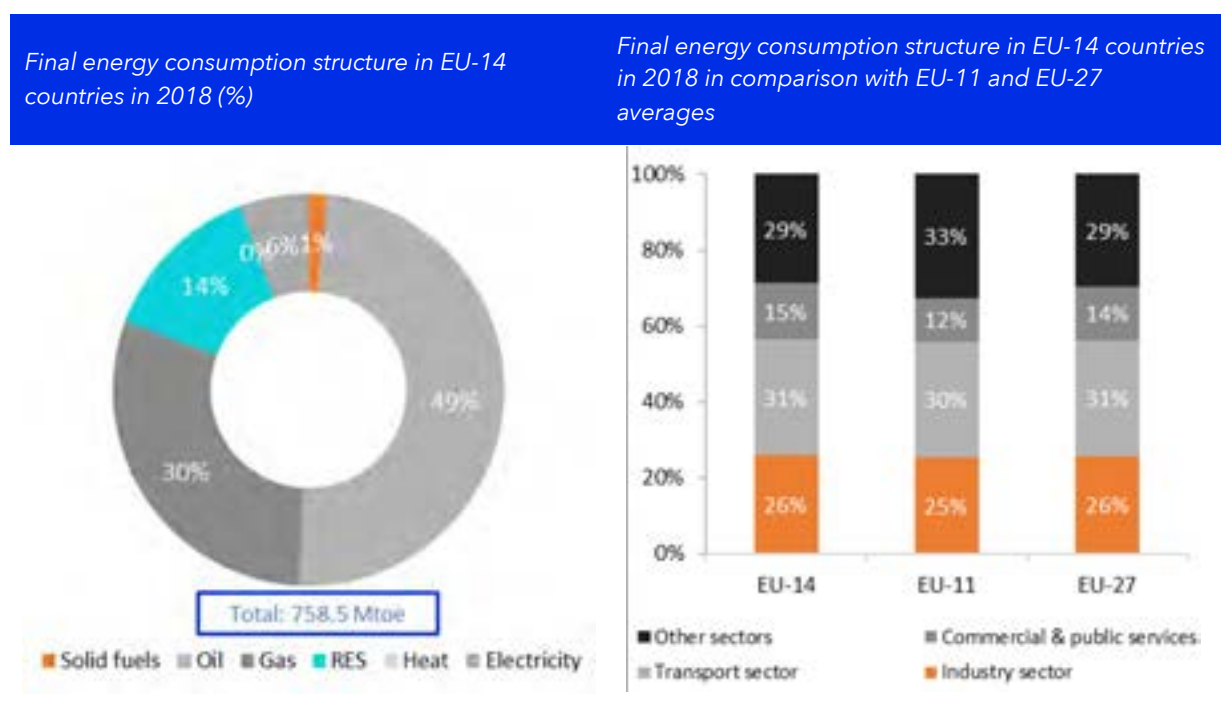
2.2.3 Final energy consumption

Final energy consumption in EU-14 countries was about 758.5 Mtoe in 2018. It represented 81% of the total final energy consumption of the European Union.

The key fuel in final energy consumption in EU-14 countries was oil – 49%. The second largest was gas – 30%, followed by renewable energy sources with 14%. The mix was completed by 1% of solid fuels and 6% of electricity in final energy consumption.

The structure of the final energy consumption in EU-14 countries was closed to the one in EU-11. Only small differences appeared. The share on final energy consumption in industry and transport sector were higher in EU-14 than in EU-11 by 1pp. (26% versus 25% and 31% versus 30% respectively). The use of final energy in commercial and public services was higher in EU-14 than in EU-11 (15% versus 12%) but other sectors (including residential) represented 29% of final energy consumption in EU-11 countries and as much as 33% in EU-11.

Item 10: Final energy consumption structure in EU-14 countries



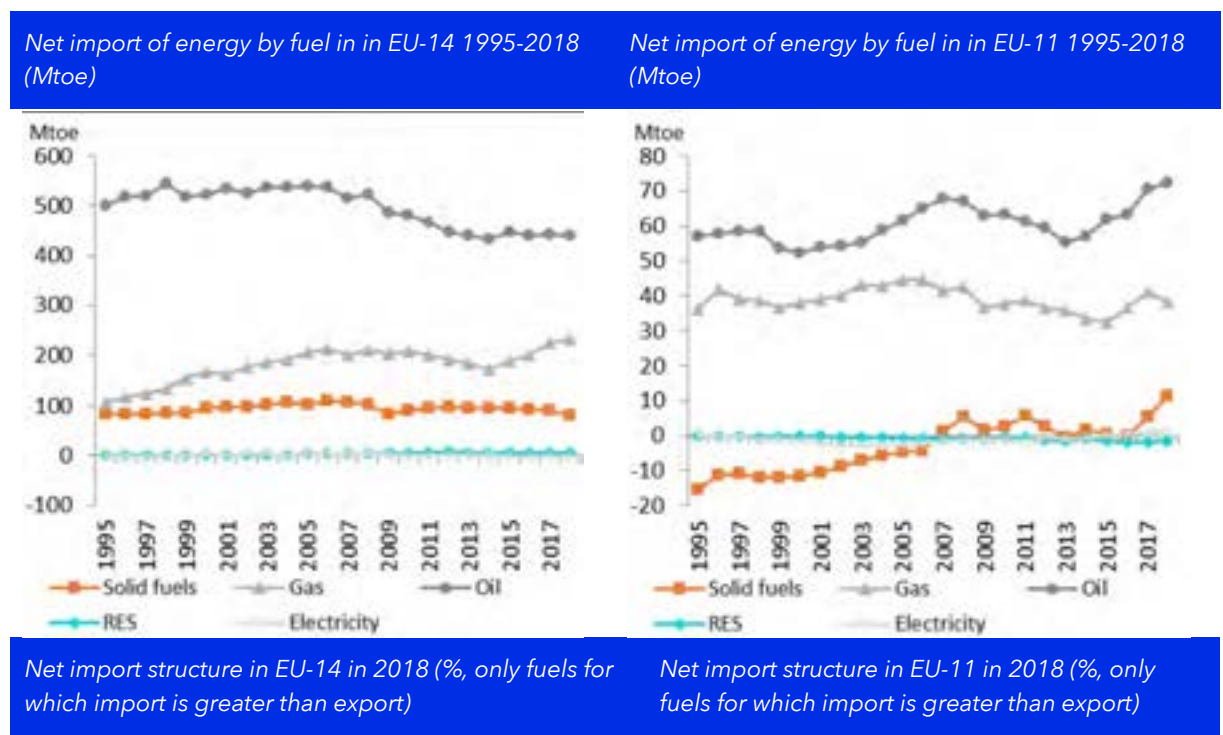
Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Heat (H8000), Electricity (E7000), Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial & public services - FC_OTH_CP_E, Other - FC_OTH_E-FC_OTH_CP_E. Errors in summation to 100% are due to rounding

2.2.4 Energy import and import dependency

EU-14 member states imported net 758.4 Mtoe of energy in 2018. It represented only 86% of total net energy imports of the European Union.

Net import structure was dominated by petroleum products. The share of it in case of EU-14 and EU-11 were very close – 58% and 59% respectively. The second fuel which share of import was the highest was gas. The difference between EU-14 and EU-11 countries was 1pp (i.e. 30% EU-14 and 31% EU-11). Net import of solid fuels to EU-14 countries was higher than in case of EU-11 countries – 11% versus 9%. The mix were completed by electricity and non-renewable waste.

Item 11: Structure of net import of energy in EU



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil

and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Electricity (E7000). Errors in summation to 100% are due to rounding

Net import of energy to EU-14 countries were characterized by stable solid fuel imports and a decrease of oil imports. Net import of gas to EU-14 increased significantly over past 23 years. It almost doubled. In opposite to this the evolution of fuels net imports to EU-11 countries over past 23 years shows increases of oil and solid fuels imports. At the same time the import of gas remained at similar level.

Solid fuel supplies to EU-14 originated mostly from outside of the European Union - 91% whereas the same import of solid fuels to EU-11 was originating from outside EU in 79%.

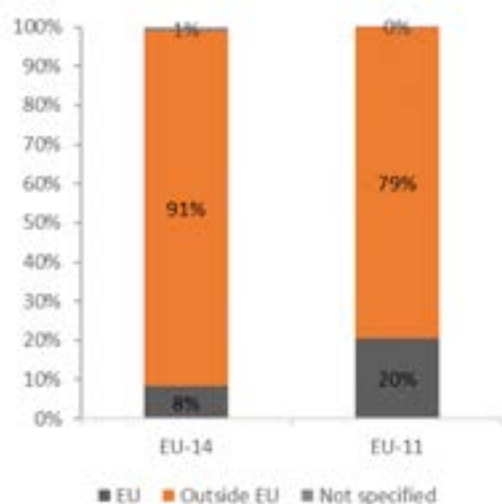
The crude oil import to EU-14 and EU-11 differed only by 1pp. Most of crude oil was imported from outside of EU - 80% in case of EU-14 and 79% in case of EU-11 countries.

EU-14 countries imported less gas from outside EU than EU-11 - 78% versus 89%. It is interesting to notice that 15% of gas imports to EU-14 member states were coming from non-specified sources.

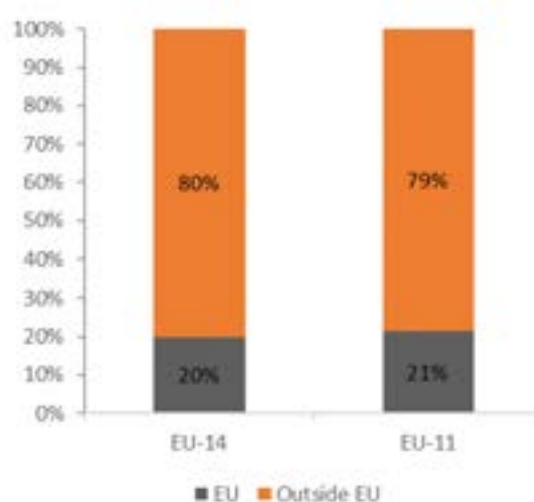
In gas of electricity most of import was coming from EU - 73% for EU-14 countries and 84% for EU-11. EU-14 countries imported 23% of electricity from outside of EU, whereas EU-11 countries imported 16% of electricity from outside of EU.

Item 12: Foreign fuel suppliers

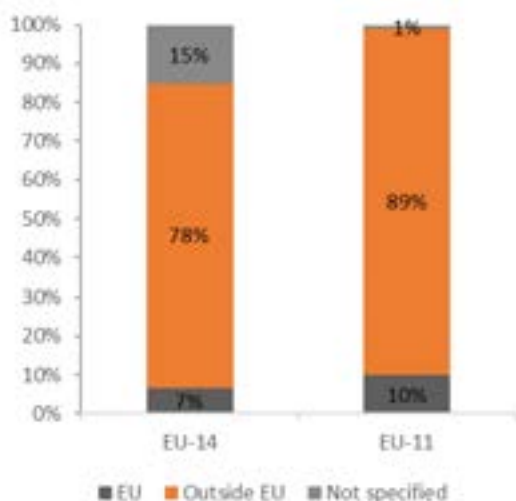
Foreign suppliers of solid fuels in EU-14 and EU-11 in 2018 (%)



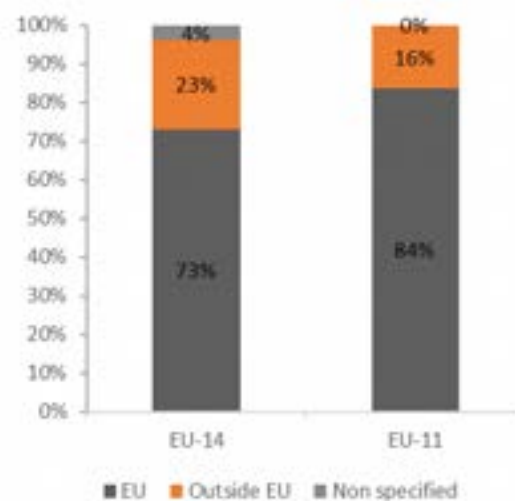
Foreign suppliers of crude oil in EU-14 and EU-11 in 2018 (%)



Foreign suppliers of gas in EU-14 and EU-11 in 2018 (%)



Foreign suppliers of electricity in EU-14 and EU-11 in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fossil fuels - C000X0350-0370, Gas - Natural gas (G3000), Oil - Oil and petroleum products (excluding biofuel portion) (O4000XBIO), Electricity - E7000. Errors in summation to 100% are due to rounding

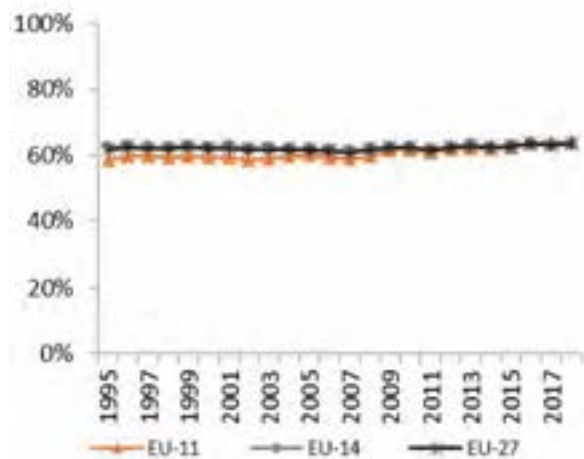
2.2.5 Energy intensity

The final energy consumption and gross inland consumption ratio, which measure energy efficiency, in 2018, was lower for EU-14 countries by 4pp. Over past 23 years the ratio for EU-11 countries improved and in 2018 the difference between EU-25 countries was close to 0pp.

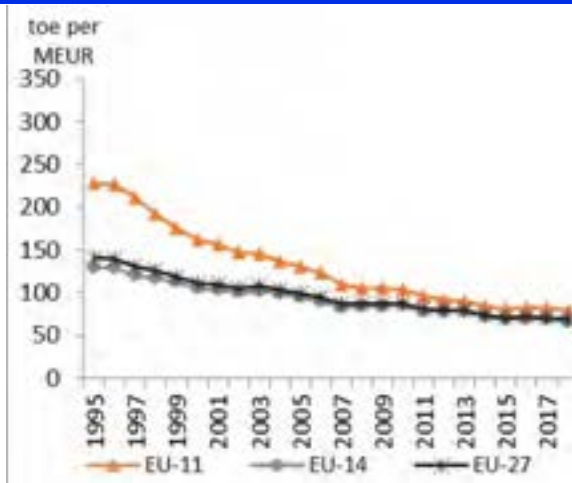
Simultaneously, a decrease of energy volume associated with generating gross domestic product was noticed in EU-14 countries. When compared to EU-11 ratio one can notice that over past 23 years the difference between EU-25 countries reduced from about 100 toe per MEUR to about 15 toe per MEUR.

Item 13: Final energy consumption in EU-14 countries in relation to selected indicators

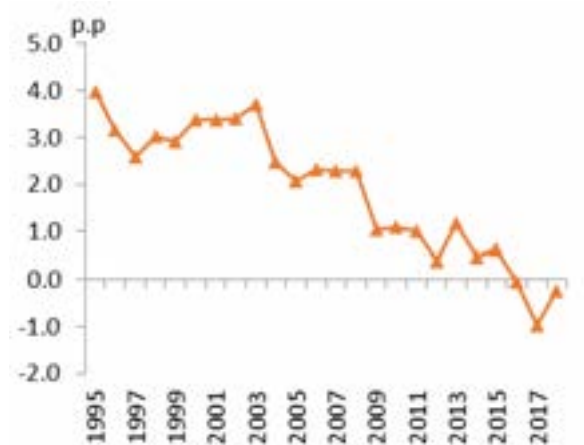
Final energy consumption to gross inland consumption ratio in EU-11, EU-14 and EU-27 countries in 1995-2018 (%)



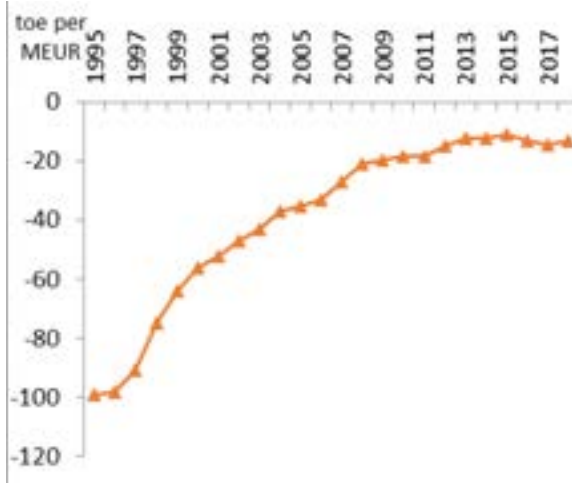
Final energy consumption to gross domestic product ratio in EU-14 in 1995-2018 in comparison with EU-11 and EU-27 averages (toe per M EUR)



Difference between final energy consumption to gross inland consumption ratio for EU-14 and EU-11 countries in 1995-2018



Difference between final energy consumption to gross domestic product ratio for EU-14 and EU-11 countries in 1995-2018 (toe per M EUR)

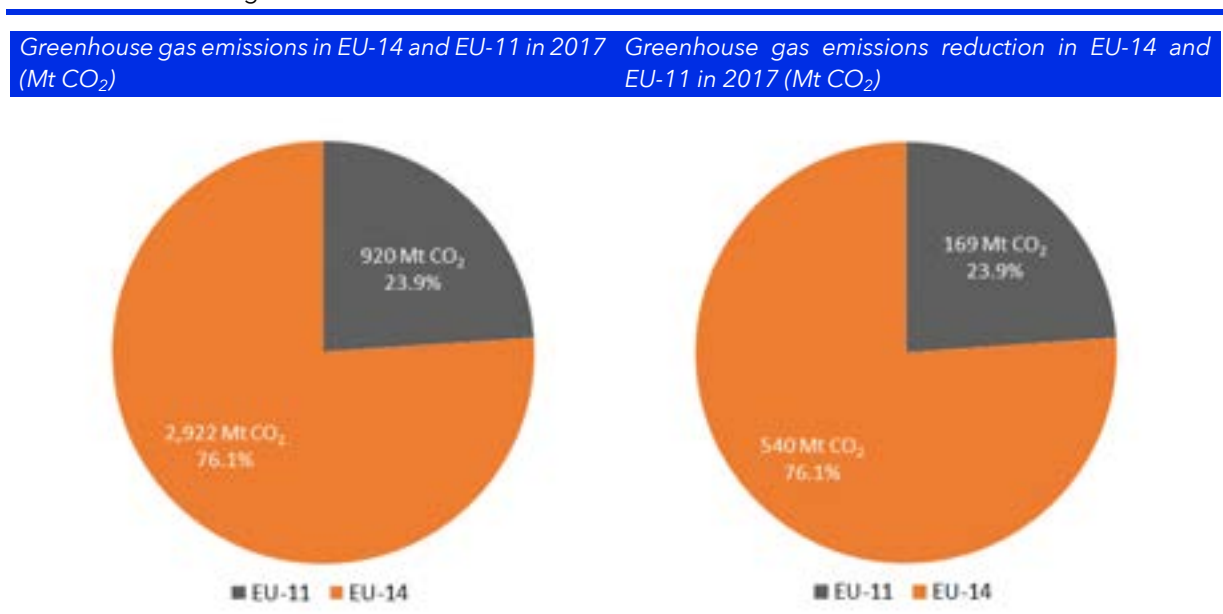


Source: Eurostat data for 2018, extracted in 2020. Detail references: Final energy consumption - FEC, Gross inland consumption - GIC, Gross Domestic Product - Gross domestic product at market prices B1GQ, Current prices - CP-MEUR

2.2.6 Greenhouse gas emissions

Greenhouse gas emissions generated by EU-14 countries amounted in 2017 to 2,922 Mt CO₂. It represented about 76.1% of EU-25 countries emissions. The reduction of greenhouse gas emissions achieved by EU-25 in years 1995-2017 was proportional to the share of emission. EU-14 countries reduced the emission by 540 Mt CO₂ which represents 76.1% of the total reduction generated by EU-14 and EU-11 countries. Respective greenhouse gas emission reduction in years 1990-2017 was characterized by the fact that 43.2% of the total reduction was attributed to EU-11 countries versus only 23.9% in period 1995-2017.

Item 14: Greenhouse gas emissions in EU-25



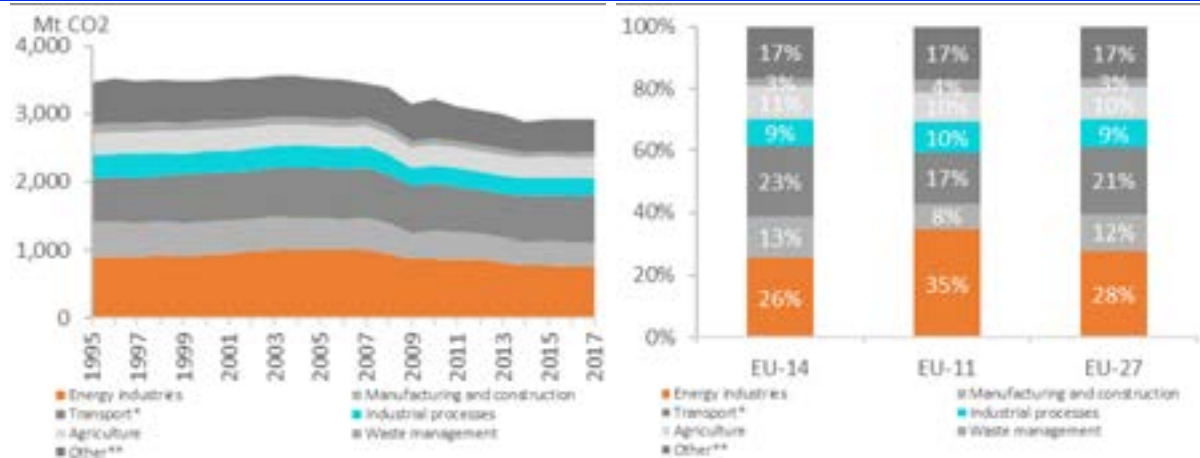
Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - values for EU-11, EU-14 and EU-27 recalculated by the Author; Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. The percentages of GHG emission and reduction show the share of EU-11 in the sum of EU-25 and respectively for EU-14. Errors in summation to 100% are due to rounding

The greenhouse gas emissions were reduced in EU-14 countries mostly in waste management and manufacturing and construction. At the same time, the emissions from transport increased over past 23 years. The emissions structure in EU-14 was still dominated by energy industry emissions - 26%. It was less than in case of EU-11 countries - 35%. The share of emissions from manufacturing and construction and transport were still higher in EU-14 countries than in EU-11 (13% versus 8% and 23% versus 17% respectively). The share of emissions from industrial processes, agriculture and waste management were similar in EU-11 and in EU-14 countries (1pp of difference).

The average greenhouse gas emission for EU-14 was below EU-11 and EU-27 levels. At the same time, the CAGR of greenhouse gas emissions in EU-14 countries was higher than in EU-11 by a half (1.1% versus 0.5%). Only two countries of EU-14 were not able to achieve a higher GHG emission reduction that EU-11 average.

Item 15: Greenhouse gas emissions in EU-14

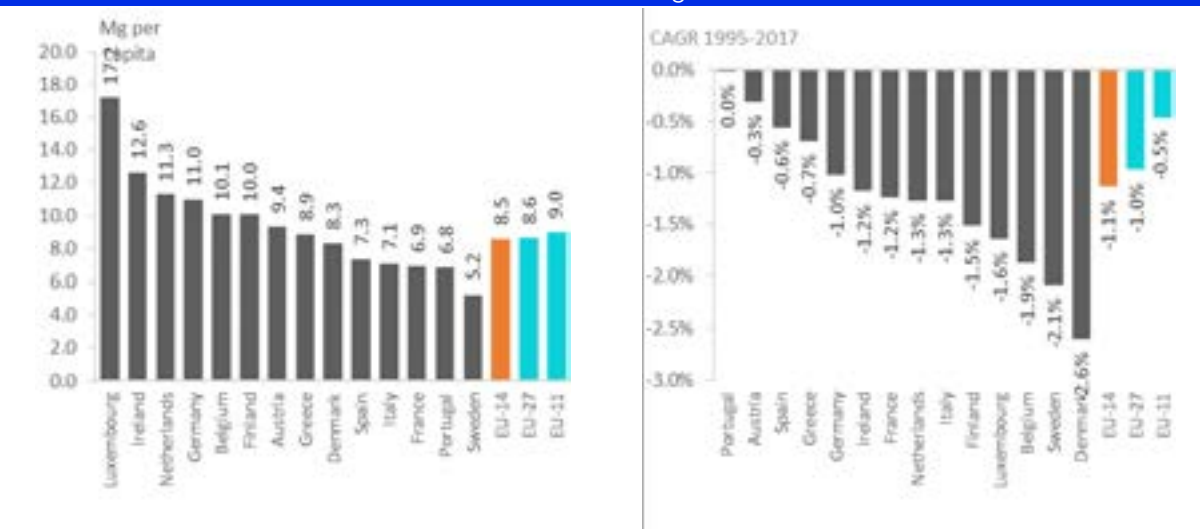
Greenhouse gas emissions in EU-14 by sectors in 1995-2017 (Mt CO₂) Greenhouse gas emissions in EU-14 by sectors in 2017 in comparison with EU-11 and EU-27 averages (%)



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - * values for EU-11, EU-14 and EU-27 recalculated by the Author; Energy industry - Fuel combustion in energy industries (CRF1A1), Manufacturing and construction - Fuel combustion in manufacturing industries and construction (CRF1A2), Transport - Fuel combustion in transport (CRF1A3), Industrial processes - Industrial processes and product use (CRF2), Agriculture - Agriculture (CRF3), Waste management - Waste management (CRF5), Other = Other fuel combustion sectors (CRF1A4)+ Other fuel combustion sectors n.e.c. (CRF1A5) + Fuels - fugitive emissions (CRF1B)+Other sectors (CRF6); Total GHG emissions equal to All sectors (excluding LULUCF and memo items) (CRF1-6X4_MEMO) i.e. emission from all sectors excluding Land use, land use change, and forestry (LULUCF), Transport and storage of CO₂ (memo item), International aviation (memo item), International navigation (memo item), Multilateral operations (memo item), Biomass - CO₂ emissions (memo item). Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. Errors in summation to 100% are due to rounding

Item 16: Greenhouse gas emissions in EU-14 and EU-27

Greenhouse gas emissions per capita in EU-14 in 2017 in comparison with EU-11 and EU-27 averages Change in greenhouse gas emissions per capita in EU-14 in 2017 in comparison with EU-11 and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - values for EU-11, EU-14 and EU-27 recalculated by the Author; Greenhouse gases (CO₂, N₂O in

CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG

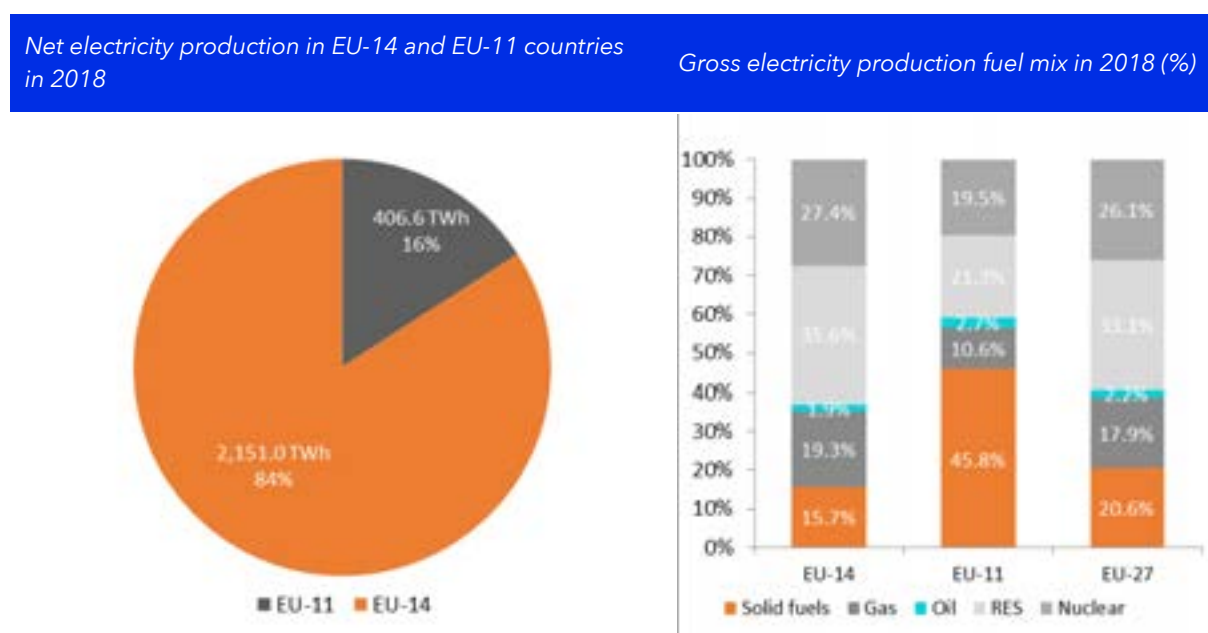
Conclusions

- EU-14 countries represented in 2018 75% of primary energy production, 86.3% of its import and 81% of gross inland consumption of EU.
 - The primary energy production in EU-14 were dominated by renewable energy sources and nuclear which are not greenhouse gas emitting fuels which was not the case in EU-11 dominated by fossil fuels.
 - Both final energy consumption to gross inland energy production ratio and final energy consumption to GDP ratio of EU-14 and EU-11 countries were approaching the each other.
 - EU-14 countries were responsible for 76.1% of greenhouse gas emissions in the total of EU-25 countries. The emission of GHG per capita was lower in EU-14 countries and its CAGR 1995-2018 was higher than EU-11 countries.
-

2.3 Overview of the electricity sector

Net electricity production in EU-14 countries was equal to 2,151.0 TWh in 2018. It represented 84% of net electricity production in EU-25. Gross electricity production was dominated by renewable energy sources in EU-14 countries (35.6% of production) which was much higher than the average for EU-11 equal to 21.3%. The share of gas in EU-14 production mix was higher than in EU-11 countries (19.3% versus 10.6%) but the share of oil was lower (1.9% versus 2.7%). The share of solid fuels was lower in the production mix in EU-14 than in EU-11 (15.7% versus 45.8%). The share of nuclear was higher in EU-14 - 27.4% versus 19.5% in EU-11.

Item 17: Net electricity production and gross electricity production fuel mix in EU-14



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Electricity Production - NEP, Gross Electricity Production - GEP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

The production of electricity was increasing in EU-14 countries faster than in EU-11 (1.1% versus 0.5% CAGR 1995-2018).

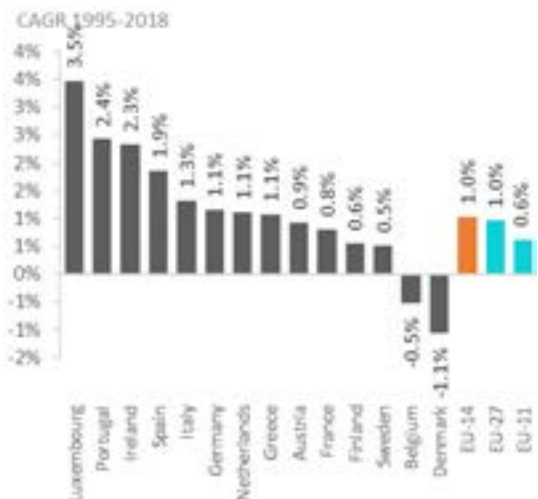
The final consumption of electricity was increasing in EU-14 slower than in EU-11 (0.6% versus 1.7%). It was interesting when compared to faster growth of electricity production in EU-14 versus EU-11. Only three countries final electricity consumption was growing faster than EU-11 average.

The final electricity consumption per capita was higher in EU-14 countries than in EU-11 (0.5 toe per capita versus 0.3 toe per capita). All EU-14 countries were characterized by higher final electricity consumption than EU-11 average.

The structure of electricity consumption in EU-14 was characterized by lower share of industry use (37.6% versus 40.9%) and higher share of residential use (28.5% versus 25.6%). The shares of transport and commercial sectors were similar.

Item 18: Growth of net electricity production and final energy consumption in EU-14 countries

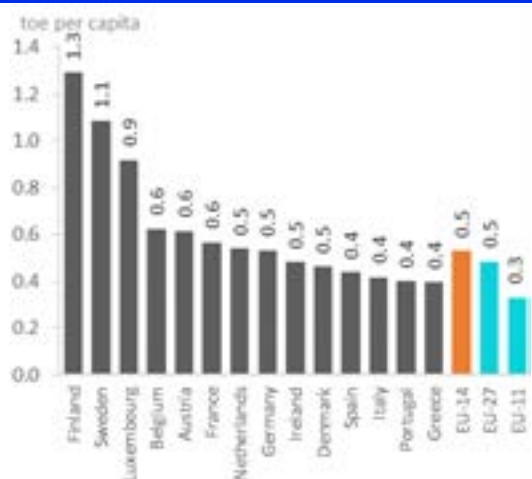
Growth of net electricity production in EU-14 countries in 1995-2018 in comparison with EU-11 and EU-27 countries



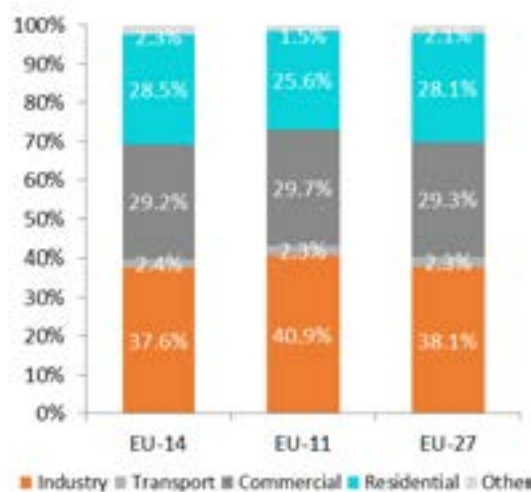
Growth of final consumption of electricity in EU-14 countries in 1995-2018 in comparison with EU-11 and EU-27 countries



Final consumption of electricity per capita in EU-14 in 2018 in comparison with EU-11 and EU-27 (toe per capita)



Final consumption of electricity in EU-14 by sectors in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Electricity E7000. Errors in summation to 100% are due to rounding

Conclusions

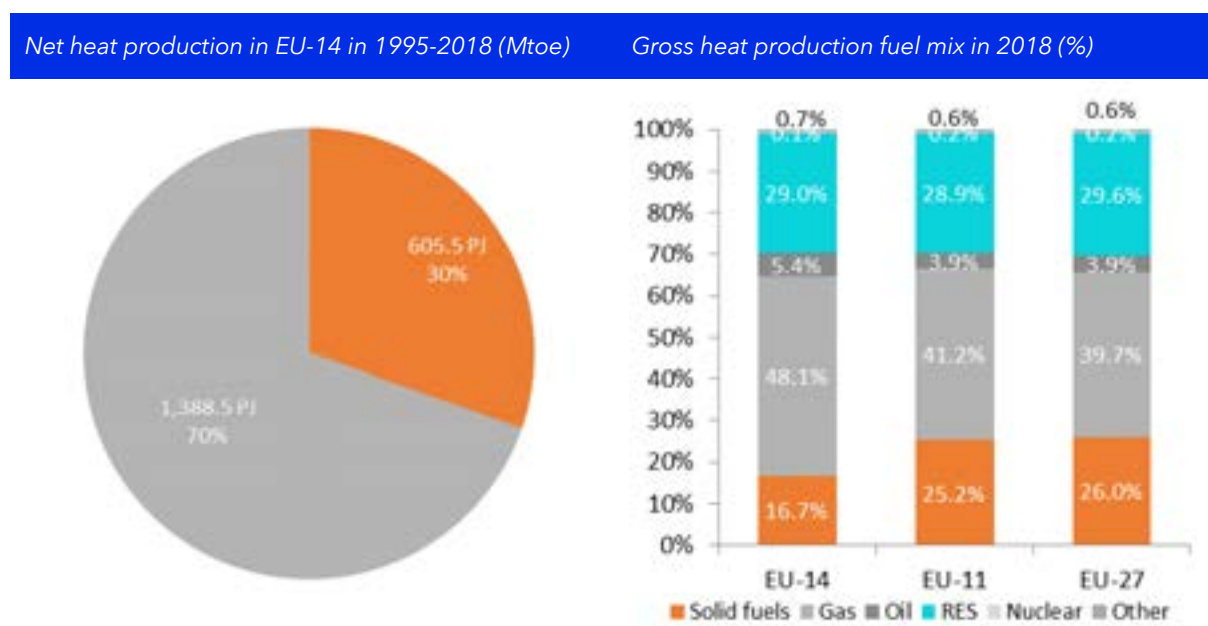
- EU-14 countries represented in 2018 84% of electricity production in EU-25 countries.
- Most of electricity was generated from not greenhouse gas emitting sources i.e. renewable energy sources and nuclear - 63% versus 40.8% in EU-11.
- The electricity production was growing faster in EU-14 than the final consumption. The opposite situation was in EU-11 countries.

2.4 Overview of the heat sector

Net heat production in EU-14 countries was equal to 1,388.5 PJ. It represented about 70% of total EU-25 heat production.

Most of the heat was produced from gas in EU-14 countries but its share in gross heat production was higher than in EU-11 (48.1% versus 41.2%). At the same time, the share of solid fuels was lower in EU-14 than in EU-11 - 16.7% versus 25.2%. The share of oil was higher in EU-14 than in EU-11 countries (5.4% versus 3.9%) but the share of renewable energy sources was almost equal (29.0% and 28.9%).

Item 19: Net heat production and gross heat production fuel mix in EU-14



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Heat Production - NHP, Gross Heat Production - GHP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

The production of heat in EU-14 countries was increasing. The CAGR for years 1995-2018 was equal to 0.3%, whereas it was decreasing in EU-11 countries at CAGR -1.9%.

The consumption of heat was also increasing in EU-14 countries by 1.5% CAGR 1995-2018. The use of heat in EU-11 countries was decreasing by -2.4%.

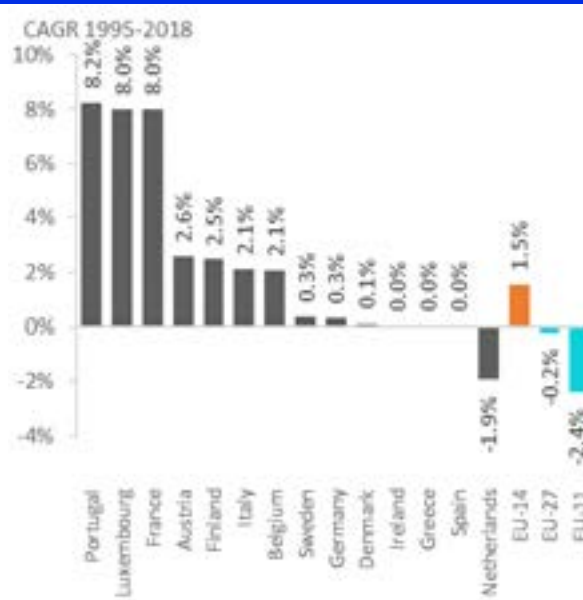
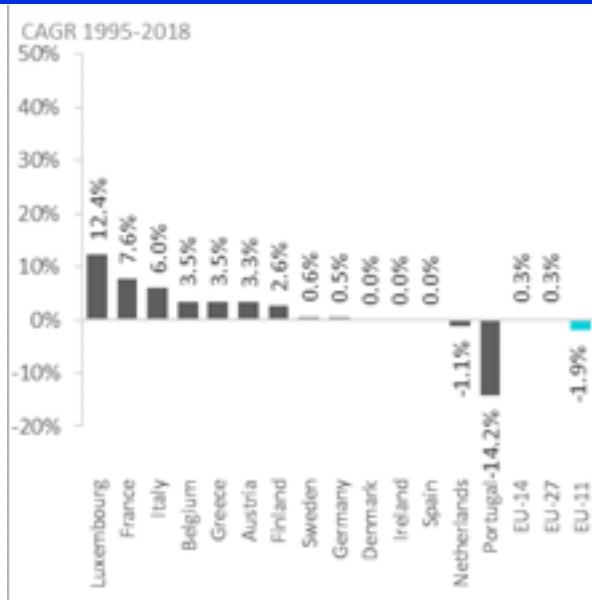
Despite the changes the final consumption of heat per capita in EU-14 countries remained lower than in EU-14 countries (0.10 toe per capita versus 0.13 toe per capita).

The final consumption of heat in EU-14 countries was dominated by residential sector in the same way as in EU-11 but the share of this use in EU-14 countries was 40.1% and 60.5% in EU-11. The share of heat use in industry and commercial sector were higher in EU-14 countries - 37.9% versus 19.7% and 21.3% versus 19.3%. The residential and industry sectors consumed similar amount of heat in EU-14 countries whereas the residential sector was three times bigger than the industrial one in EU-11 countries.

Item 20: Growth of net heat production and final heat consumption in EU-14 countries

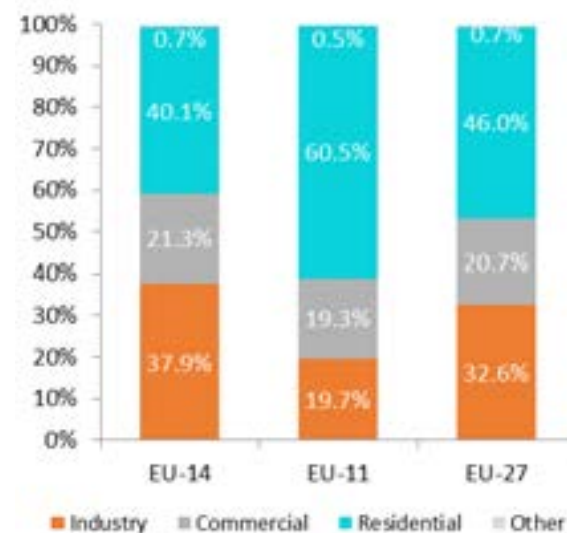
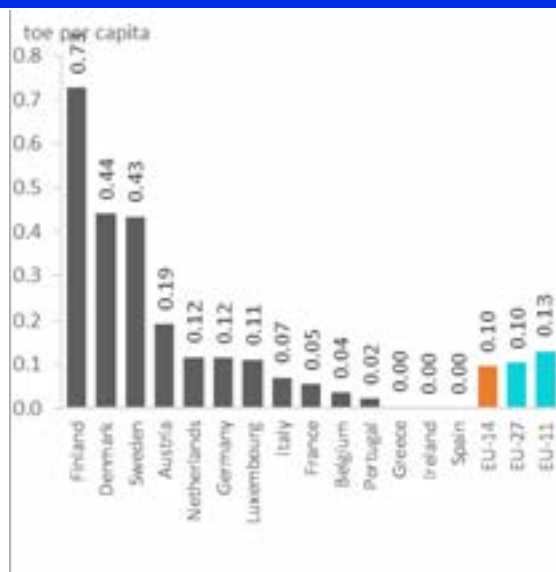
Growth of net heat production in EU-14 countries in 1995-2018 in comparison with EU-11 and EU-27 countries

Growth of final consumption of heat in EU-14 countries in 1995-2018 in comparison with EU-11 and EU-27 countries



Final consumption of heat per capita in EU-14 in 2018 in comparison with EU-11 and EU-27 (toe per capita)

Final consumption of heat in EU-14 by sectors in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Heat H8000. Errors in summation to 100% are due to rounding

Conclusions

- EU-14 countries represented in 2018 70% of heat production in EU-25 countries.
- Heat production and consumption were increasing in EU-14 countries whereas they were decreasing in EU-11.
- The residential sector and industry in EU-14 had almost the same consumption whereas in EU-11 the residential sector was three times bigger than the industrial one.

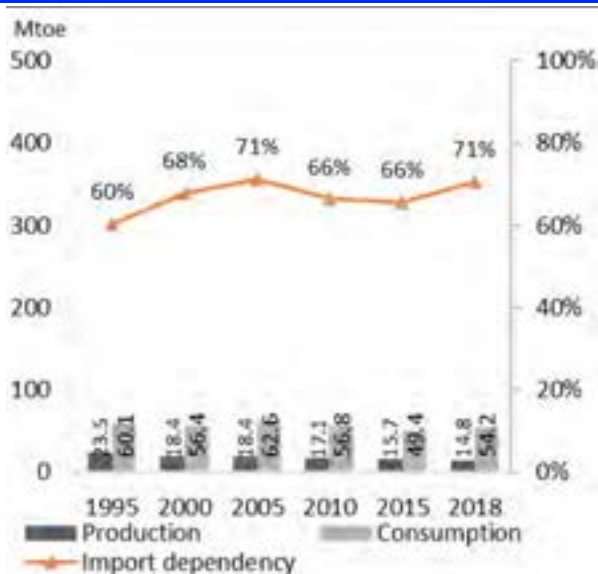
2.5 Overview of gas sector

EU-14 countries produced about 44.4 Mtoe of natural gas in 2018. At the same time the consumption reached the level of 270.1 Mtoe. It means an import dependency of 86% on average of EU-14 countries.

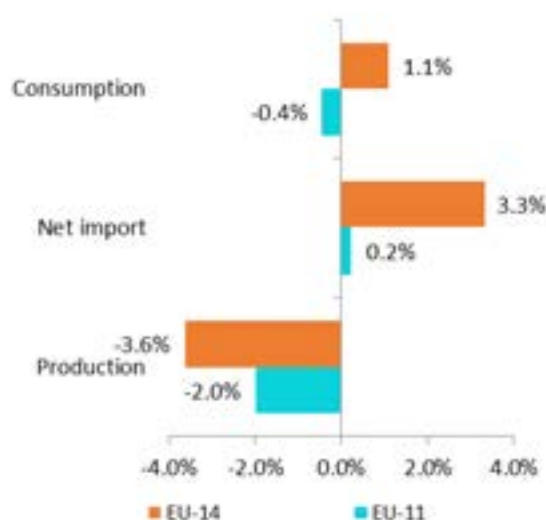
The level of production dropped over past 23 years by 3.6% which was higher compared to the drop in EU-11 countries - 2.0%. At the same time, the consumption of gas increased in EU-14 countries by 1.1% whereas it decreased in EU-11. The import was also growing faster in EU-14 countries (3.3%) than in EU-11 - 0.2%.

Item 21: Gas sector in EU-14 countries

Gas production, gross consumption and import dependence in EU-14 in 1995-2018 (Mtoe)



Changes in gas production, consumption and import in EU-14 and EU-11 countries in 1995-2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gas production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Natural Gas G3000

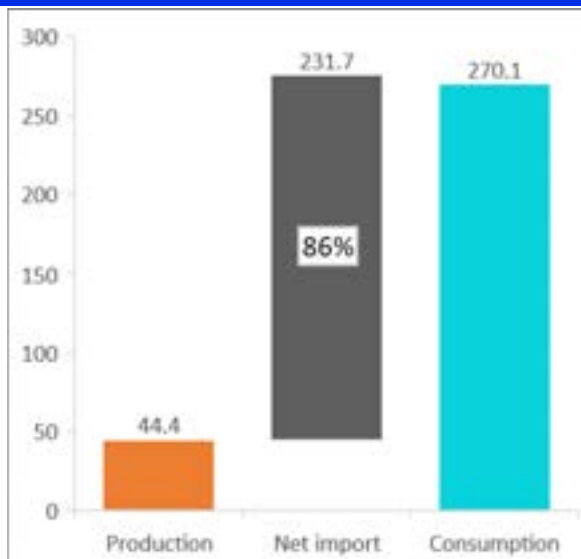
Gas production in EU-14 represented 75% of total EU-25 production. The consumption represented 83% of the total EU-25 consumption. Therefore, the share of production in EU-14 was lower whereas the share of consumption was higher than in EU-14 countries. Consequently, net import to EU-14 represented only 86% of total import to EU-25 countries. The import dependency of EU-14 countries was higher - 86% compared to 71% of EU-11 countries.

The final consumption of gas per capita in EU-14 countries was higher than in EU-11. The average value for EU-14 was 0.49 toe per capita and it was 0.32 toe per capita in EU-11 countries.

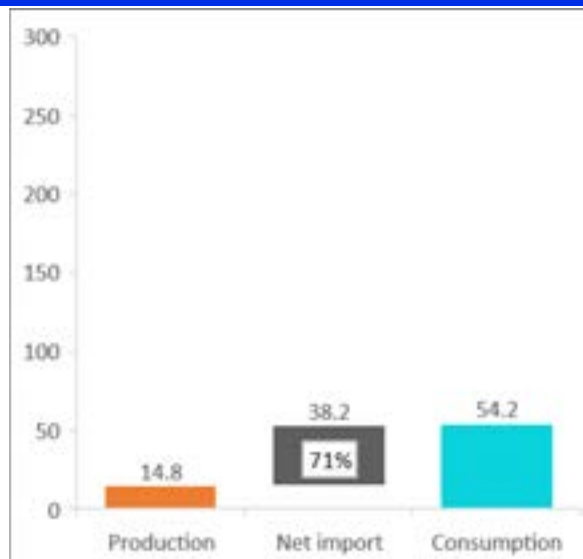
Gas consumption structure was similar in EU-25 countries. The use was dominated by industry (39% and 37.1% in EU-25 countries respectively) and residential sector (39.6% and 39.1% in EU-25 countries respectively). The share of gas use in transport was lower in EU-14 countries (1.5% versus 3.2%) but the same value for commercial sector was higher - 20.5% versus 16.7%.

Item 22: Final consumption of gas per capita in EU-14 countries

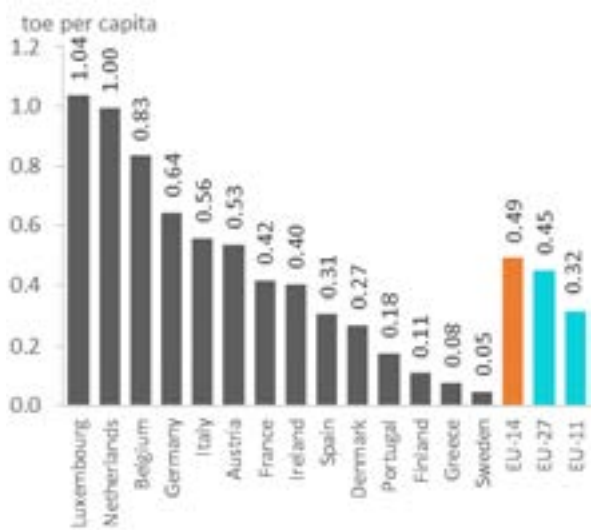
EU-14 countries gas balance and import dependency in 2018



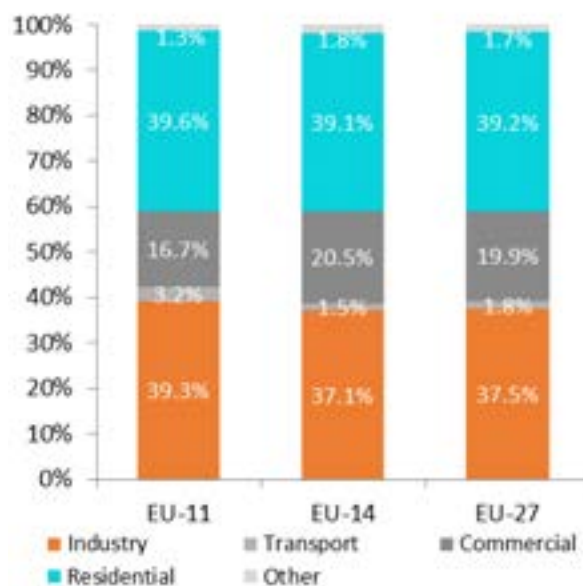
EU-11 countries gas balance and import dependency in 2018



Final consumption of gas per capita in EU-14 countries in 2018 and in EU-11, EU-15 and EU-27 averages (toe per capita)



Gas final consumption by sectors in EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Natural Gas G3000. Errors in summation to 100% are due to rounding

Conclusions

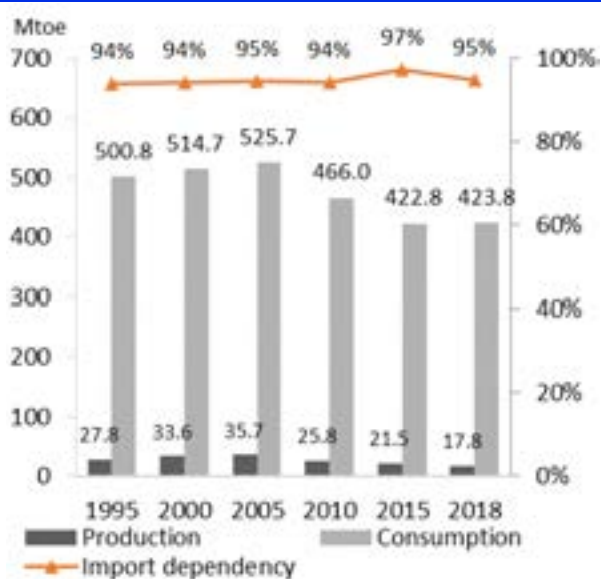
- EU-14 countries represented in 2018 75% of gas production, 83% of gas consumption and 86% of gas import in EU-25 countries.
- Gas use structure was similar in both EU-25 countries.
- Gas consumption was increasing in EU-11 countries whereas it was decreasing in EU-14.

2.6 Overview of the oil sector

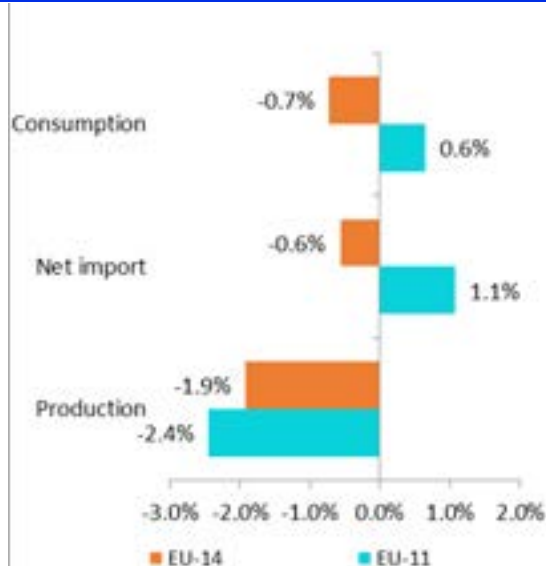
Oil production in EU-14 countries in 2018 was 17.8 Mtoe and the consumption was 423.8 Mtoe. The production of oil dropped over past 23 years by 1.9% whereas in EU-11 countries it dropped by 2.4%. At the same time, the consumption of oil and its import decreased in EU-14 countries (respectively -0.7% and -0.6%). In EU-11 countries the import and consumption of oil increased.

Item 23: Oil sector in EU-14 countries

Oil production, gross consumption and import dependence in EU-14 in 1995-2018 (Mtoe)



Changes in oil production, consumption and import in EU-25 countries in 1995-2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Oil production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO.

The production of oil in EU-14 countries represented 73% of the total production in EU-25 countries. The share of net import to EU-14 countries was higher - 86% of total import goes to EU-14 countries. EU-14 member states were responsible for 85% of the total consumption of oil in EU-25 countries.

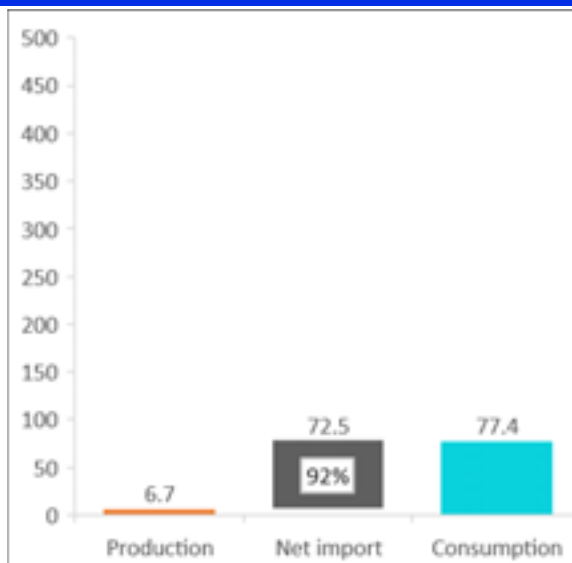
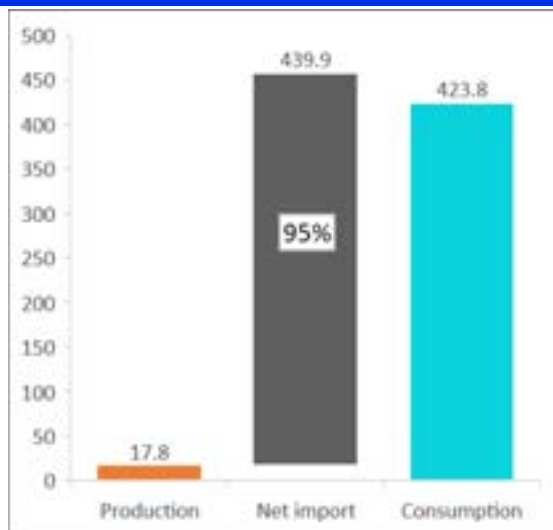
Oil import dependency of EU-14 countries was higher than EU-11 - 95% versus 92%.

The consumption of oil per capita in EU-14 countries remained higher than the average of EU-11. All countries were characterized by higher final oil consumption than EU-11 average.

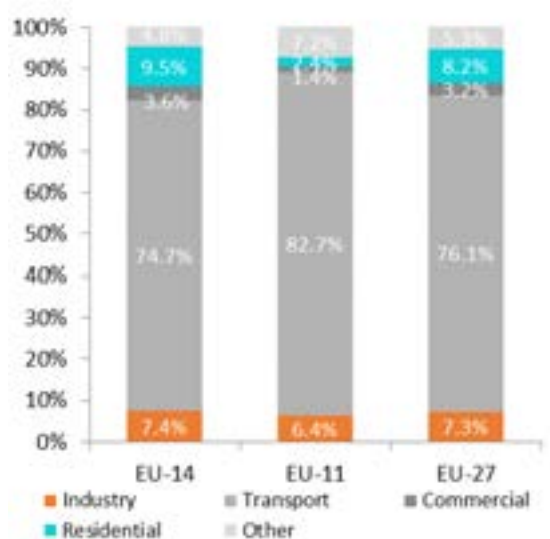
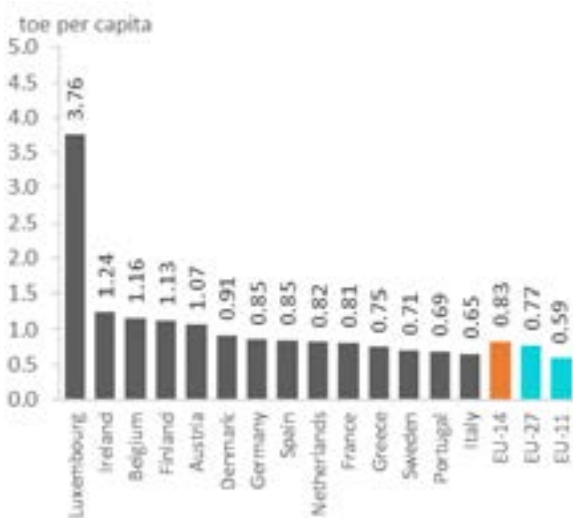
The oil consumption structure of EU-14 countries was dominated by transport, but its share was lower than in EU-11 countries (74.7% versus 82.7%). In opposite EU-14 countries share of gas in other sectors was higher than the one for EU-11 countries.

Item 24: Final consumption of oil per capita in EU-14 countries

EU-14 countries oil balance and import dependency in 2018 EU-11 countries oil balance and import dependency in 2018



Final consumption of oil per capita in EU-11 countries in 2018 and in EU-11, EU-15 and EU-27 averages (toe per capita) Oil final consumption by sectors in EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Errors in summation to 100% are due to rounding

Conclusions

- EU-14 countries represented in 2018 73% of oil production, 85% of oil consumption and 86% of oil import in EU-25 countries.
- Oil production was decreasing in EU-25 countries whereas the consumption and net import were increasing in EU-11 countries but decreasing in EU-14.
- Oil consumption per capita was higher in EU-14 countries than EU-11 average.

2.7 Overview of current EU climate policy in EU-14 countries

Europe 2020 strategy targets on climate and energy and the post-2020 climate and energy framework Also known as the '20-20-20' targets, the Europe 2020 strategy's three climate and energy targets were interrelated and mutually support one another:

- A 20% reduction in GHG emissions compared with 1990 levels;
- A 20% share of renewable energy in gross final energy consumption; and
- A 20% cut in energy consumption compared to a 2020 business-as-usual projection.

In 2014, the European Council agreed on a post-2020 climate and energy framework. The 2030 Climate and Energy Policy Framework includes three targets for 2030:

- At least 40% cut in GHG emissions (from 1990 levels),
- At least 27% share for renewable energy; and
- Further improvements in energy efficiency (compared to a projected business-as-usual scenario for 2030).

In 2018, the revised Renewable energy directive and amending Directive on Energy Efficiency increased the ambition of the latter two targets for renewable energy and energy efficiency. The current targets for 2030 are:

- At least 40% cut in GHG emissions (from 1990 levels),
- minimum 32% share for renewable energy; and
- At least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030).

Item 25: Summary of EU-28 targets for 2020 and 2030

| | EU-28 2020 targets | EU-28 2030 targets |
|----------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | 20% reduction from 1990 levels (14% reduction from 2005 level) | at least 40% reduction from 1990 levels |
| Share of energy from renewables | 20% energy from renewables | minimum 32% share for renewable energy |
| Improvement in energy efficiency | 20% improvement in energy efficiency | at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |

Source: EU website

2.7.1 Greenhouse gas emissions

The greenhouse gas emission reduction targets are summarized in Item 26.

Item 26: Summary of greenhouse gas emissions targets for EU-28 for 2020 and 2030

| | EU-28 2020 | EU-28 2030 |
|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | 20% reduction from 1990 levels (14% reduction from 2005 level) | 40% reduction from 1990 levels |
| Greenhouse gas emissions in ETS | 21% reduction from 2005 | 43% by 2030 compared to 2005 |
| National emission reduction targets in No-ETS - Effort Sharing Decision (ESD) | -20% +20% depending on country, reduction of at least 10% in total EU emissions from the non-EU ETS sectors compared with 2005 levels | - |
| National emission reduction targets in No-ETS - Effort Sharing Regulation (ESR) | - | 0% to -40% compared to 2005 levels depending on the country reduce emissions by 30% by 2030 compared with 2005 |

Source: EU website

The achievement of greenhouse gas emissions EU wide target of 20% reduction from 1990 levels to 2020 was based on two elements:

- EU wide target of 21% reduction in EU ETS sectors from 2005 levels.
- National emission reduction targets in Non-ETS sectors defined in Effort Sharing Decision (ESD).

The target for EU ETS sectors were set for the whole EU and there were no targets for countries. In 2017 the emission of greenhouse gas for EU-28 was reported at the level of 78.34 comparing to the target for 2020 of 80. (emissions were measured to the reference year 1990 emissions).

In case on non-ETS sectors specific targets were agreed for countries based on Effort Sharing Decision. There are listed in table Item 27.

The achievement of greenhouse gas emissions EU wide target of 40% reduction from 1990 levels to 2030 is based on two elements:

- EU wide target of 43% reduction in EU ETS sectors from 2005 levels.
- National emission reduction targets in Non-ETS sectors defined in Effort Sharing Regulations (ESR).

The target for EU ETS sectors is set for the whole EU and there are no targets for countries. In case on non-ETS sectors specific targets were agreed for countries based on Effort Sharing Regulations. There are listed in table Item 27.

Item 27: Summary of national targets for greenhouse gas emissions targets for 2020 and 2030 compared with 2005 levels

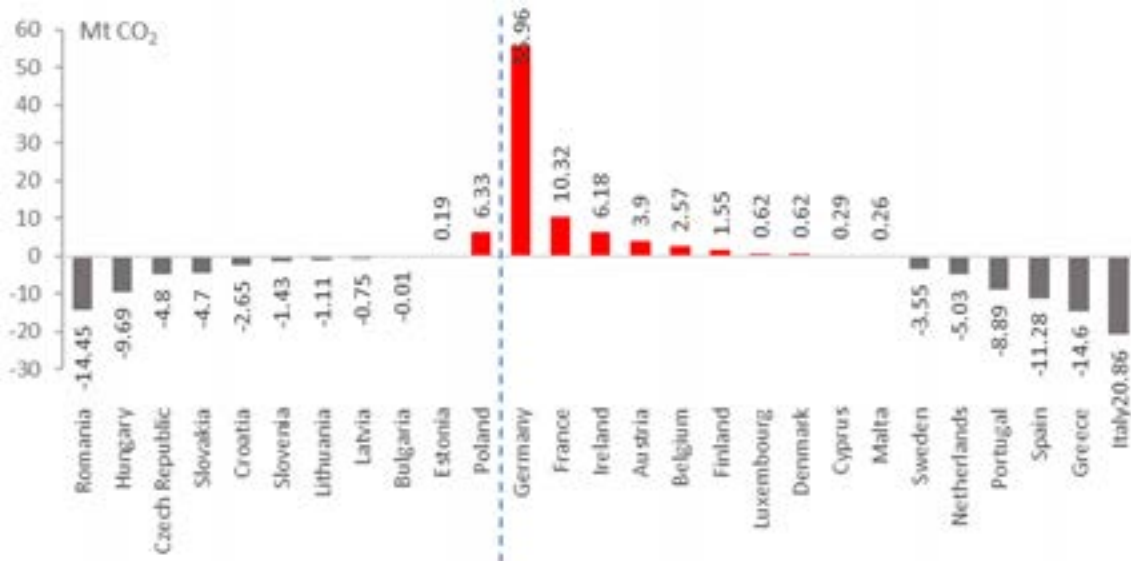
| Country | ESD - 2020 targets | ESR - 2030 targets |
|----------------|--------------------|--------------------|
| Belgium | -15% | -35% |
| Bulgaria | 20% | 0% |
| Czechia | 9% | -14% |
| Denmark | -20% | -39% |
| Germany | -14% | -38% |
| Estonia | 11% | -13% |
| Ireland | -20% | -30% |
| Greece | -4% | -16% |
| Spain | -10% | -26% |
| France | -14% | -37% |
| Croatia | 11% | -7% |
| Italy | -13% | -33% |
| Cyprus | -5% | -24% |
| Latvia | 17% | -6% |
| Lithuania | 15% | -9% |
| Luxembourg | -20% | -40% |
| Hungary | 10% | -7% |
| Malta | 5% | -19% |
| Netherlands | -16% | -36% |
| Austria | -16% | -36% |
| Poland | 14% | -7% |
| Portugal | 1% | -17% |
| Romania | 19% | -2% |
| Slovenia | 4% | -15% |
| Slovakia | 13% | -12% |
| Finland | -16% | -39% |
| Sweden | -17% | -40% |
| United Kingdom | -16% | -37% |

Source: EU website

Most of EU-14 countries were above their respective targets for greenhouse gas emissions levels in ESD mechanism. Only six countries were below the limit. In case of EU-11 most of the countries were below their limits.

Item 28: Difference between GHG emissions in 2017 and targets for European Union countries

Difference between GHG emissions in 2017 and targets for European Union countries for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Greenhouse gas emissions, base year 1990 [T2020_30], Greenhouse gas emissions in ESD sectors [T2020_35]

Currently the information about country specific targets for 2030 in ESR mechanism were communicated only as percentages of 2005 levels. The absolute values are still under discussion.

2.7.2 Renewable energy sources

The Europe 2020 strategy's second climate change and energy target had the objective of renewable energy reaching a 20% share of gross final energy consumption by 2020. Gross final energy consumption comprises the energy supplied to final consumers for all energy uses and the consumption of electricity and heat by the energy sector for electricity and heat production, including losses of electricity and heat in distribution and transmission. The recast Renewable Energy Directive¹ adopted in 2018 set a new EU-level target: by 2030, the renewable energy share should reach at least 32%. (see Item 29)

Item 29: Summary of EU-28 targets regarding share of renewable sources in gross final consumption of energy in 2020 and 2030

| | EU-28 2020 targets | EU-28 2030 targets |
|---------------------------------|---------------------------------------------|---------------------------------------------|
| Share of energy from renewables | 20% energy from renewables | minimum 32% share for renewable energy |
| EU wide target | 20% share of gross final energy consumption | 32% share of gross final energy consumption |
| National targets | From 10% to 49% of gross final consumption | Not yet available |

Source: EU website

The share of renewable energy in gross final consumption for EU-27 countries was 18.9% in 2018. Comparing to the target of 20% for 2020 one can conclude that there is high chance to achieve the target.

Country specific targets for share of energy from renewable energy sources in gross final consumption of energy in 2005 and 2020 have been set. (see

¹ Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources.

Item 30).

Item 30: National overall targets for the share of energy from renewable sources in gross final consumption of energy in 2020

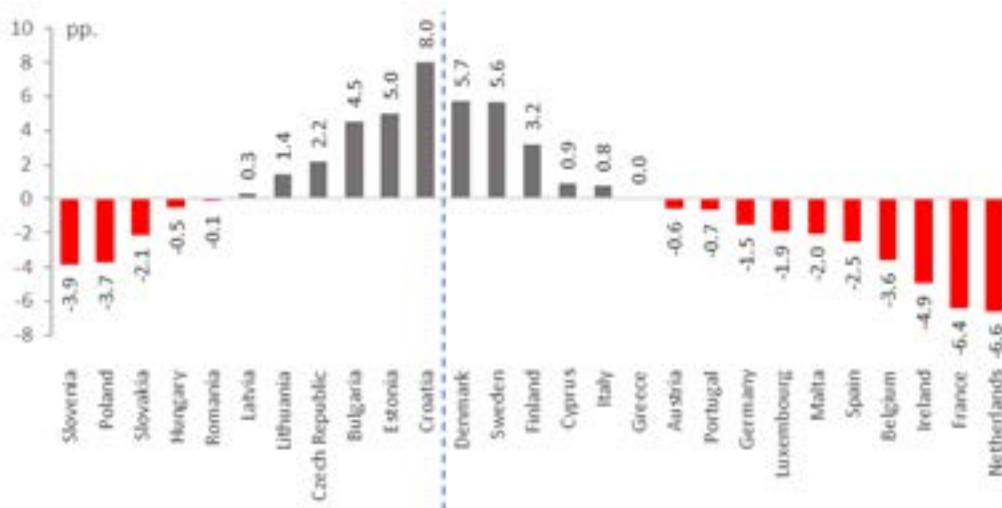
| | Share of energy from renewable sources in gross final consumption of energy, 2005 | Target for share of energy from renewable sources in gross final consumption of energy, 2020 |
|-----------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Belgium | 2,2% | 13% |
| Bulgaria | 9,4% | 16% |
| Czech Republic | 6,1% | 13% |
| Denmark | 17,0% | 30% |
| Germany | 5,8% | 18% |
| Estonia | 18,0% | 25% |
| Ireland | 3,1% | 16% |
| Greece | 6,9% | 18% |
| Spain | 8,7% | 20% |
| France | 10,3% | 23% |
| Croatia | - | 20% |
| Italy | 5,2% | 17% |
| Cyprus | 2,9% | 13% |
| Latvia | 32,6% | 40% |
| Lithuania | 15,0% | 23% |
| Luxembourg | 0,9% | 11% |
| Hungary | 4,3% | 13% |
| Malta | 0,0% | 10% |
| Netherlands | 2,4% | 14% |
| Austria | 23,3% | 34% |
| Poland | 7,2% | 15% |
| Portugal | 20,5% | 31% |
| Romania | 17,8% | 24% |
| Slovenia | 16,0% | 25% |
| Slovak Republic | 6,7% | 14% |
| Finland | 28,5% | 38% |
| Sweden | 39,8% | 49% |
| United Kingdom | 1,3% | 15% |

Source: EU website. DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

Six of eleven EU-14 countries achieved the target of share of renewable energy in the energy mix in 2020 set by EU. In case of EU-11 also only six countries reached their respective targets.

Item 31: Difference between target and current share of energy from renewable energy sources in gross final energy consumption in EU countries

Difference between current (2018) share of energy from renewable energy sources in gross final energy consumption and targets for 2020 in EU countries



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Share of energy from renewable sources [nrg_ind_ren]

Country specific targets for share of energy from renewable energy sources in gross final consumption of energy in 2030 are still under development.

2.7.3 Energy efficiency

In 2012, under the Energy Efficiency Directive 2012/27/EU², EU set a 20% energy efficiency target by 2020 (when compared to the projected use of energy in 2020). In concrete terms, this means lowering EU's final energy consumption to no more than 1,086 million tons of oil equivalent (Mtoe) and primary energy consumption to no more than 1,483 Mtoe.

To achieve this, EU countries were required to set their own indicative national energy efficiency targets.

In December 2018, the revised Energy Efficiency Directive³ entered into force (amending Directive EU (2018/2002) updating some specific provisions and introducing new elements. Above all, it establishes a headline EU energy efficiency target for 2030 of at least 32.5% (compared to projections), with a clause for a possible upwards revision by 2023. The 32.5 % target for 2030 translates into final energy consumption of 956 Mtoe and/or primary energy consumption of 1,273 Mtoe in EU-28 (see

² Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency

³ Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December 2018 amending Directive 2012/27/EU on energy efficiency.

Item 32.

Item 32: Summary of energy efficiency EU-28 targets for 2020 and 2030

| | EU-28 2020 targets | EU-28 2030 targets |
|----------------------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Improvement in energy efficiency | 20% improvement in energy efficiency | at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |
| Primary energy consumption | < 1,483 Mtoe | < 1,273 Mtoe (< 1,128 Mtoe EU-27) |
| Final energy consumption | < 1,086 Mtoe | < 956 Mtoe (<846 Mtoe EU-27) |

Source: EU website

The reported primary energy production for 2018 was equal to 1,375.7 Mtoe. Comparing to the primary energy consumption target for 2020 for EU-28 countries one can conclude that the target will be achieved. An effort is necessary to meet EU-28 target for 2030.

The reported final energy consumption for 2018 was equal to 989.4 Mtoe. Comparing to the primary energy consumption target for 2020 for EU-28 countries one can conclude that the target will be achieved. An effort is necessary to meet EU-28 target for 2030.

The country specific targets for primary and final energy consumption for 2020 are listed in

Item 33. Specific country targets for 2030 have not made available yet.

Item 33: Summary of country specific energy efficiency targets for 2020

| EU Member State | Absolute level of energy consumption in 2020 [Mtoe] as notified from Member States in 2013, in the NEEAP 2014, Annual Reports or in separate notifications to the European Commission in 2015 and 2016 | |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| | Primary energy consumption | Final energy consumption |
| Austria | 31,5 | 25,1 |
| Belgium | 43,7 | 32,5 |
| Bulgaria | 16,9 | 8,6 |
| Croatia | 11,15 | 7 |
| Cyprus | 2,2 | 1,8 |
| Czech Republic | 39,6 | 25,3 |
| Denmark | 17,4 | 14,4 |
| Estonia | 6,5 | 2,8 |
| Finland | 35,9 | 26,7 |
| France | 219,9 | 131,4 |
| Germany | 276,6 | 194,3 |
| Greece | 24,7 | 18,4 |
| Hungary | 24,1 | 14,4 |
| Ireland | 13,9 | 11,7 |
| Italy | 158 | 124 |
| Latvia | 5,4 | 4,5 |
| Lithuania | 6,5 | 4,3 |
| Luxembourg | 4,5 | 4,2 |
| Malta | 0,7 | 0,5 |
| Netherlands | 60,7 | 52,2 |
| Poland | 96,4 | 71,6 |
| Portugal | 22,5 | 17,4 |
| Romania | 43 | 30,3 |
| Slovakia | 16,4 | 9 |
| Slovenia | 7,3 | 5,1 |
| Spain | 119,8 | 80,1 |
| Sweden | 43,4 | 30,3 |
| United Kingdom | 177,6 | 129,2 |
| Sum of indicative targets EU-28 | 1,528.3 | 1077.1 |
| Sum of indicative targets EU-27* | 1,348.7 | 947.9 |

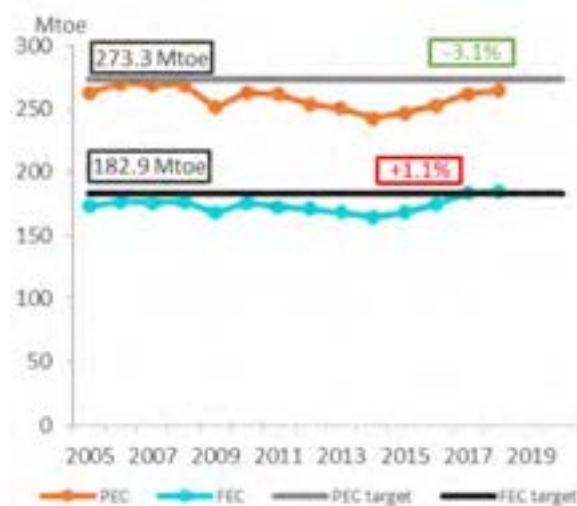
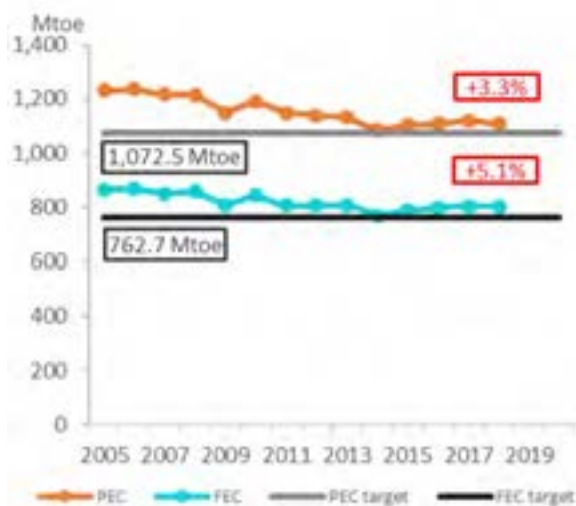
Source: EU website * - recalculated by the Author

The primary energy production in EU-11 countries was above target of 1,072.5 Mtoe by +3.3% whereas EU-11 countries were below their common target of 273.3 Mtoe by -3.1%. In case of final energy consumption, EU-14 member states and EU-14 were both above the targets - +5.1% for EU-14 countries and +1.1% for EU-11. One should remember that the targets for EU-25 are for illustration purposes. The binding targets were set for EU as a whole and for specific countries.

Item 34: Energy efficiency target data for EU-14 countries

Primary energy consumption and final energy consumption in EU-14 countries in 2005-2018 and targets for 2020

Primary energy consumption and final energy consumption in EU-11 countries in 2005-2018 and targets for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Primary energy consumption - Primary energy consumption (Europe 2020-2030) (PEC2020-2030), final energy consumption - Final energy consumption (Europe 2020-2030) (FEC2020-2030). EU-25 data estimated based on Eurostat data

Country specific targets for 2030 in energy efficiency improvements have not been communicated yet.

Conclusions

- EU wide targets of greenhouse gas emissions reduction, energy efficiency improvements and increase of share of renewable energy sources were achieved in 2017/2018 results. The final check will be performed based on 2020 data.
- The country specific targets in all three areas have not yet been achieved in all countries based on 2018 data. It relates both to EU-25 countries.
- EU wide targets of greenhouse gas emissions reduction, energy efficiency improvements and increase of share of renewable energy sources for 2030 are still to be achieved.
- The country specific targets for 2030 have not been fully communicated yet.

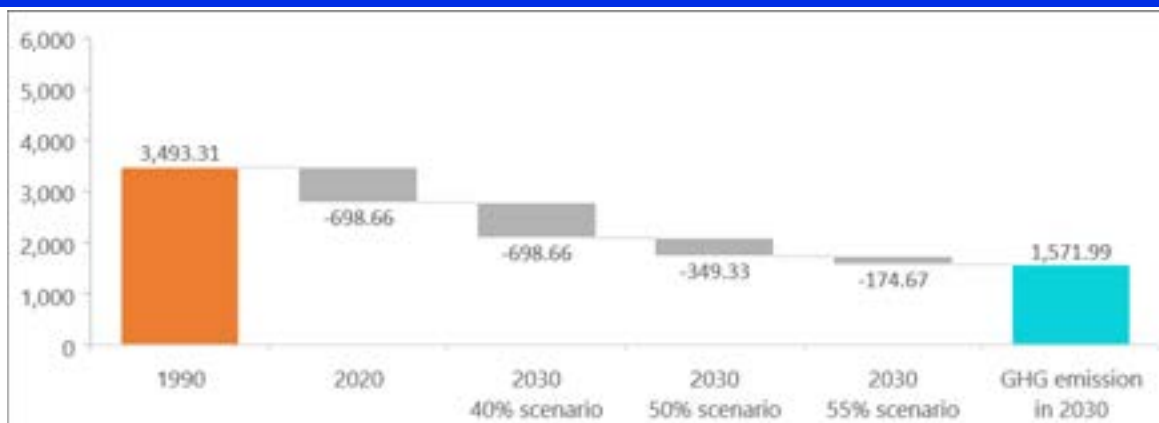
2.8 Overview of up-to-date information regarding “Green Deal”

At the current stage of discussions regarding the European Green Deal only partial information are available regarding the future targets. EU is proposing to increase the greenhouse gas emission reduction to 50% or 55% for 2030. This is a proposition included in the draft proposal of “Climate Law”. Assuming EU-14 countries greenhouse gas emissions in 1990, an estimation of EU 2030 target emissions can be drafted. The 2020 target of 20% reduction resulted in 698.66 Mt CO₂ emission drop. Further increase of the target to 40% in 2030 require additional 698.66 Mt CO₂ reduction. If the 50% target proposed under European Green Deal is applied then additional 349.33 Mt CO₂ emission decrease is needed, or 524.00 Mt CO₂ decrease, if 55% target is adopted.

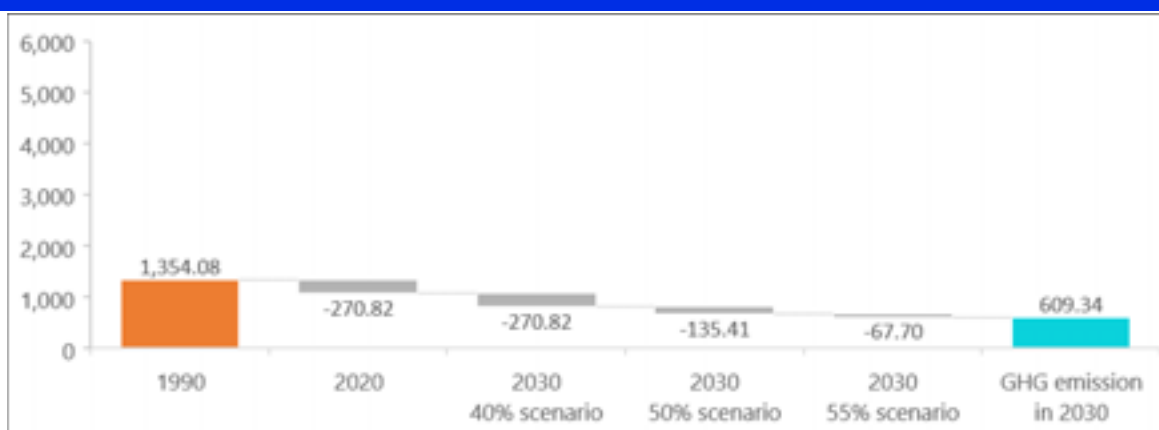
The reduction levels for EU-11 are proportional to the level of greenhouse gas emissions in 1990, as the percentages are the same.

Item 35: Estimation regarding greenhouse gas emissions in EU-25 under different scenarios (Mt CO₂)

Estimation regarding greenhouse gas emissions in EU-14 under different scenarios (Mt CO₂)



Estimation regarding greenhouse gas emissions in EU-11 under different scenarios (Mt CO₂)



Source: Eurostat data for 2018, extracted in 2020. Estimations delivered by the Author

Nevertheless, it is worth to highlight that, if the current structure of greenhouse gas emissions target is maintain, then the 50% target for 2030 is an EU wide target. It is not a binding element for specific countries. Country specific targets could be expected as per ESD and ESR but there is no way to anticipate the potential targets.

At the same time, the review of key EU regulations around climate and energy as:

- Emissions Trading System Directive;
- Effort Sharing Regulation;
- Land use, land use change and forestry Regulation;
- Energy Efficiency Directive;
- Renewable Energy Directive;
- CO₂ emissions performance standards for cars and vans
- Energy Taxation Directive

can bring some additional targets in area of share of energy from renewable energy sources and energy efficiency. For the moment, any estimation of potential targets is not available nor possible to estimate.

Conclusions

- Very few information is available up to date about the details of the Green Deal Strategy. Especially there is no information about country specific targets. Any estimations are based on assumptions and guesses.
-



3 Austria

3.1 General information

Austria is the ninth biggest country within EU-14 group in terms of total country area and represents 2.7% of the area. At the same time, it is the 13th country in EU-27 with 2.2% of the area. It represents 2.6% of EU-14 population and 2.0% of EU-27 population, but 3.2% of its total nominal GDP of EU-14 and 2.9% of EU-27. Due the robust economic growth in 1995-2018 period, in 2018 Austrian GDP per capita amounted to 111% of the whole EU average (110% in 1995).

Item 36: Austria - key data



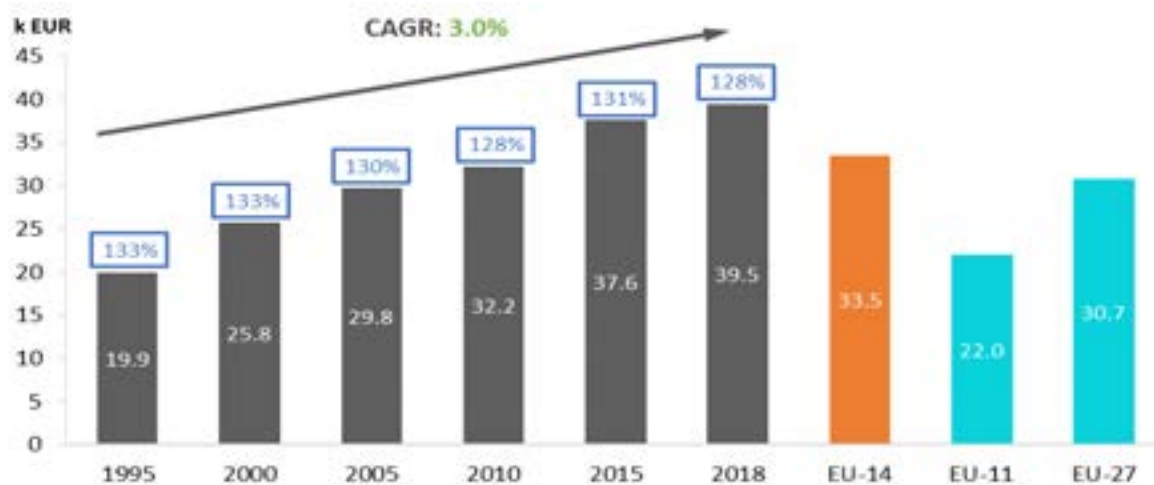
Key data

| | |
|------------------------------------------------------|--------|
| Population (M) | 8.8 |
| GDP per capita (EUR, nominal) | 43,640 |
| GDP per capita (EUR, PPS) | 39,450 |
| GDP as share of EU-14 | 3.0% |
| GDP as share of EU-27 | 2.9% |
| Energy intensity of the economy (kgoe per 1,000 EUR) | 99.7 |
| Greenhouse gas emissions (Mg per capita) | 9.4 |

Source: Eurostat data for 2018, extracted in 2020

With the compounded annual growth rate amounting to 3.0% Austrian economy considerably grew in the period of 1995-2018 (see Item 37). Its GDP per capita was above EU-14 and EU-27 averages (equal to 118% and 128% of the respective averages). Its GDP per capita was also 179% of the average GDP per capita for EU-11 countries.

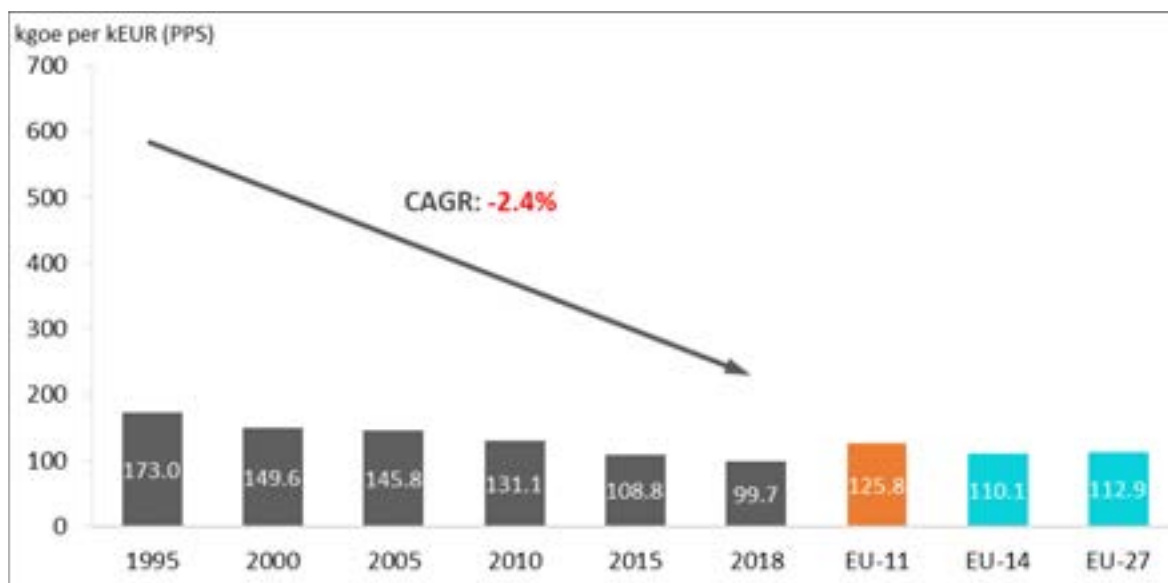
Item 37: GDP per capita in Austria for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in 2018 (kEUR, PPS) and share of Austria GDP per capita in relation to EU-27 average



Source: Eurostat data for 2018, extracted in 2020. Detail references: GDP per capita - Gross domestic product at market prices (B1GQ), Current prices, purchasing power standard per capita (CP_PPS_HAB)

The Austrian economy energy intensity was about 99.7 kgoe per 1,000 EUR PPS in 2018, thanks to a decrease of the energy intensity indicator during the years 1995-2018. It dropped by 73.3 kgoe per 1,000 EUR PPS, i.e. it was reduced by about 42%. The energy intensity of Austria in 2018 represented 91% and 88% of EU-14 and EU-27 averages. At the same time, it represented 79% of EU-11 average.

Item 38: Energy intensity of the economy in Austria in 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)



Source: Eurostat data for 2018, extracted in 2020. Values for EU-25 were recalculated based on energy intensity and GDP data from Eurostat. Detail references: Energy intensity of GDP in purchasing power standards (PPS) - EI_GDP_PPS

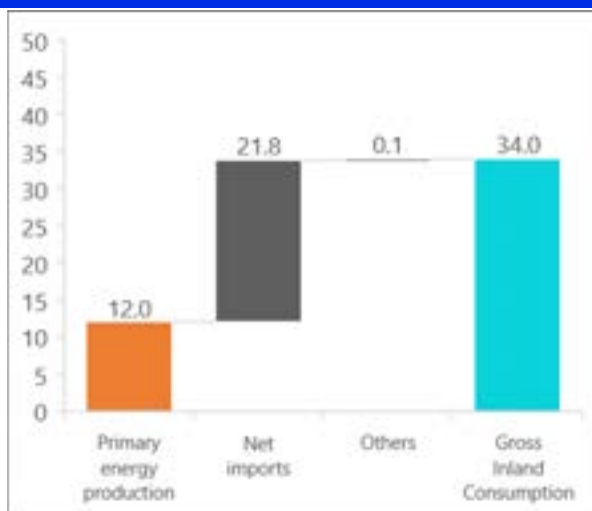
3.2 Energy balance of Austria

The energy balance of Austria in 2018 is presented in Item 39. The primary energy production in Austria was equal to 12 Mtoe in 2018. Net imports added 21.8 Mtoe to the balance. The total gross inland consumption accounted for 34.0 Mtoe. The level of import of energy to Austria grew slowly during last 23 years from less than 20 Mtoe to a little more than this. At the same time the level of net import reported to the energy needs decreased slowly and it was about 65%.

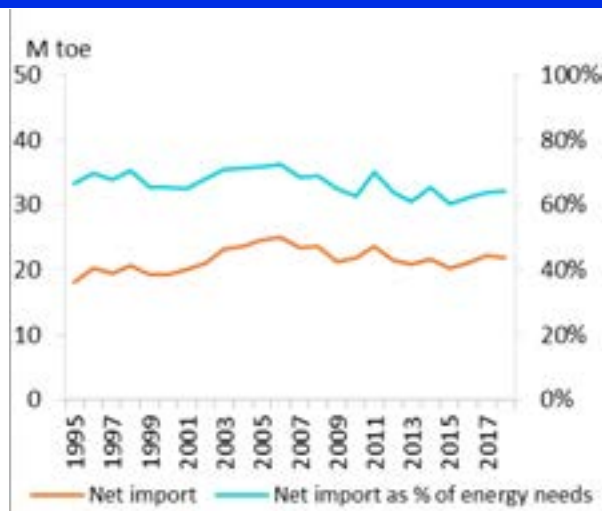
The primary energy production increased over past 23 years, as well as gross energy consumption. National production was meeting only 35% of the country gross consumption and this factor increased over last 23 years from 32%.

Item 39: Energy balance in Austria

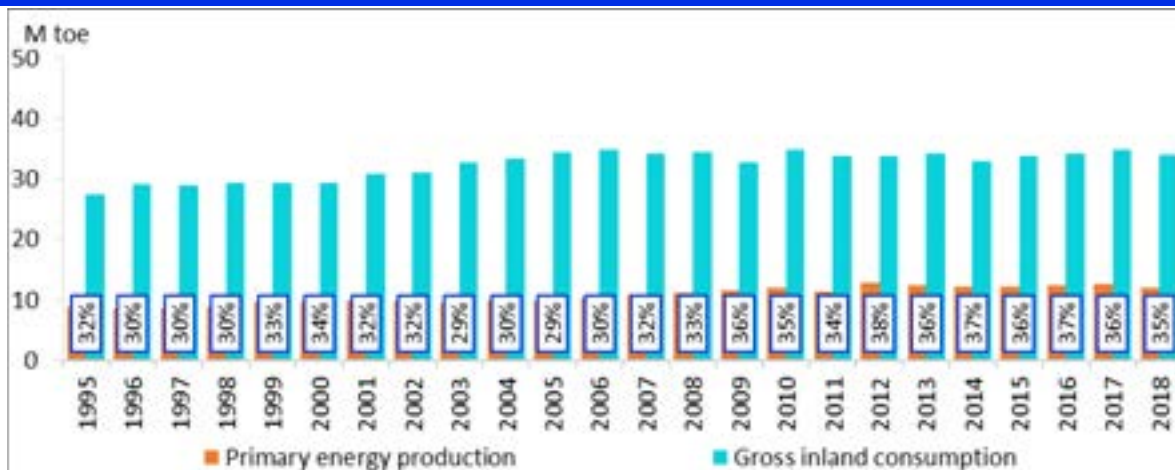
Energy balance in Austria in 2018 (Mtoe)



Net import of energy in Austria in 1995-2018 (Mtoe and as percentage of GIC)



Gross inland consumption, primary energy production (Mtoe) and ratio of primary energy production to gross inland consumption in 1995-2018 in Austria (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Gross inland consumption - GIC. Net imports = Import (IMP) - Export (EXP), Other = Change in stock (STK-CHG) - International maritime bunkers (INTMARB)

The primary energy production in Austria was dominated by renewable energy sources. About 82% of the total production came from RES. The mix was completed by 6% share of oil and 7% share of gas in the mix. Usage of solid fuels and nuclear energy was null.

When compared to the European averages, Austria was characterized by very high share of renewable energy sources in the energy mix - 82% versus 38% EU-14 average and 34% EU-27 average. The share of gas in the Austrian fuel mix was a little lower than in EU-14 and EU-27 (7% versus 9% in EU-14 and EU-27). At the same time, the share of oil was higher in Austria than the averages for EU-14 and EU-27 (6% versus 4% and 5%). In opposite to EU averages Austria was not using solid fuels and nuclear energy for primary energy production.

The comparison of Austria to EU-11 averages was mainly characterized by much higher share of RES (82% versus 22%), lack of solid fuels use in Austria (versus 45% in EU-11) and absence of nuclear energy in the energy mix (15% in EU-11). The shares of oil and gas were similar in both Austria and EU-11.

Item 40: Primary energy structure in Austria

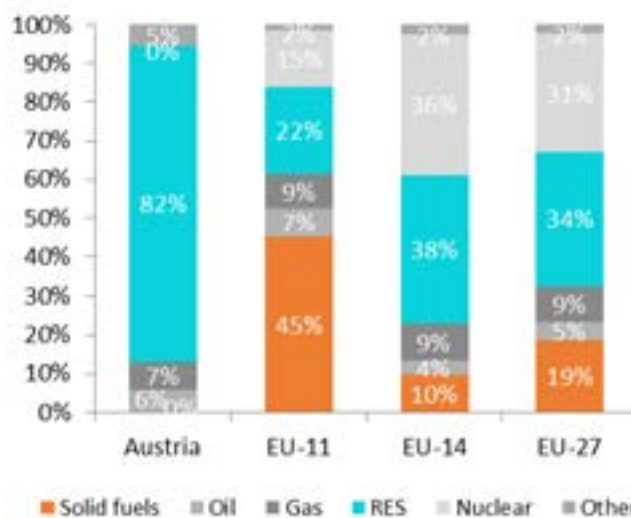
Primary energy structure in Austria in 2018 (%)



Total: 12.0 Mtoe

Legend: Solid fuels, Oil, Gas, RES, Nuclear, Other

Primary energy production structure in Austria in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

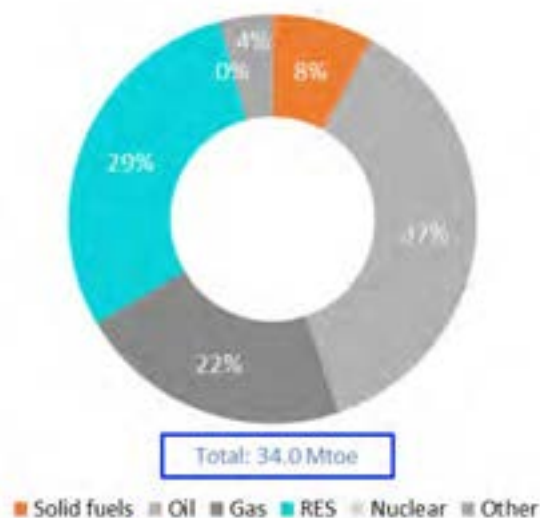
Gross inland consumption of energy in Austria was dominated by oil (37%), gas (22%) and renewable energy sources (29%). The mix was completed by 8% of solid fuels and 4% of other energy sources.

Comparing to European averages gross inland consumption of energy in Austria was marked by low share of solid fuels (8% versus 11% in EU-14 and 14% in EU-27). The share of oil was higher in Austria (37%) than in EU-14 (35%) and EU-27 (34%) whereas the share of gas was almost the same (22-23%). Austria was characterized by much higher share of renewable energy sources in the mix - 29% versus 16% and 15% in EU-14 and EU-27 respectively, and lack of nuclear energy in the mix (versus 14% in EU-14 and 13% in EU-27).

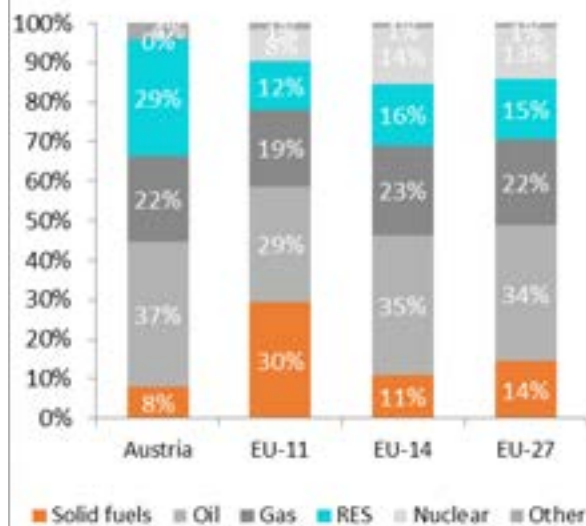
When compared to EU-11 the main difference was around much lower share of solid fuels consumption in Austria (8% versus 30% in EU-11) and higher share of renewable energy sources (29% versus 12%). The share of gas and oil use in Austria were also higher than in EU-11 countries (37% versus 29% and 22% versus 19% respectively). EU-11 average gross final consumption included nuclear energy at 8%. Austria was not using nuclear energy.

Item 41: Gross inland consumption structure in Austria

Gross inland consumption structure in Austria in 2018 (%)



Gross inland consumption structure in Austria in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gross inland consumption – GIC, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion)(O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear – Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

The final energy consumption in Austria was dominated by oil (37%), followed by electricity (21%), gas (19%) and renewable energy sources (16%). The mix was completed by heat (6%) and solid fuels (1%).

The sectoral final energy consumption in Austria was characterized by higher share of industrial and transport sectors than in EU-14 and EU-27 (30% and 34% versus 26% and 31% in EU-14 and EU-27). The share of commercial and public services was lower in final energy consumption in Austria (10%) than in EU-14 (15%) and EU-27 (14%).

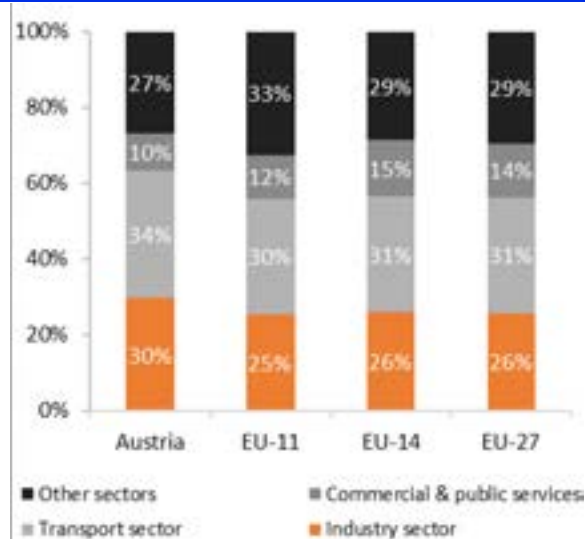
When compared to EU-11 Austria the same conclusions as related to EU-14 and EU-27 can be drawn.

Item 42: Final energy consumption structure in Austria

Final energy consumption structure in Austria in 2018 (%)



Final energy consumption structure in Austria in 2018 in comparison with EU-11, EU-14, and EU-27 averages



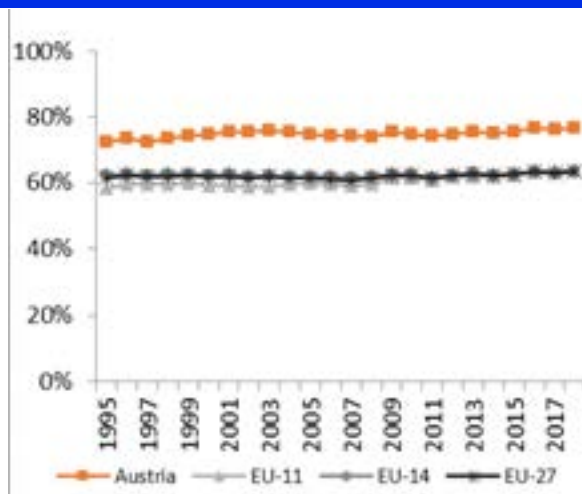
Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Heat (H8000), Electricity (E7000), Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial & public services - FC_OTH_CP_E, Other - FC_OTH_E-FC_OTH_CP_E. Errors in summation to 100% are due to rounding

Austrian final energy consumption to gross inland consumption ratio which measure energy efficiency was higher than the averages for EU-11, EU-14 and EU-27. The situation remained stable for last 23 years.

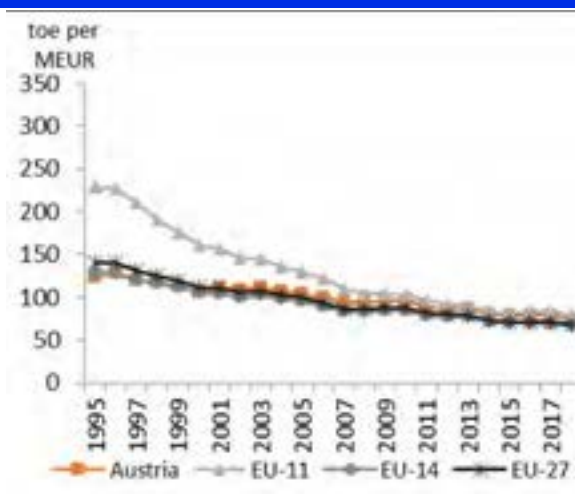
Simultaneously, a decrease of energy volume associated with generating gross domestic product was noticed in line with the averages for EU-14 and EU-27 averages.

Item 43: Final energy consumption in Austria in relation to selected indicators

Final energy consumption to gross inland consumption ratio in Austria in 1995-2018 (%)



Final energy consumption to gross domestic product ratio in Austria in 1995-2018 in comparison with EU-11, EU-14, and EU-27 averages (toe per M EUR)



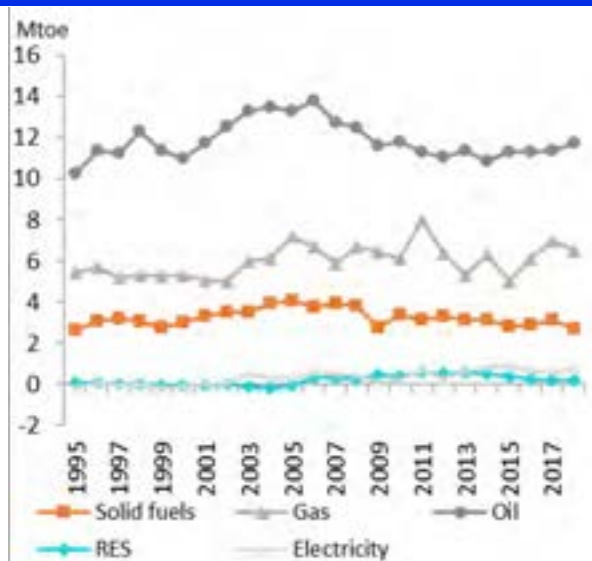
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final energy consumption - FEC, Gross inland consumption - GIC, Gross Domestic Product - Gross domestic product at market prices B1GQ, Current prices - CP-MEUR

Net import of energy to Austria by fuels remained generally stable. A slow increase of oil and gas imports can be observed. The import of electricity and renewable energy sources increased of last 23 years too.

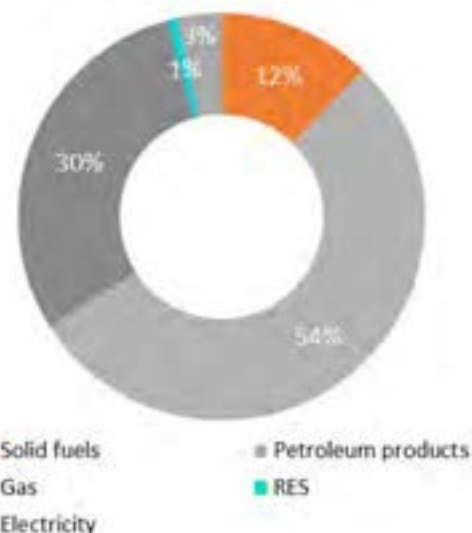
The import structure of energy to Austria was dominated by oil (54%) and gas (30%). The imports were completed by 12% of solid fuels, 3% of electricity and 1% of renewable energy sources.

Item 44: Net import of energy in Austria

Net import of energy by fuel in 1995-2018 (Mtoe)



Net import structure in 2018 (% only fuels for which import is greater than export)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Electricity (E7000). Errors in summation to 100% are due to rounding

Solid fuels were imported to Austria mainly from Poland (51%), Czech Republic (14%), USA (13%) and several other countries.

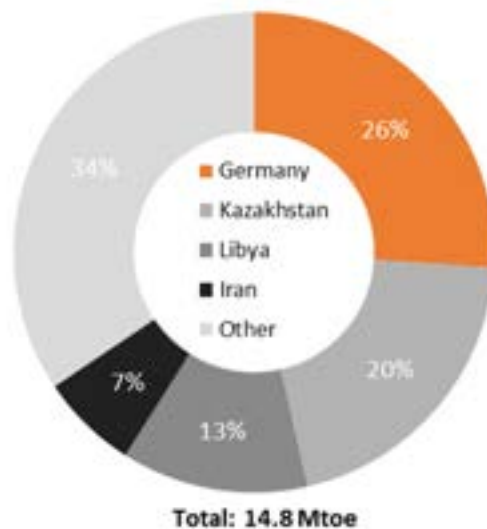
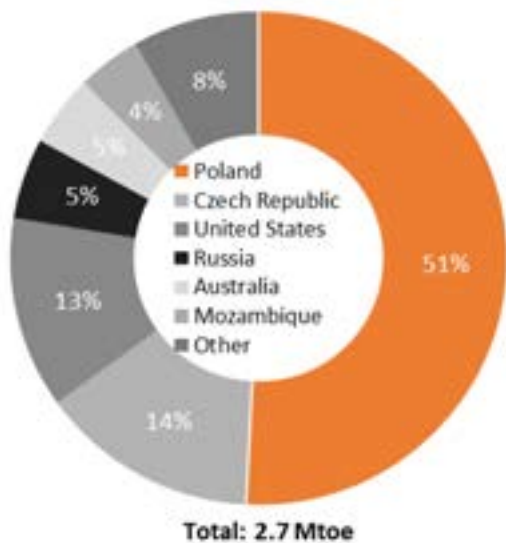
Main oil importers to Austria were Germany (26%), Kazakhstan (20%) and Libya (13%). The remaining 41% were imported from various locations.

Austria was not specifying where gas was imported from.

Electricity was mainly imported from Germany (54%) and Czech Republic (39%). Smaller amounts were imported from Switzerland, Hungary, Slovenia, and Italy (total of 7%).

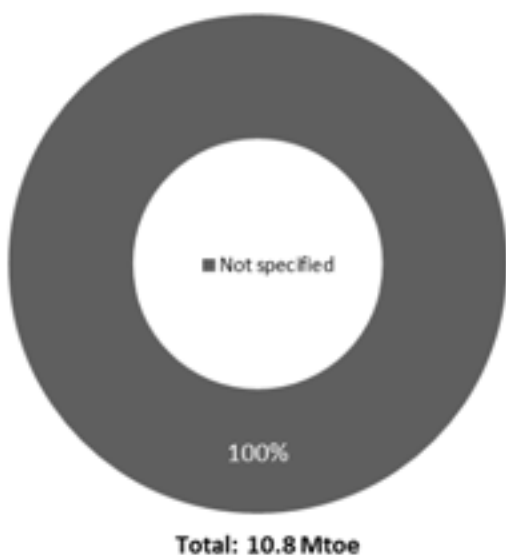
Item 45: Foreign fuel suppliers

Foreign suppliers of solid fuels in Austria in 2018 (%) Foreign suppliers of crude oil in Austria in 2018(%)



Foreign suppliers of gas in Austria in 2018 (%)

Foreign suppliers of electricity in Austria in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fossil fuels - C000X0350-0370, Gas - Natural gas (G3000), Oil - Oil and petroleum products (excluding biofuel portion) (O4000XBIO), Electricity - E7000. Errors in summation to 100% are due to rounding

3.3 Greenhouse gas emissions

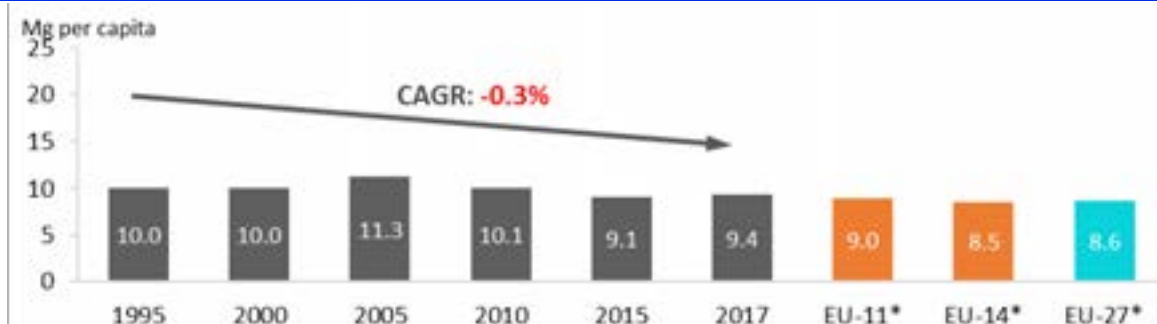
Between 1995-2017 greenhouse gases emissions in Austria were increased - from over 78.7 Mt CO₂ in 1995 to 82.3 Mt CO₂ in 2017, but average emissions per capita decreased to 9.4 Mg CO₂ per capita in 2017 (from 10.0 Mg CO₂ per capita in 1995), which was higher comparing to EU-14 and EU-27 averages (8.5 Mg CO₂ per capita and 8.6 Mg CO₂ per capita, respectively), and also higher than in EU-11 (9.0 Mg CO₂ per capita)

There were some noteworthy changes in the Austrian structure of greenhouse gas emissions over the period considered. The significance of waste management and other emissions dropped swiftly by 59% and 36%, as well as emissions from energy industries 15%. On other hand, transport emissions and industrial processes gained in importance increasing by 53% and 26% respectively.

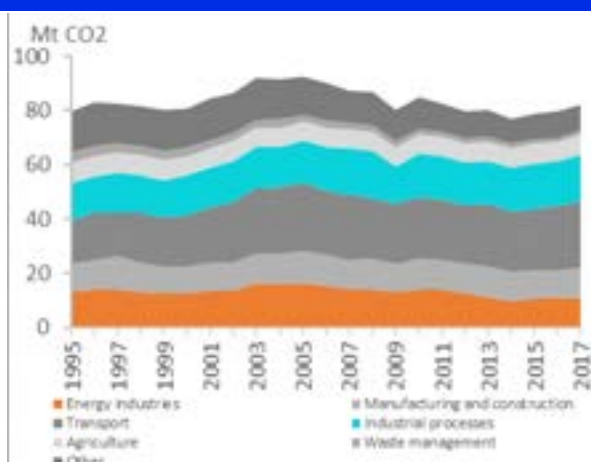
Comparing to EU-11, EU-14 and EU-27 countries, Austria was characterized by higher share of emissions from transport (29% versus 17%, 23% and 21%). The share of GHG emissions linked to energy industries was at EU-27 levels.

Item 46: Greenhouse gas emissions in Austria

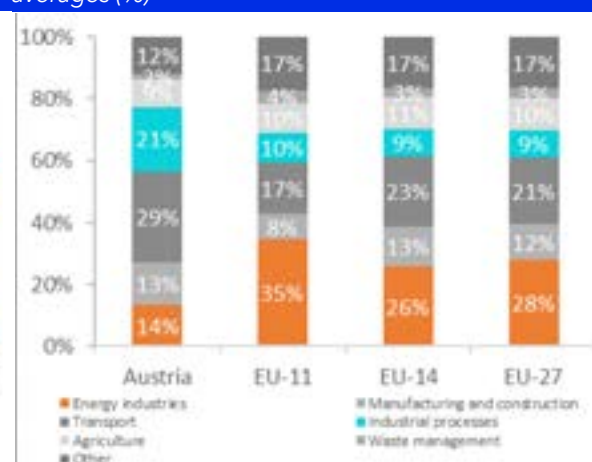
Greenhouse gas emissions per capita in Austria in 1995-2017 in comparison with EU-11, EU-14 and EU-27 averages in 2017 (Mg per capita)



Greenhouse gas emissions in Austria by sectors in 1995-2017 (Mt CO₂)



Greenhouse gas emissions in Austria by sectors in 2017 in comparison with EU-11, EU-14 and EU-27 averages (%)



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - * values for EU-11, EU-14 and EU-27 recalculated by the Author; Energy industry - Fuel combustion in energy industries (CRF1A1), Manufacturing and construction - Fuel combustion in manufacturing industries and construction (CRF1A2), Transport - Fuel combustion in transport (CRF1A3), Industrial processes - Industrial processes and product use (CRF2), Agriculture - Agriculture (CRF3), Waste management - Waste management (CRF5), Other = Other fuel combustion sectors (CRF1A4)+ Other fuel combustion sectors n.e.c. (CRF1A5) + Fuels

- fugitive emissions (CRF1B)+Other sectors (CRF6); Total GHG emissions equal to All sectors (excluding LULUCF and memo items) (CRF1-6X4_MEMO) i.e. emission from all sectors excluding Land use, land use change, and forestry (LULUCF), Transport and storage of CO₂ (memo item), International aviation (memo item), International navigation (memo item), Multilateral operations (memo item), Biomass - CO₂ emissions (memo item). Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. Errors in summation to 100% are due to rounding

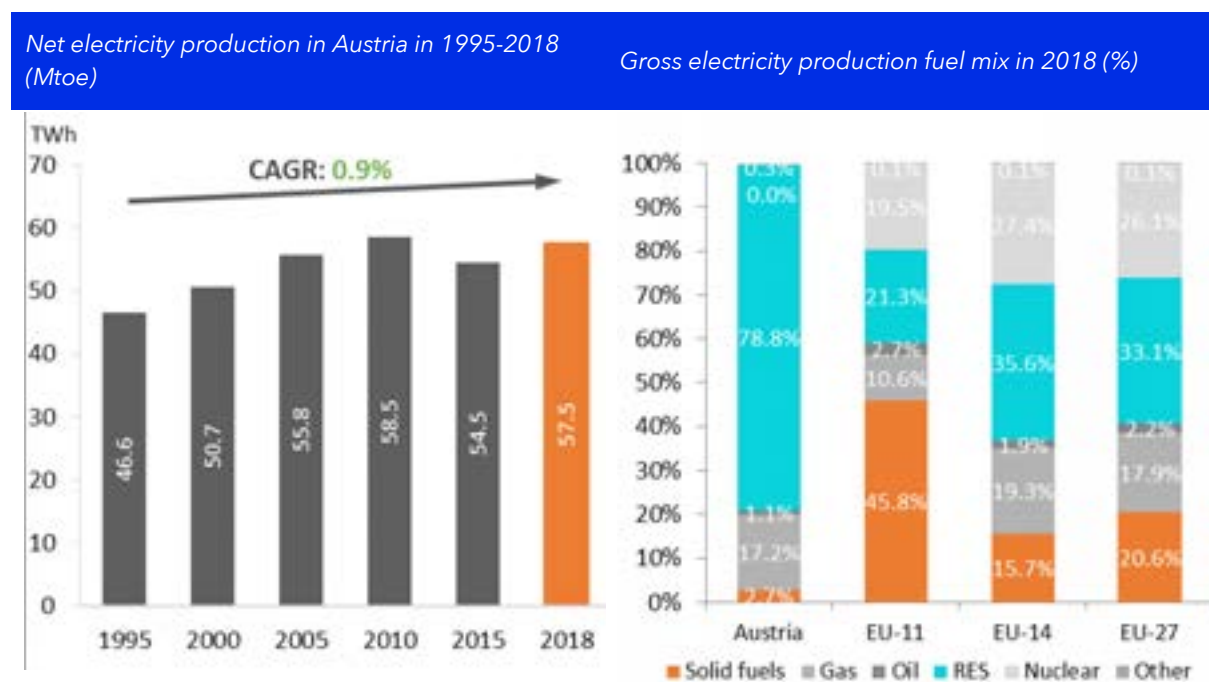
3.4 Overview of electricity sector

Item 47 presents electricity production and the current fuel mix of Austria. Over last 23 years net electricity production increased from 46.6 TWh in 1995 to 57.5 TWh in 2018 (CAGR 0.9%). As visible, net electricity production represented 2.7% of EU-14 total electricity production, which was lower compared to Austrian GDP share of 3.2%.

The Austrian fuel mix was dominated by renewable energy sources with shares of 78.8%. The mix was completed by 17.2% of gas and small shares of solid fuels (2.7%) and oil (1.1%). Compared to EU-14 and EU-27 countries, Austria had a much bigger share of renewable energy sources in its energy mix. On other hand, the country produced relatively less electricity from solid fuels, gas, and oil, respectively 2.7%, 17.2% and 1.1%.

When compared to EU-11 average fuel mix one can notice much higher share of renewable energy sources used in Austria than in EU-11 (78.8% versus 21.3%) and significantly lower use of solid fuels (2.7% versus 45.8%). The share of gas was higher in Austria (17.2% versus 10.6%) but the share of oil was lower (1.1% versus 2.7%). Austria was not using nuclear energy for electricity generation in opposite to EU-25 averages where the share of nuclear was 19.5% and 27.4% respectively.

Item 47: Net electricity production and gross electricity production fuel mix in Austria



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Electricity Production - NEP, Gross Electricity Production - GEP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding

biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

In Item 48 the evolution of final per capita consumption of electricity and its breakdown by economic sector are presented. In recent years final consumption of electricity in Austria increased (CAGR in the period of 1995-2019 was around 0.9%) and its level was higher compared to EU-14 and EU-27 countries. Austrian final energy consumption per capita represented 115.9% of EU-14 level and 127.0% of EU-27 level.

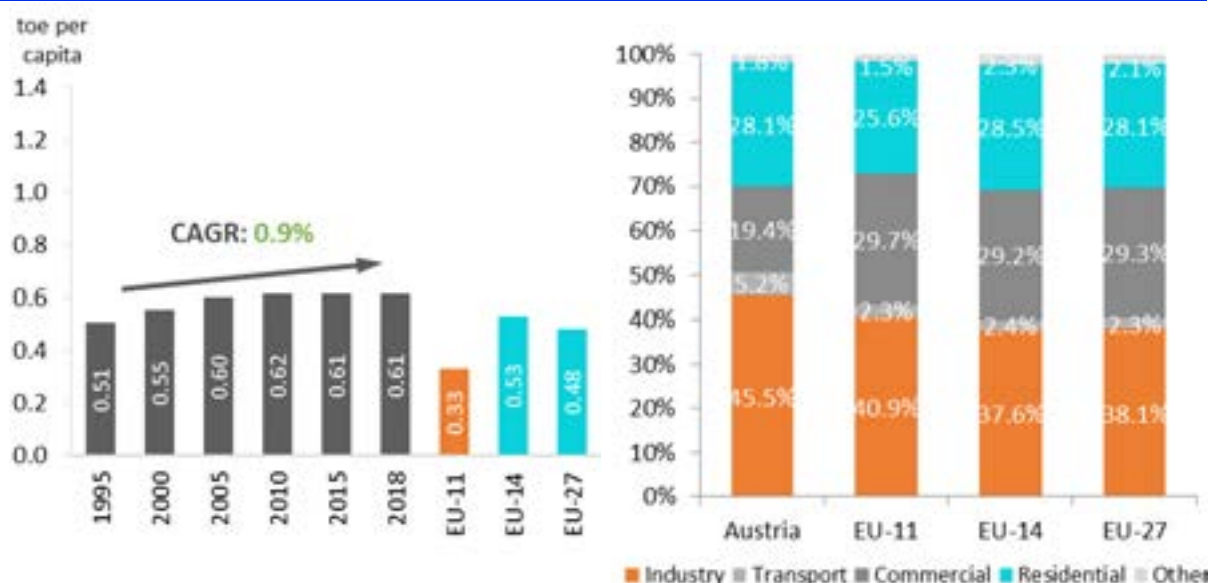
The structure of final electricity consumption in Austria was dominated by industry (45.5% versus 37.6% in EU-14 countries). Relatively more energy was used in transport (5.2% versus 2.4%) and less in commercial and residential sectors (19.4% and 28.1% versus 29.2% and 28.5%).

Austria was consuming relatively more electricity in industry sector than EU-11 countries (45.5% versus 40.9%) and transport (5.2% versus 2.3%). At the same time, it used relatively less electricity in residential and commercial sectors (28.1% and 19.4% versus 25.6% and 29.7%).

Item 48: Final consumption of electricity in Austria

Final consumption of electricity per capita in Austria (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Final consumption of electricity in Austria by sectors in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Electricity E7000. Errors in summation to 100% are due to rounding

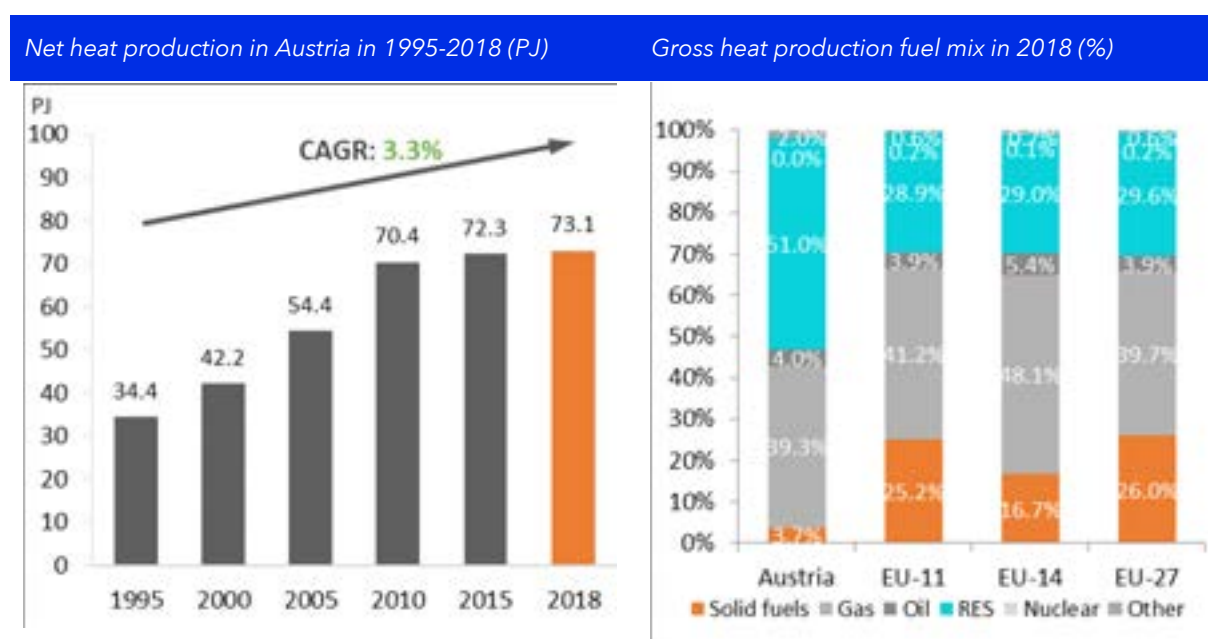
3.5 Overview of heat sector

Item 49 presents heat production and the current fuel mix of Austria. Over last 23 years net heat production increased from 34.4 PJ in 1995 to 73.1 PJ in 2018 (CAGR 3.3%).

The Austrian fuel mix of heat production was dominated by renewable energy sources with share of 51.0% and gas with share of 39.3%. The mix was completed by 3.7% of solid fuels and 4.0% of oil. Compared to EU-14 and EU-27 countries, Austria had a much bigger share of renewable energy sources in its heat production mix. On other hand, the country produces relatively less heat from solid fuels and oil, respectively 3.7% and 4.0%. The share of gas was also lower – 39.3% versus 48.1% in EU-14. Austria did not use nuclear energy for heat production where some heat was produced in nuclear facilities in EU-14 countries (0.1%).

When compared to EU-11 average fuel mix one can notice much higher share of renewable energy sources used in Austria than in EU-11 (51.0% versus 28.9%) and significantly lower use of solid fuels (3.7% versus 25.2%). The share of gas was lower in Austria (39.3% versus 41.2%) but the share of oil was higher (4.0% versus 3.9%). Austria was not using nuclear energy for heat generation in opposite to EU-11 where the share of nuclear was 0.2%.

Item 49: Net heat production and gross electricity production fuel mix in Austria



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Heat Production - NHP, Gross Heat Production - GHP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

Item 50 presents final heat consumption per capita and its breakdown by sectors.

The per capita demand for heat in Austria increased from 0.11 toe per capita in 1995 to 0.19 toe per capita in 2018. As a result, within the 23 years analyzed, heat consumption per capita increased at CAGR of 2.6%. The heat consumption remained higher than the

averages for EU-11, EU-14 and EU-27, respectively 0.13 toe per capita, 0.10 toe per capita and 0.10 toe per capita.

The structure of final consumption of heat in Austria was characterized by higher share of commercial (38.5% compared to 21.3% in EU-14) and higher residential usage (45.3% compared to 40.1% in EU-14). The share of industry in heat consumption was lower than the averages (15.6% compared to 37.9% in EU-14).

In relation to EU-11 countries, the structure of final heat consumption in Austria was characterized by lower share of residential sector (45.3% versus 60.5%) and higher share of commercial sector (38.5% versus 19.3%). The industrial use of heat consumed 15.6% of it in Austria whereas 19.7% in EU-11.

Item 50: Final consumption of heat in Austria

Final consumption of heat per capita in Austria (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Final consumption of heat in Austria by sectors in 2018 (%)



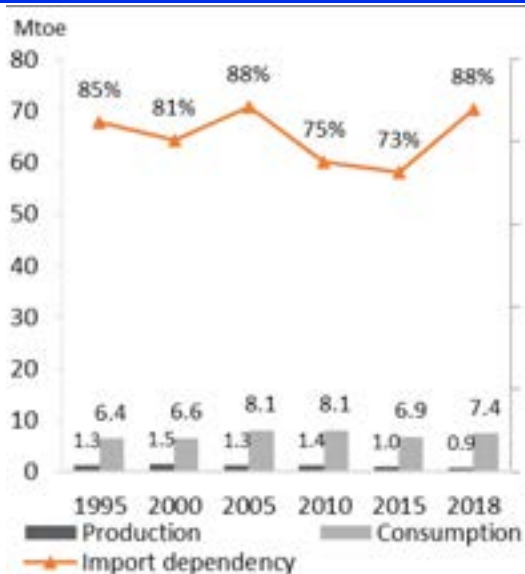
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Heat H8000. Errors in summation to 100% are due to rounding

3.6 Overview of gas sector

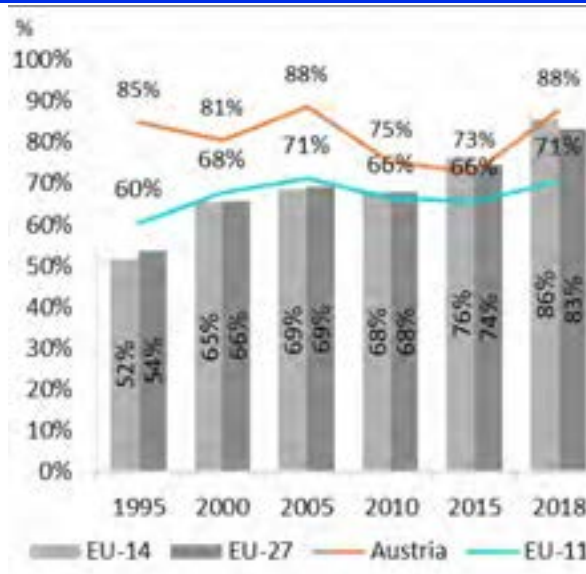
Austria consumed 7.4 Mtoe of gas in 2018. It increased from 1995 to 2010 and then decreased. National production accounted for 0.9 Mtoe and it decreased over past 23 years from 1.3 Mtoe to the current value. The remaining part of gas was imported. The country dependency on import was fluctuating from 73% to 88% over past 23 years. In 2018 the country was more dependent on import than EU-11, EU-14 and EU-27 average values.

Item 51: Gas sector in Austria

Gas production, gross consumption and import dependence in Austria in 1995-2018 (Mtoe)



Gas Import dependence in Austria and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gas production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Natural Gas G3000

The final consumption of gas per capita in Austria increased from 0.43 toe per capita to 0.53 toe per capita over past 23 years. This value was higher than the average values for EU-14, EU-11 and EU-27 countries.

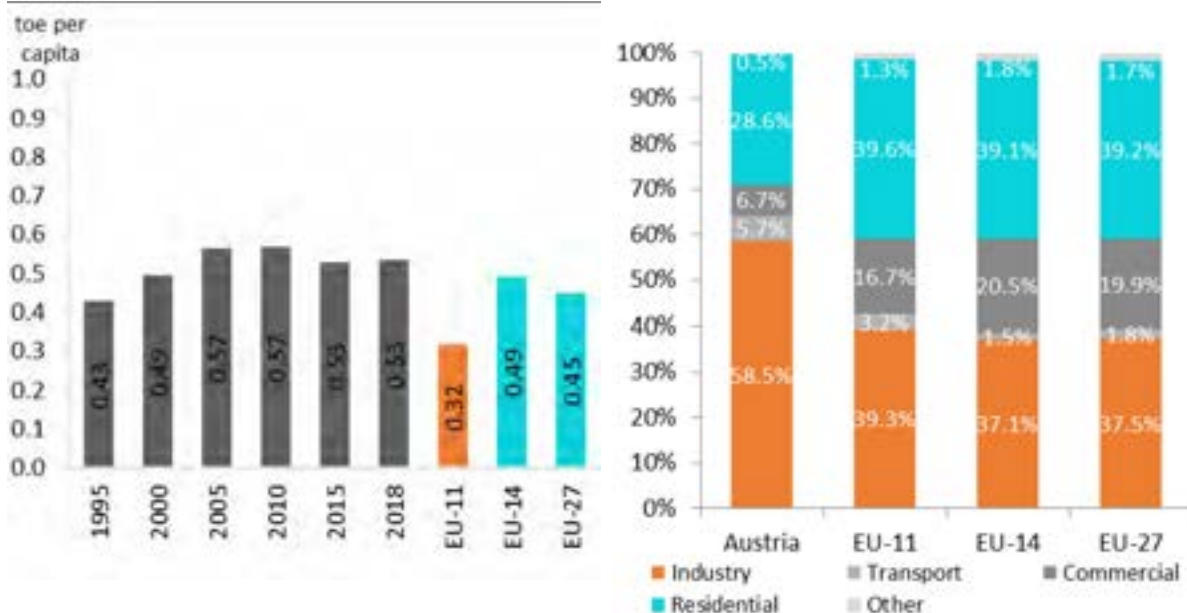
The structure of final gas consumption in Austria in 2018 was characterized by high share of industry - 58.5% versus 37.1% in EU-14. The share of use of gas in transport, commercial and residential applications were lower than the averages for EU-14 countries.

When compared to EU-11 countries, Austria was using relatively more gas industry than EU-11 countries - 58.5% versus 39.3%. The country was also using more gas in transport - 5.7% versus 3.2%. On other hand, the share of gas used in commercial and residential sectors was lower than in EU-11 countries, 6.7% versus 16.7% and 28.6% versus 39.6% respectively.

Item 52: Final consumption of gas per capita in Austria in 1995-2018 and gas final consumption by sectors in Austria and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of gas per capita in Austria (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Gas final consumption by sectors in Austria and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Natural Gas G3000. Errors in summation to 100% are due to rounding

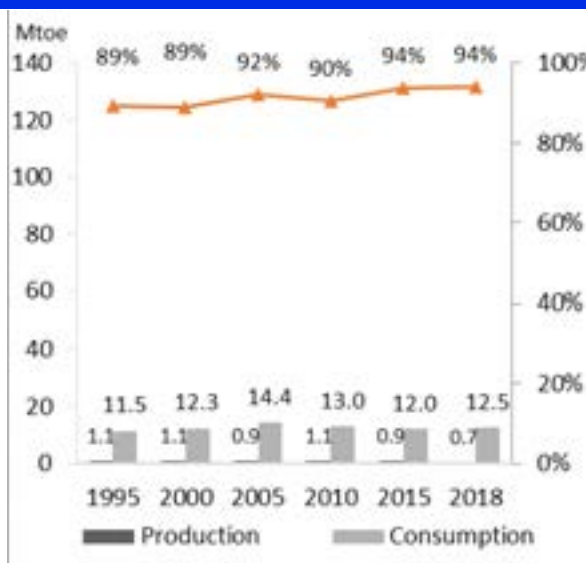
3.7 Overview of oil sector

The oil consumption of Austria grew from 11.5 Mtoe in 1995 to 12.5 Mtoe in 2018. At the same time the national production dropped from 1.1 Mtoe to 0.7 Mtoe. Therefore, the level of import dependency was high - between 89% and 94%.

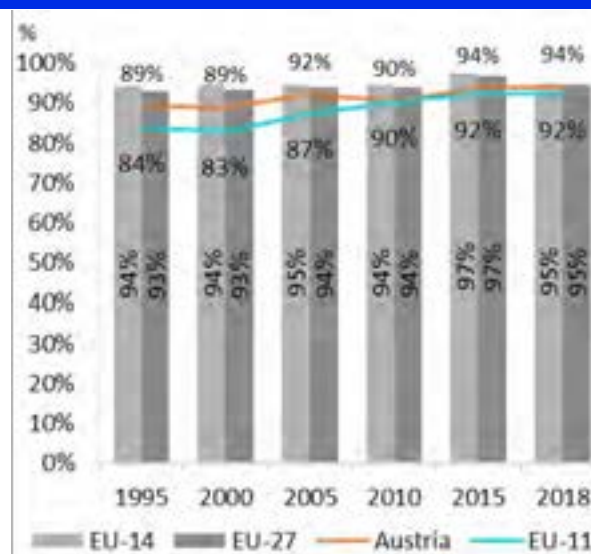
When compared to EU-14 and EU-27 average import dependency, the country had a lower import dependency of 94% versus 95% in EU-14 and EU-27 countries. At the same time, the import dependency of the country was higher than EU-11 average - 94% versus 92%.

Item 53: Oil sector in Austria

Oil production, gross consumption and import dependence in Austria in 1995-2018 (Mtoe)



Oil Import dependence in Austria and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Oil production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Import dependence above 100% has been rounded to 100%

The final consumption of oil per capita in Austria increased from 1.04 toe per capita in 1995 to 1.36 toe per capita in 2005 and then dropped to 1.07 toe per capita in 2018. The level of final consumption per capita remained higher than the one for EU-11, EU-14 and EU-27.

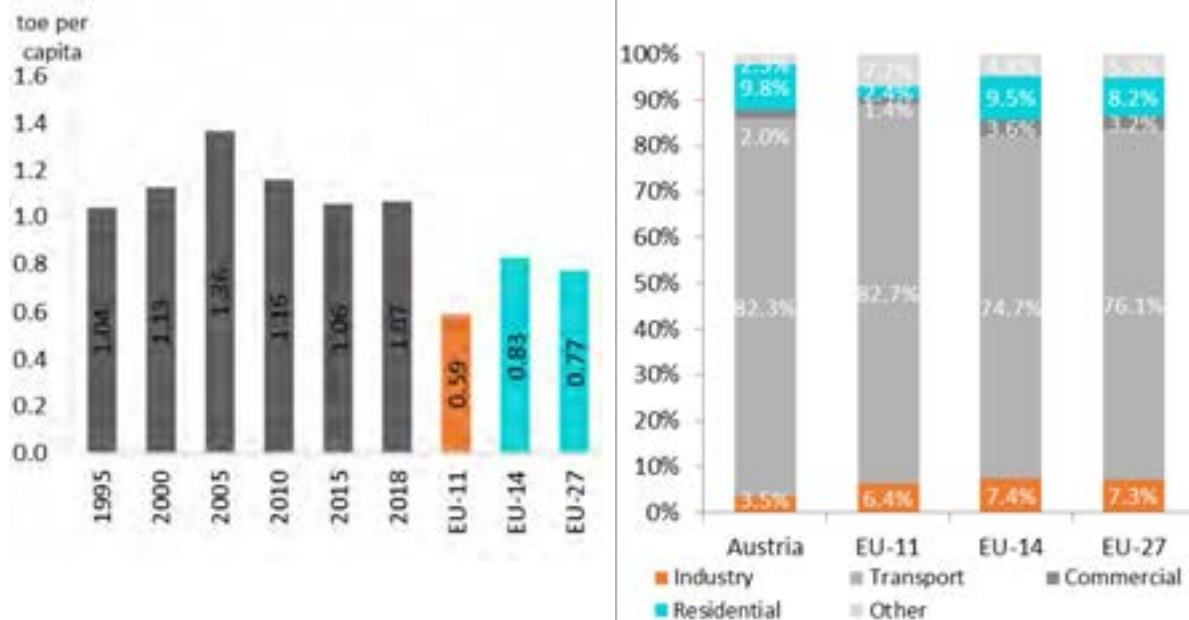
Oil consumption was dominated by transport sector - 82.3% versus 74.7% in EU-14 countries. Relatively less oil was used in industry - 3.5% versus 7.4% and in commercial sector - 2.0% versus 3.6%. The residential use of oil was higher than EU-14 average - 9.8% versus 9.5%.

The relative consumption of oil in Austria compared to EU-11 was lower in 2018 - 82.3% versus 82.7%. The use in industry was also relatively lower - 3.5% versus 6.4%. At the same time commercial and residential sector were consuming relatively more oil in the country than EU-11 averages - 2.0% and 9.8% versus 1.4% and 2.4%.

Item 54: Final consumption of oil per capita in Austria in 1995-2018 and oil final consumption by sectors in Austria and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of oil per capita in Austria (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Oil final consumption by sectors in Austria and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Errors in summation to 100% are due to rounding

3.8 EU climate policy and its targets for Austria

Austria is subject to EU energy and climate regulations and therefore, specific targets were set and verified regarding greenhouse gas emission, share of energy from renewable energy sources and energy efficiency improvements (see Item 55)

Item 55: Energy and climate targets for Austria for 2020 and 2030

| | Austria 2020 targets | Austria 2030 targets |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | EU wide target of 20% reduction from 1990 levels (14% from 2005 level) | EU wide target of 40% reduction from 1990 levels |
| Greenhouse gas emissions in ETS | EU wide target of 21% reduction from 2005 | EU wide target of 43% reduction from 2005 |
| National emission reduction targets in non-ETS - Effort Sharing Decision (ESD) | -16% in relation to their 2005 levels | - |
| National emission reduction targets in non-ETS - Effort Sharing Regulations (ESR) | - | -36% in relation to their 2005 levels |
| Share of energy from renewable energy sources | EU wide target of 20% energy from renewables | EU wide target of minimum 32% share for renewable energy |
| EU wide target of share of energy from renewable energy sources | EU wide target of 20% share of gross final energy consumption | EU wide target of 32% share of gross final energy consumption |
| National target of share of energy from renewable energy sources | 34% of gross final consumption | Not yet available |
| Improvement in energy efficiency | EU wide target of 20% improvement in energy efficiency | EU wide target of at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |
| Primary energy consumption | EU wide target < 1,483 Mtoe National target < 31.5 Mtoe | EU wide target of 1,273 Mtoe (< 1,128 Mtoe EU-27) National targets not available yet |
| Final energy consumption | EU wide target < 1,086 Mtoe National target < 25.1 Mtoe | EU wide target < 956 Mtoe (< 846 Mtoe EU-27) National targets not available yet |

Source: EU website

In following chapter, the overview of Austria targets and performance are summarized.

3.8.1 Greenhouse gas emissions

EU set a target for CO₂ reduction by 20% compared to 1990 level at EU level. Regardless the fact that the target was not binding for specific country, the level of CO₂ emission in Austria was below EU wide target in 2018.

The non-ETS greenhouse gas emissions the binding national targets for Austria was 47.75 Mt of CO₂ equivalent emissions. Comparing to 2018 provisional results the level of emissions exceeds the target by 6.1%.

Item 56: Energy efficiency target data for Austria

Greenhouse gas emissions level in Austria and EU-28, base year 1990, and EU 2020 target



Greenhouse gas emissions in Effort Sharing Decision (ESD) sectors



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Greenhouse gas emissions, base year 1990 [T2020_30], Greenhouse gas emissions in ESD sectors [T2020_35]

3.8.2 Renewable energy sources

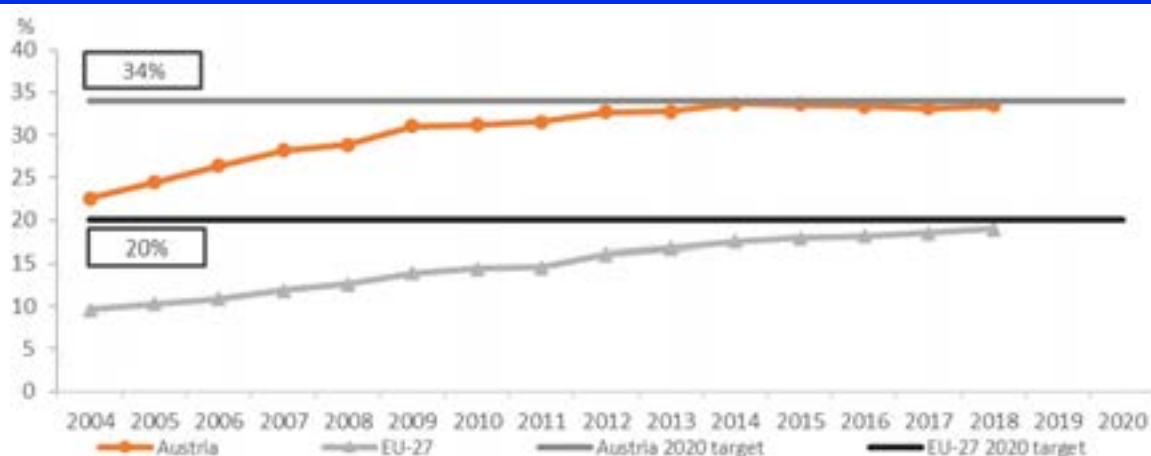
The following targets were set for Austria regarding the share of energy from renewable energy sources in gross final energy consumption:

- a 20% share of gross final energy consumption by 2020,
- a 34% national target for share of energy from renewable sources in gross final consumption of energy in 2020.

The share of energy from renewable energy sources in Austria was below EU wide and country specific targets in 2018.

Item 57: Share of energy from renewable energy sources in gross final energy consumption in Austria

Share of energy from renewable energy sources in gross final energy consumption in Austria in 2005-2018 and targets for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Share of energy from renewable sources [nrg_ind_ren]

3.8.3 Energy efficiency

The energy efficiency target set for Austria were respectively:

- Primary Energy Consumption in 2020: 35.1 Mtoe
- Final energy consumption in 2020: 25.1 Mtoe

Following the information provided in Item 58 the results for 2018 were above the targets in both criteria, respectively +1.0% of primary energy consumption and 11.2% of final energy consumption. This does not exclude Austria to achieve the targets in 2020.

Item 58: Energy efficiency target data for Austria

Primary energy consumption and final energy consumption in Austria in 2005-2018 and targets for 2020

Ratio of primary energy consumption to target for 2020 and final energy consumption to target for 2020 in Austria, EU-11, EU-14 and EU-27 in 2018



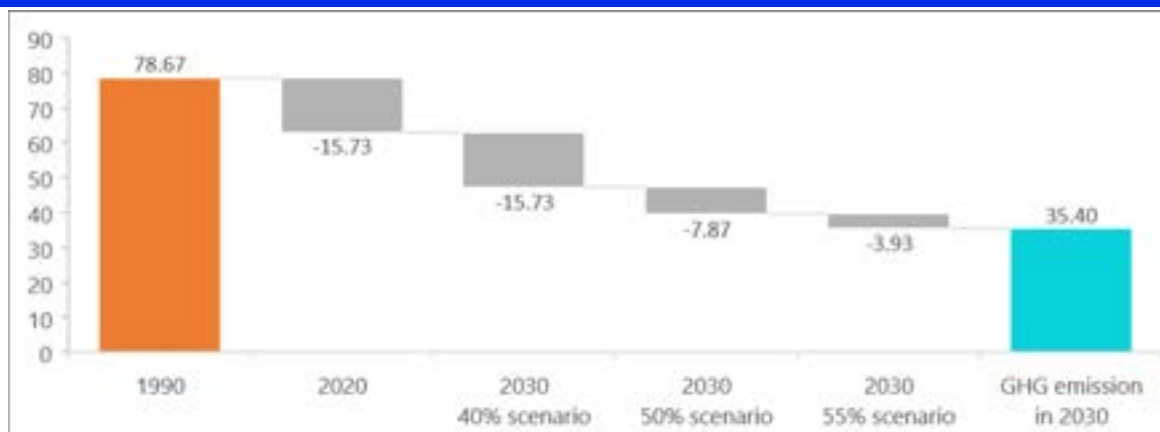
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Primary energy consumption - Primary energy consumption (Europe 2020-2030)(PEC2020-2030), final energy consumption - Final energy consumption (Europe 2020-2030) (FEC2020-2030). EU-25 data estimated based on Eurostat data

3.9 Review of potential impact of Green Deal propositions

At the current stage of discussions regarding the European Green Deal only partial information are available regarding the future targets. EU is proposing to increase the greenhouse gas emission reduction to 50% or 55% for 2030. This is a proposition included in the draft proposal of "Climate Law". Assuming the Austria greenhouse gas emissions in 1990, an estimation of EU 2030 target emissions can be drafted. The 2020 target of 20% reduction resulted in 15.73 Mt CO₂ emission drop. Further increase of the target to 40% in 2030 require additional 15.73 Mt CO₂ reduction. If the 50% target proposed under European Green Deal is applied then additional 7.87 Mt CO₂ emission decrease is needed, or 11.80 Mt CO₂ decrease, if 55% target is adopted.

Item 59: Estimation regarding greenhouse gas emissions in Austria under different scenarios (Mt CO₂)

Estimation regarding greenhouse gas emissions in Austria under different scenarios (Mt CO₂)



Source: Eurostat data for 2018, extracted in 2020. Estimations delivered by the Author

Nevertheless, it is worth to highlight that, if the current structure of greenhouse gas emissions target is maintain, then the 50% target for 2030 is an EU wide target. It is not a binding element for specific countries. Country specific targets could be expected as per ESD and ESR but there is no way to anticipate the potential targets.

At the same time, the review of key EU regulations around climate and energy as:

- Emissions Trading System Directive;
- Effort Sharing Regulation;
- Land use, land use change and forestry Regulation;
- Energy Efficiency Directive;
- Renewable Energy Directive;
- CO₂ emissions performance standards for cars and vans
- Energy Taxation Directive

can bring some additional targets in area of share of energy from renewable energy sources and energy efficiency. For the moment, any estimation of potential targets is not available nor possible to estimate.



4 Belgium

4.1 General information

Belgium is the second smallest country within EU-14 group in terms of total country area and represents 1.0% of the area. At the same time, it is the 23rd country in EU-27 with 0.7% of the area. It represents 3.3% of EU-14 population and 2.6% of EU-27 population, but 3.8% of its total nominal GDP of EU-14 and 3.4% of EU-27. Despite the robust economic growth in 1995-2018 period, in 2018 Belgian GDP per capita amounted to 118% of the whole EU average (126% in 1995).

Item 60: Belgium - key data



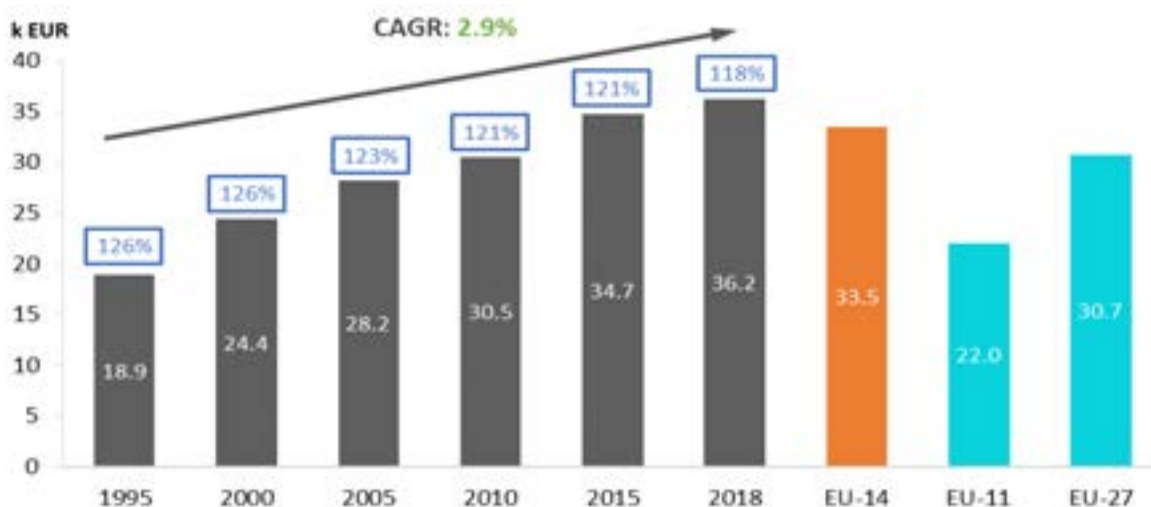
Key data

| | |
|------------------------------------------------------|--------|
| Population (M) | 11.4 |
| GDP per capita (EUR, nominal) | 40,210 |
| GDP per capita (EUR, PPS) | 36,230 |
| GDP as share of EU-14 | 3.8% |
| GDP as share of EU-27 | 3.4% |
| Energy intensity of the economy (kgoe per 1,000 EUR) | 157.5 |
| Greenhouse gas emissions (Mg per capita) | 10.1 |

Source: Eurostat data for 2018, extracted in 2020

With the compounded annual growth rate amounting to 2.9% Belgian economy considerably grew in the period of 1995-2018 (see Item 61). Its GDP per capita was above EU-14 and EU-27 averages (equal to 108% and 118% of the respective averages). Its GDP per capita was also 165% of the average GDP per capita for EU-11 countries.

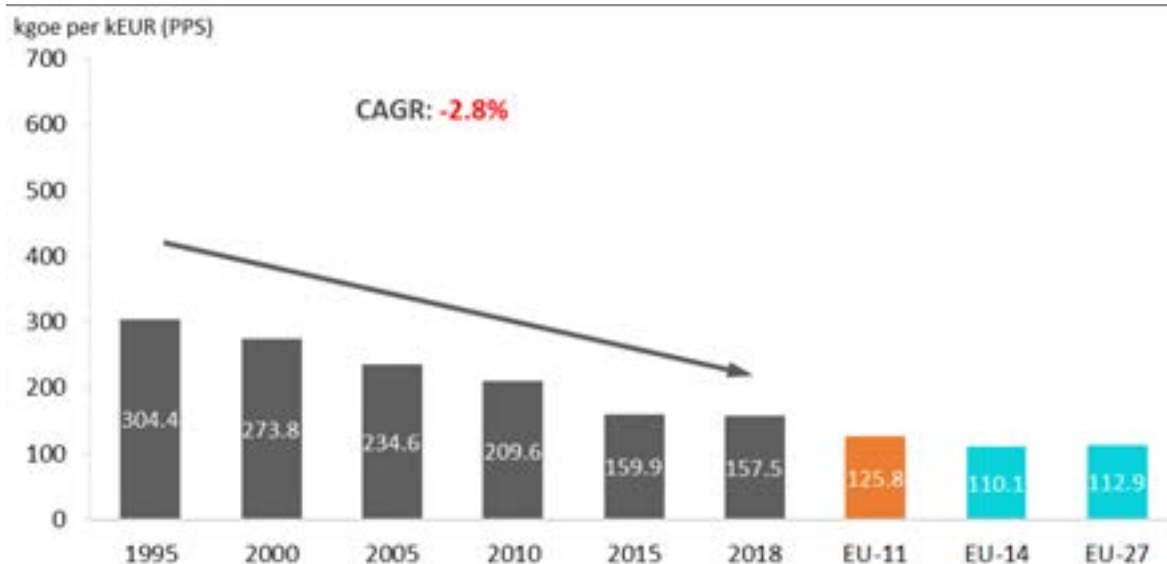
Item 61: GDP per capita in Belgium for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in 2018 (kEUR, PPS) and share of Belgium GDP per capita in relation to EU-27 average



Source: Eurostat data for 2018, extracted in 2020. Detail references: GDP per capita - Gross domestic product at market prices (B1GQ), Current prices, purchasing power standard per capita (CP_PPS_HAB)

The Belgian economy energy intensity was about 157.5 kgoe per 1,000 EUR PPS in 2018, thanks to a decrease of the energy intensity indicator during the years 1995-2018. It dropped by 146.9 kgoe per 1,000 EUR PPS, i.e. it was reduced by about 48%. The energy intensity of Belgium in 2018 represented 143% and 140% of EU-14 and EU-27 averages. At the same time, it represented 125% of EU-11 average.

Item 62: Energy intensity of the economy in Belgium in 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)



Source: Eurostat data for 2018, extracted in 2020. Values for EU-11 and EU-14 were recalculated based on energy intensity and GDP data from Eurostat. Detail references: Energy intensity of GDP in purchasing power standards (PPS) - EI_GDP_PPS

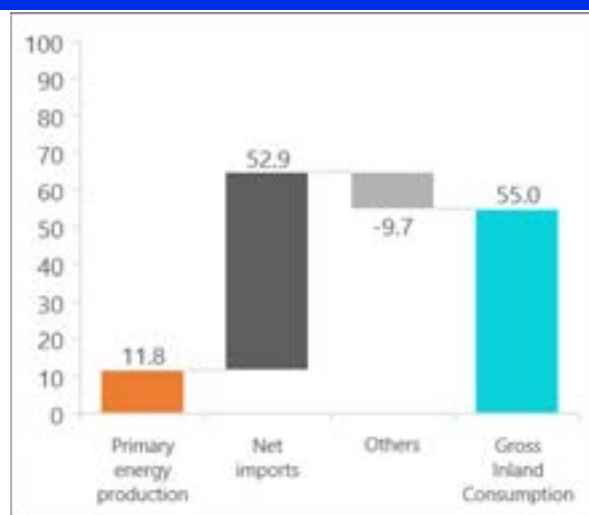
4.2 Energy balance of Belgium

The energy balance of Belgium in 2018 was presented in Item 63. The primary energy production in Belgium was equal to 11.8 Mtoe in 2018. Net imports added 52.9 Mtoe to the balance. The total gross inland consumption accounted for 55.0 Mtoe. The level of import of energy to Belgium grew slowly during last 23 years from less than 50 Mtoe to a little more than this. At the same time the level of net import reported to the energy needs increased from about 87% to 96% in 2018.

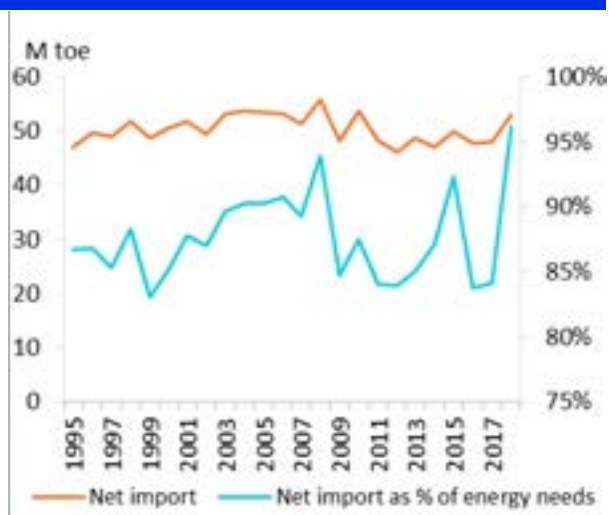
The primary energy production increased over past 23 years, as well as gross energy consumption. National production was meeting only 21% of the country gross consumption and this factor was the same as it was 23 years ago.

Item 63: Energy balance in Belgium

Energy balance in Belgium in 2018 (Mtoe)



Net import of energy in Belgium in 1995-2018 (Mtoe and as percentage of GIC)



Gross inland consumption, primary energy production (Mtoe) and ratio of primary energy production to gross inland consumption in 1995-2018 in Belgium (%)



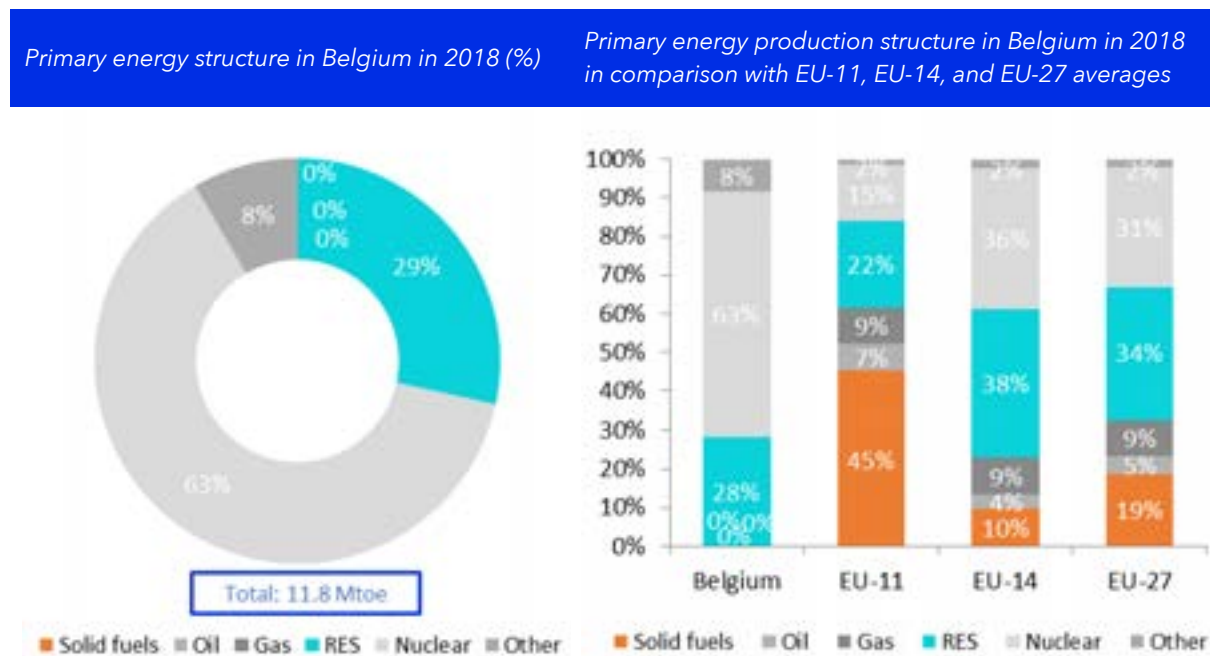
Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Gross inland consumption - GIC. Net imports = Import (IMP) - Export (EXP), Other = Change in stock (STK-CHG) - International maritime bunkers (INTMARB)

The primary energy production in Belgium was dominated by nuclear energy. About 63% of the total production came from it. The mix was completed by 29% share of renewable energy sources and 8% other sources in the mix. Usage of solid fuels, oil and gas was null.

When compared to the European averages, Belgium was characterized by very high share of nuclear in the energy mix - 63% versus 36% EU-14 average and 31% EU-27 average. The share of renewable energy sources in the Belgian fuel mix was lower than in EU-14 and EU-27 (28% versus 38% in EU-14 and EU-27). At the same time, the share of other energy sources was higher in Belgium than the averages for EU-14 and EU-27 (8% versus 2%). In opposite to EU averages Belgium was not using solid fuels, gas, and oil for primary energy production.

The comparison of Belgium to EU-11 averages was mainly characterized by much higher share of nuclear energy (63% versus 15%) and lack of solid fuels, oil and gas use in Belgium (versus 45%, 7% and 9% in EU-11). The share of other energy sources was also higher in Belgium - 8% than in EU-11 - 2%.

Item 64: Primary energy structure in Belgium



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H) , Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

Gross inland consumption of energy in Belgium was dominated by oil (42%), gas (27%) and nuclear energy (13%). The mix was completed by 6% of solid fuels, 8% of renewable energy sources and 4% of other energy sources.

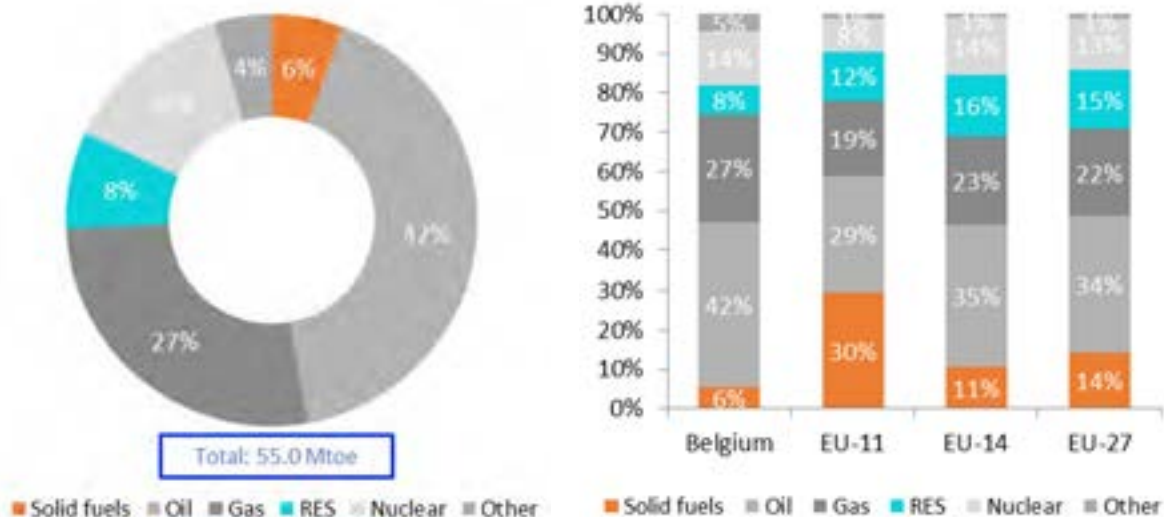
Comparing to European averages gross inland consumption of energy in Belgium was marked by low share of solid fuels (6% versus 11% in EU-14 and 14% in EU-27). The share of oil was higher in Belgium (42%) than in EU-14 (35%) and EU-27 (34%) and the share of gas was also higher (27% versus 23% and 22% in EU-14 and EU-27). Belgium was characterized by lower share of renewable energy sources in the mix - 14% versus 16% and 15% in EU-14 and EU-27 respectively) and almost the same share of nuclear energy in the mix (versus 14% in EU-14 and 13% in EU-27).

When compared to EU-11 the main difference was around lower share of solid fuels consumption in Belgium (6% versus 30% in EU-11) and higher share of oil (42% versus 29%). The share of gas and renewable energy sources in Belgium were lower than in EU-11 countries (27% versus 29% and 8% versus 19% respectively). EU-11 average gross final consumption includes nuclear energy at 8% where it was 14% in Belgium.

Item 65: Gross inland consumption structure in Belgium

Gross inland consumption structure in Belgium in 2018 (%)

Gross inland consumption structure in Belgium in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gross inland consumption – GIC, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion)(O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear – Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

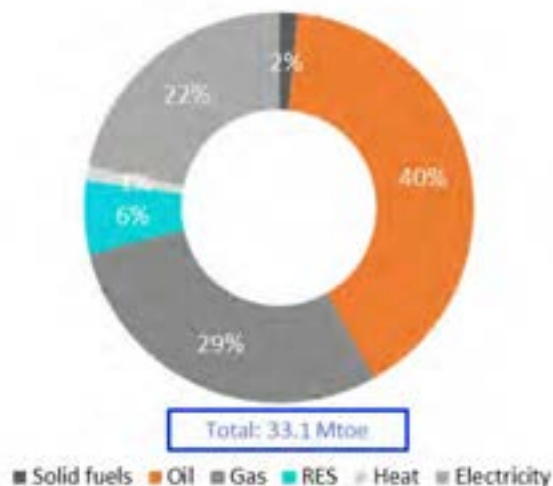
The final energy consumption in Belgium was dominated by oil (40%), followed by gas (29%) and electricity (22%). The mix was completed by renewable energy sources (6%), heat (1%) and solid fuels (2%).

The sectoral final energy consumption in Belgium was characterized by higher share of industrial but lower of transport sectors than in EU-14 and EU-27 (32% and 27% versus 26% and 31% in EU-14 and EU-27). The share of commercial and public services was lower in final energy consumption in Belgium (14%) than in EU-14 (15%) and equal to the one in and EU-27 (14%).

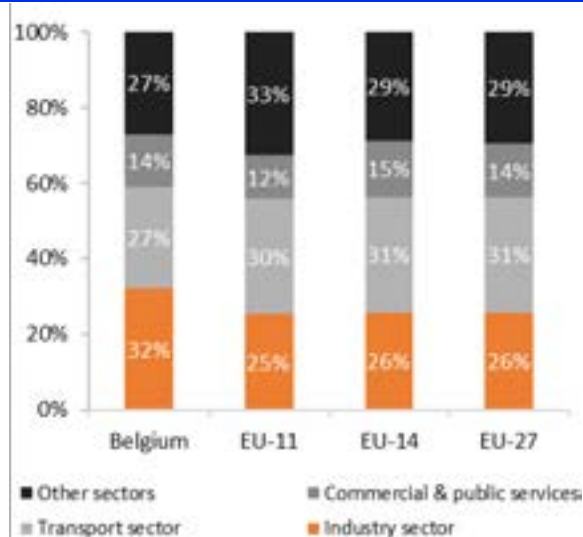
When compared to EU-11 Belgium similar conclusions as related to EU-14 and EU-27 can be drawn.

Item 66: Final energy consumption structure in Belgium

Final energy consumption structure in Belgium in 2018 (%)



Final energy consumption structure in Belgium in 2018 in comparison with EU-11, EU-14, and EU-27 averages



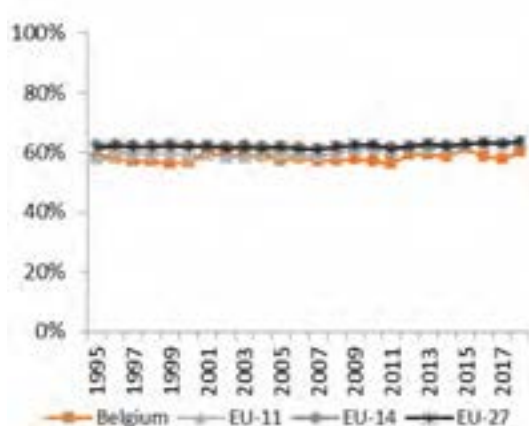
Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Heat (H8000), Electricity (E7000), Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial & public services - FC_OTH_CP_E, Other - FC_OTH_E-FC_OTH_CP_E. Errors in summation to 100% are due to rounding

Belgian final energy consumption to gross inland consumption ratio which measure energy efficiency was a little lower than the averages for EU-11, EU-14 and EU-27. The situation remained stable for last 23 years.

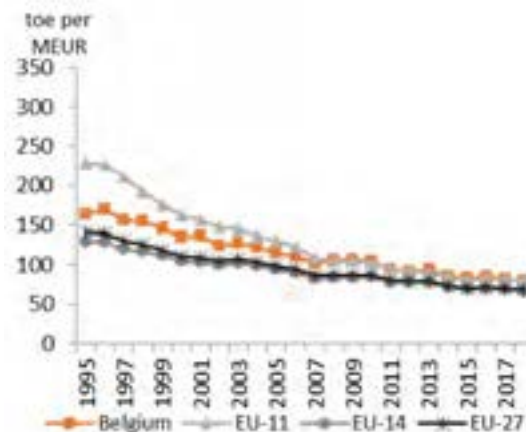
Simultaneously, a decrease of energy volume associated with generating gross domestic product was noticed in line with the averages for EU-14 and EU-27 averages but the ratio was a little higher in 1995 and it reached the average level in 2018.

Item 67: Final energy consumption in Belgium in relation to selected indicators

Final energy consumption to gross inland consumption ratio in Belgium in 1995-2018 (%)



Final energy consumption to gross domestic product ratio in Belgium in 1995-2018 in comparison with EU-11, EU-14, and EU-27 averages (toe per M EUR)



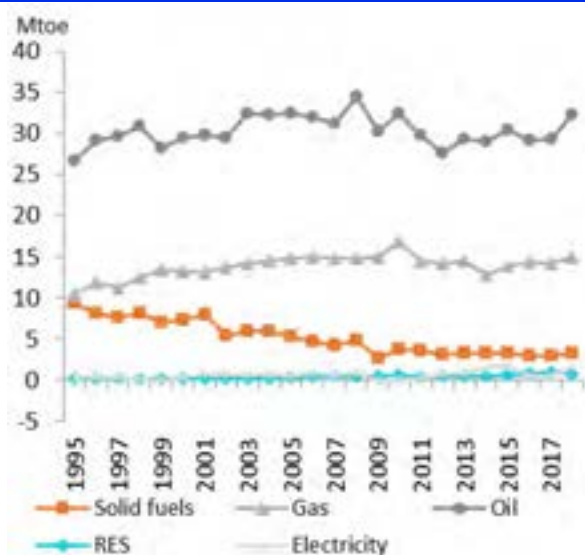
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final energy consumption - FEC, Gross inland consumption - GIC, Gross Domestic Product - Gross domestic product at market prices B1GQ, Current prices - CP-MEUR

Net import of energy to Belgium by fuels was characterized by a decrease of solid fuels imports and an increase of gas import. The level of oil import was slowly increasing.

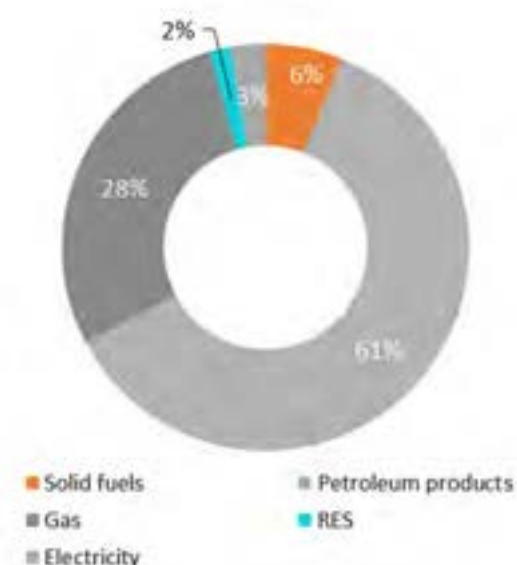
The import structure of energy to Belgium was dominated by oil (61%) and gas (28%). The imports were completed by 6% of solid fuels, 3% of electricity and 2% of renewable energy sources.

Item 68: Net import of energy in Belgium

Net import of energy by fuel in 1995-2018 (Mtoe)



Net import structure in 2018 (% only fuels for which import is greater than export)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Electricity (E7000). Errors in summation to 100% are due to rounding

Solid fuels were imported to Belgium mainly from Russia (32%), Australia (25%), USA (16%) and several other countries.

Main oil importers to Belgium were Russia (26%), Netherlands (22%), Saudi Arabia (13%) and United Kingdom (8%). The remaining 31% were imported from various locations.

Belgium was importing gas mainly from Netherlands (41%), Norway (32%) and Qatar (22%). The remaining 5% were supplied from different locations.

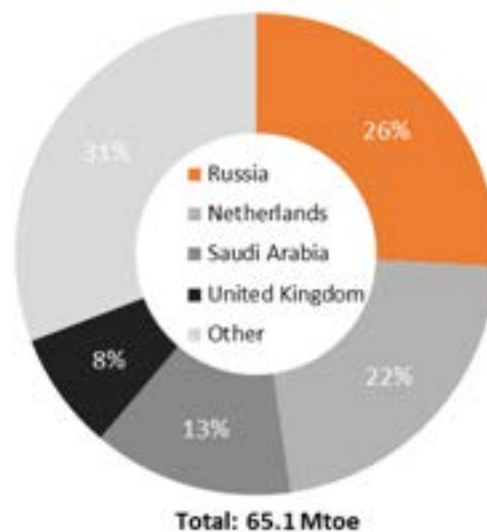
Electricity was mainly imported from Netherlands (50%) and France (50%). Smaller amounts were imported from Luxemburg (under the 1% of the total).

Item 69: Foreign fuel suppliers

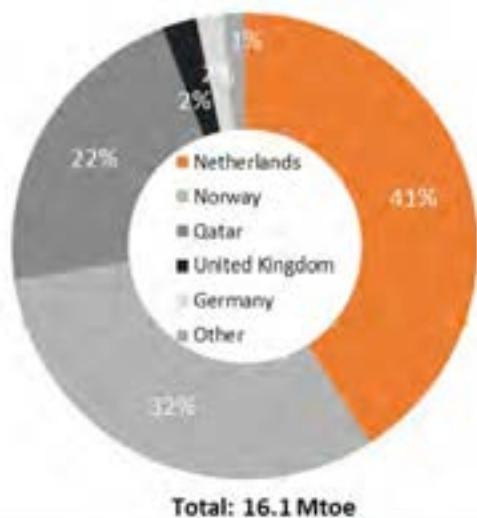
Foreign suppliers of solid fuels in Belgium in 2018 (%)



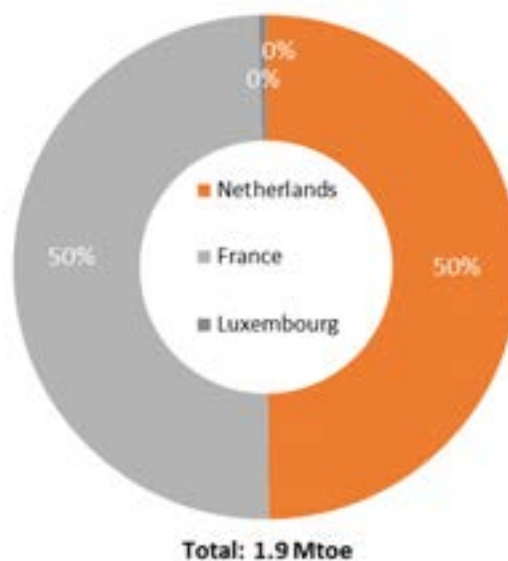
Foreign suppliers of crude oil in Belgium in 2018(%)



Foreign suppliers of gas in Belgium in 2018 (%)



Foreign suppliers of electricity in Belgium in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fossil fuels - C000X0350-0370, Gas - Natural gas (G3000), Oil - Oil and petroleum products (excluding biofuel portion) (O4000XBIO), Electricity - E7000. Errors in summation to 100% are due to rounding

4.3 Greenhouse gas emissions

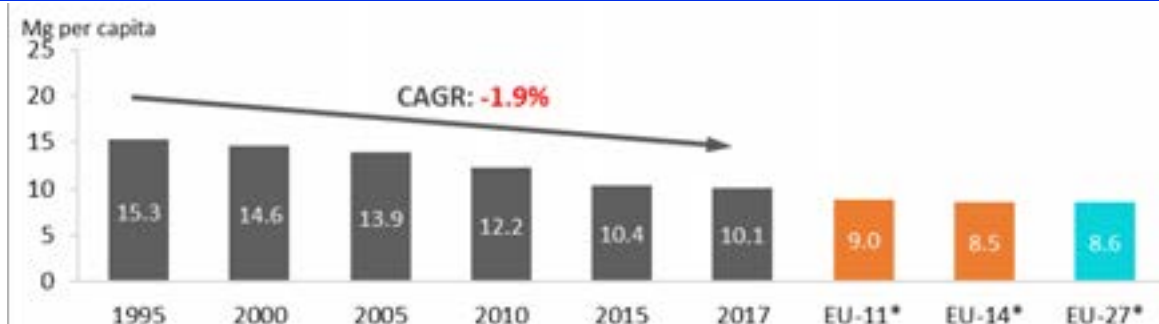
Between 1995-2017 greenhouse gases emissions in Belgium were decreased - from over 146.6 Mt CO₂ in 1995 to 114.5 Mt CO₂ in 2017. Consequently average emissions per capita decreased to 10.1 Mg CO₂ per capita in 2017 (from 15.3 Mg CO₂ per capita in 1995), which was higher comparing to EU-14 and EU-27 averages (8.5 Mg CO₂ per capita and 8.6 Mg CO₂ per capita, respectively), and also higher than in EU-11 (9.0 Mg CO₂ per capita)

There were some noteworthy changes in the Belgian structure of greenhouse gas emissions over the period considered. The significance of waste management emissions dropped swiftly by 67%, as well as emissions from energy industries 32% and manufacturing and construction 42%. On other hand, transport emissions gained in importance increasing by 13%.

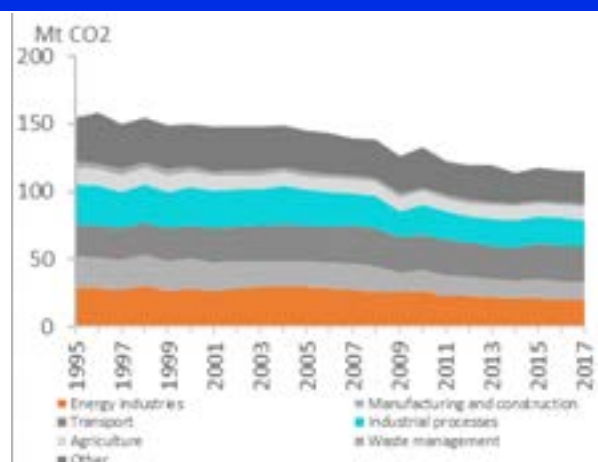
Comparing to EU-11, EU-14 and EU-27 countries, Belgium was characterized by higher share of emissions from transport (23% versus 17%, 23% and 21%) and lower from energy industries (18% versus 35% in EU-11, 26% in EU-14 and 28% in EU-27).

Item 70: Greenhouse gas emissions in Belgium

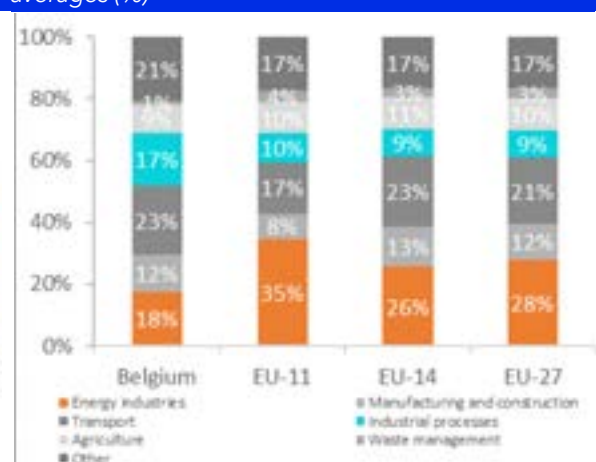
Greenhouse gas emissions per capita in Belgium in 1995-2017 in comparison with EU-11, EU-14 and EU-27 averages in 2017 (Mg per capita)



Greenhouse gas emissions in Belgium by sectors in 1995-2017 (Mt CO₂)



Greenhouse gas emissions in Belgium by sectors in 2017 in comparison with EU-11, EU-14 and EU-27 averages (%)



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - * values for EU-11, EU-14 and EU-27 recalculated by the Author; Energy industry - Fuel combustion in energy industries (CRF1A1), Manufacturing and construction - Fuel combustion in manufacturing industries and construction (CRF1A2), Transport - Fuel combustion in transport (CRF1A3), Industrial processes - Industrial processes and product use (CRF2), Agriculture - Agriculture (CRF3), Waste management - Waste management (CRF5), Other = Other fuel combustion sectors (CRF1A4)+ Other fuel combustion sectors n.e.c. (CRF1A5) + Fuels

- fugitive emissions (CRF1B)+Other sectors (CRF6); Total GHG emissions equal to All sectors (excluding LULUCF and memo items) (CRF1-6X4_MEMO) i.e. emission from all sectors excluding Land use, land use change, and forestry (LULUCF), Transport and storage of CO₂ (memo item), International aviation (memo item), International navigation (memo item), Multilateral operations (memo item), Biomass - CO₂ emissions (memo item). Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. Errors in summation to 100% are due to rounding

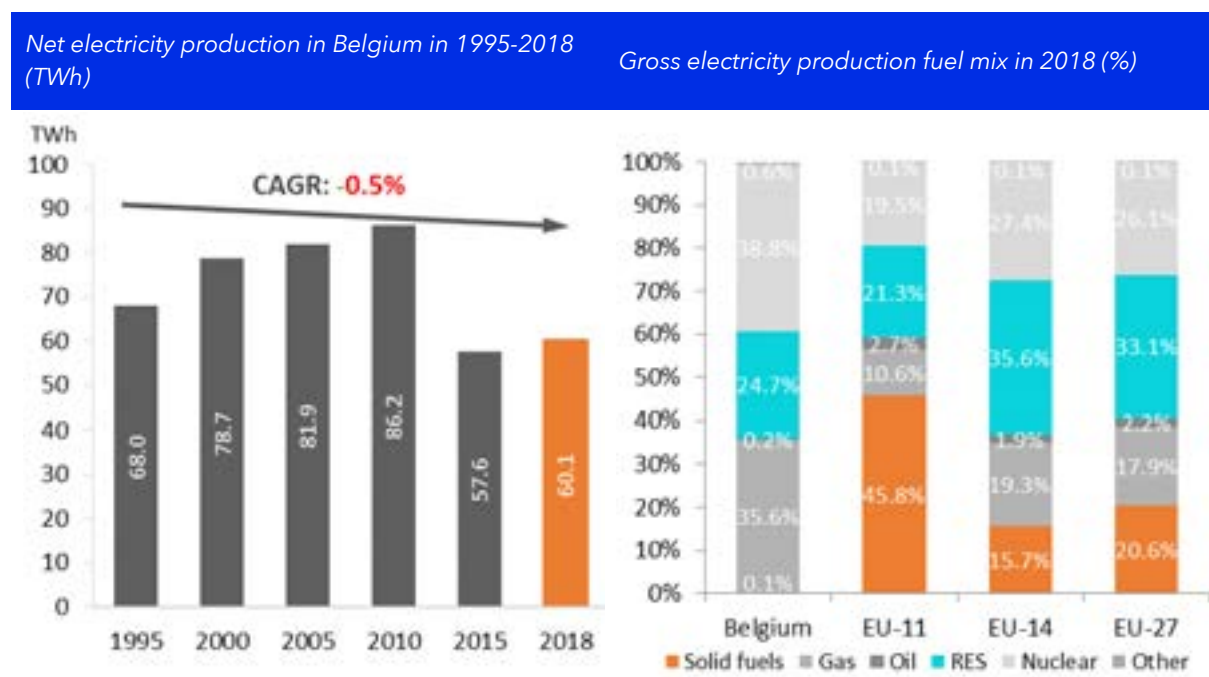
4.4 Overview of electricity sector

Item 71 presents electricity production and the current fuel mix of Belgium. Over last 23 years net electricity production decreased from 68.0 TWh in 1995 to 60.1 TWh in 2018 (CAGR -0.5%). As visible, net electricity production represented 2.8% of EU-14 total electricity production, which was lower compared to Belgian GDP share of 3.8%.

The Belgian fuel mix was dominated by nuclear energy and gas with shares of 38.8% and 35.6% respectively. The mix was completed by 24.7% of renewable energy sources and small shares of solid fuels (0.1%) and oil (0.2%). Compared to EU-14 and EU-27 countries, Belgium had a much bigger share of nuclear energy and gas in its energy mix. On other hand, the country produced relatively less electricity from solid fuels, oil, and renewable energy sources, respectively 0.1%, 0.2% and 24.7%.

When compared to EU-11 average fuel mix one can notice much higher share of nuclear energy and gas used in Belgium than in EU-11 (38.8% and 35.6% versus 19.5% and 10.6%) and significantly lower use of solid fuels (0.1% versus 45.8%). The share of oil was lower (0.2% versus 2.7%). Belgium was more relying on renewable energy sources than EU-11 countries with a share of 24.7% versus 21.3% in EU-11.

Item 71: Net electricity production and gross electricity production fuel mix in Belgium



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Electricity Production - NEP, Gross Electricity Production - GEP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding

biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

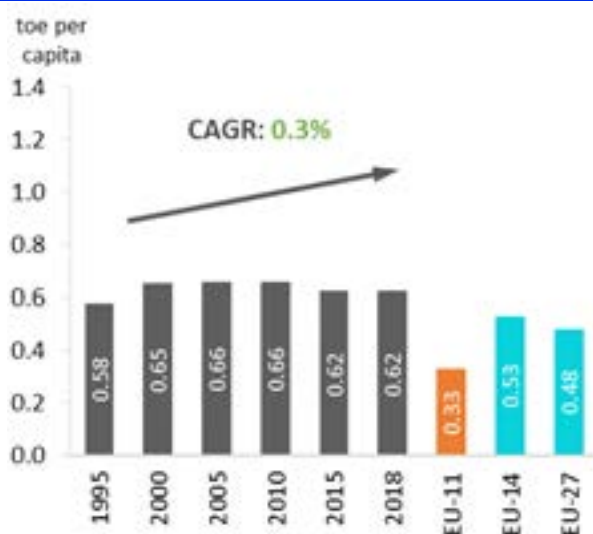
In Item 72 the evolution of final per capita consumption of electricity and its breakdown by economic sector were presented. In recent years final consumption of electricity in Belgium increased (CAGR in the period of 1995-2019 was around 0.3%) and its level was higher compared to EU-14 and EU-27 countries. Belgian final energy consumption per capita represented 117.7% of EU-14 level and 128.9% of EU-27 level.

The structure of final electricity consumption in Belgium was dominated by industry (47.0% versus 37.6% in EU-14 countries). Relatively less energy was used in transport (2.0% versus 2.4%) and in commercial and residential sectors (26.6% and 22.3% versus 29.2% and 28.5%).

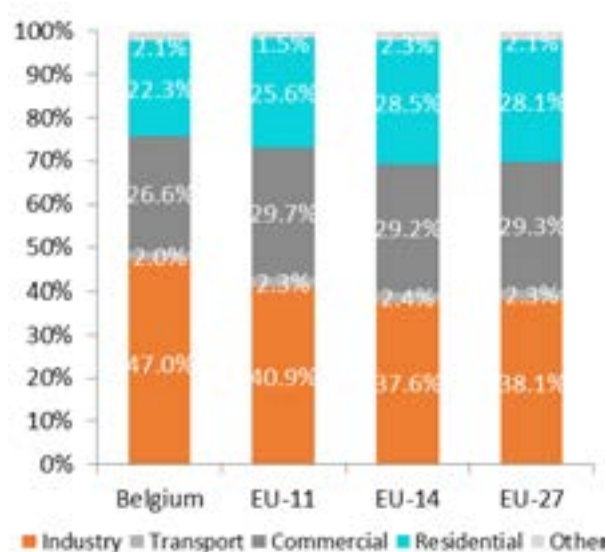
Belgium was consuming relatively more electricity in industry sector than EU-11 countries (47.0% versus 40.9%) but less in transport (2.0% versus 2.3%). At the same time, it used relatively less electricity in residential and commercial sectors (22.3% and 26.6% versus 25.6% and 29.7%).

Item 72: Final consumption of electricity in Belgium

Final consumption of electricity per capita in Belgium (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)



Final consumption of electricity in Belgium by sectors in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Electricity E7000. Errors in summation to 100% are due to rounding

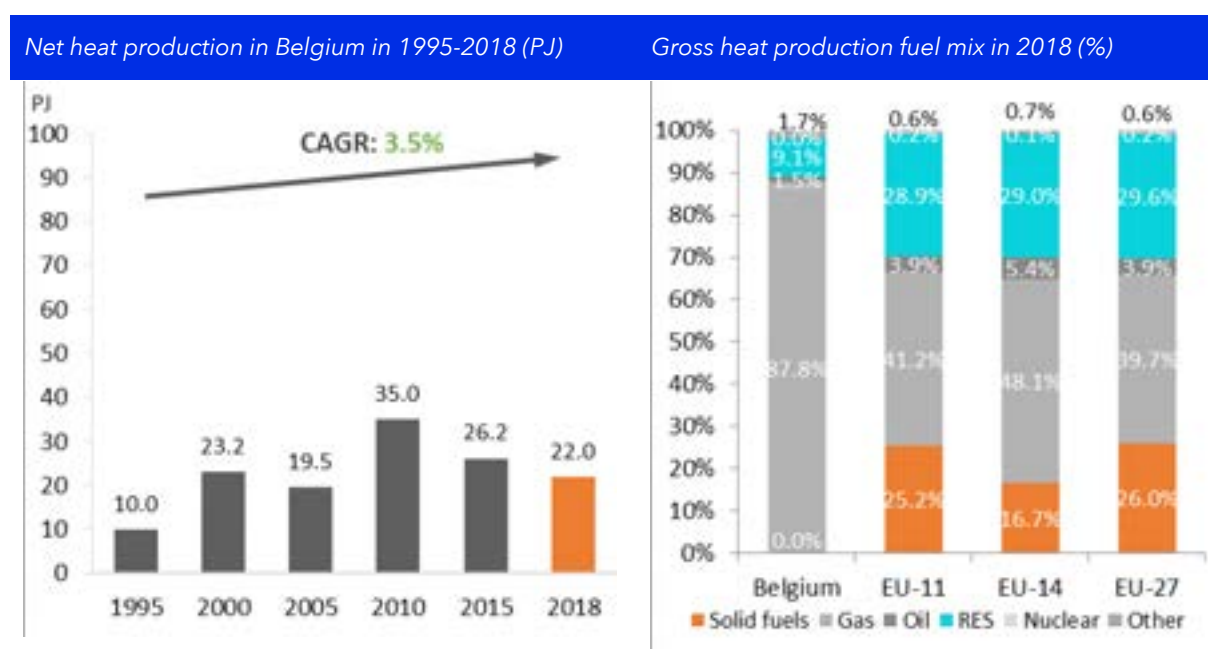
4.5 Overview of heat sector

Item 73 presents heat production and the current fuel mix of Belgium. Over last 23 years net heat production increased from 10.0 PJ in 1995 to 22.0 PJ in 2018 (CAGR 3.5%).

The Belgian fuel mix of heat production was dominated by gas with share of 87.8%. The mix was completed by 1.5% of oil and 9.1% of renewable energy sources. Compared to EU-14 and EU-27 countries, Belgium had a much bigger share of gas in its heat production mix. On other hand, the country produced relatively less heat from solid fuels, oil, and renewable energy sources, respectively 0.0%, 1.5% and 9.1%. Belgium did not use nuclear energy for heat production where some heat was produced in nuclear facilities in EU-14 countries (0.1%).

When compared to EU-11 average fuel mix one can notice much higher share of gas used in Belgium than in EU-11 (87.8% versus 28.9%) and significantly lower use of solid fuels (0.0% versus 25.2%), oil (1.5% versus 3.9%) and renewable energy sources (9.1% versus 28.9%). Belgium was not using nuclear energy for heat generation in opposite to EU-11 where the share of nuclear was 0.2%.

Item 73: Net heat production and gross electricity production fuel mix in Belgium



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Heat Production - NHP, Gross Heat Production - GHP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

Item 74 presents final heat consumption per capita and its breakdown by sectors.

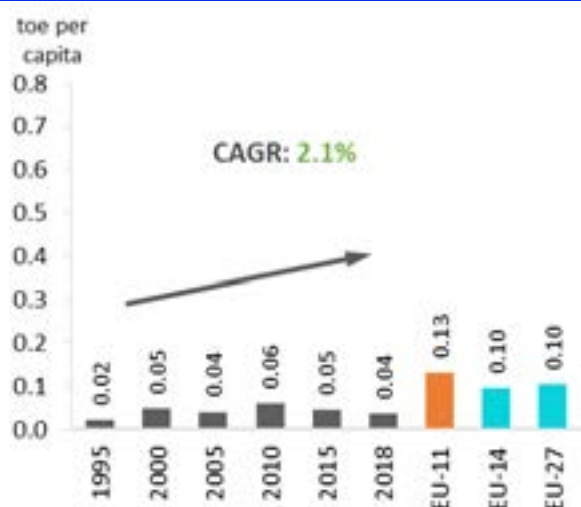
The per capita demand for heat in Belgium increased from 0.02 toe per capita in 1995 to 0.04 toe per capita in 2018. As a result, within the 23 years analyzed, heat consumption per capita increased at CAGR of 2.1%. The heat consumption remained lower than the averages for EU-11, EU-14 and EU-27, respectively 0.13 toe per capita, 0.10 toe per capita and 0.10 toe per capita.

The structure of final consumption of heat in Belgium was characterized by higher share of industrial sector (83.2% compared to 37.9% in EU-14) and lower residential (3.8% compared to 40.1% in EU-14) and commercial use (3.8% versus 19.3%)

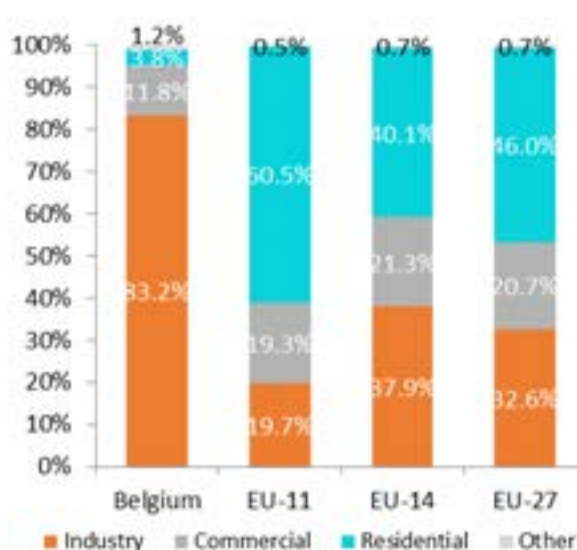
In relation to EU-11 countries, the structure of final heat consumption in Belgium was characterized by lower share of residential sector (3.8% versus 60.5%) and lower share of commercial sector (11.8% versus 19.3%). The industrial use of heat consumed 83.2% of it in Belgium whereas 19.7% in EU-11.

Item 74: Final consumption of heat in Belgium

Final consumption of heat per capita in Belgium (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)



Final consumption of heat in Belgium by sectors in 2018 (%)



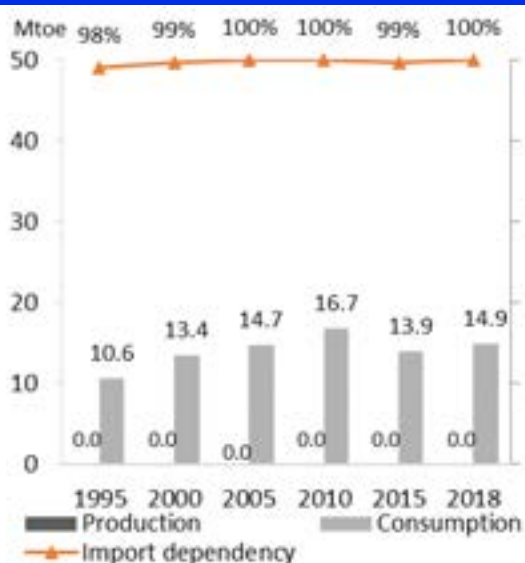
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Heat H8000. Errors in summation to 100% are due to rounding

4.6 Overview of gas sector

Belgium consumed 14.9 Mtoe of gas in 2018. It increased from 10.6 Mtoe in 1995 to 16.7 Mtoe in 2010 and then decreased to current value. There was no national production of gas in the country in 2018 despite some small production (<0.1 Mtoe) in the past. The remaining part of gas was imported. The country dependency on import was fluctuating from 98% to 100% over past 23 years. In 2018 the country was more dependent on import than EU-11, EU-14 and EU-27 average values.

Item 75: Gas sector in Belgium

Gas production, gross consumption and import dependence in Belgium in 1995-2018 (Mtoe)



Gas Import dependence in Belgium and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gas production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Natural Gas G3000

The final consumption of gas per capita in Belgium increased from 0.77 toe per capita to 0.83 toe per capita over past 23 years. This value was higher than the average values for EU-14, EU-11 and EU-27 countries.

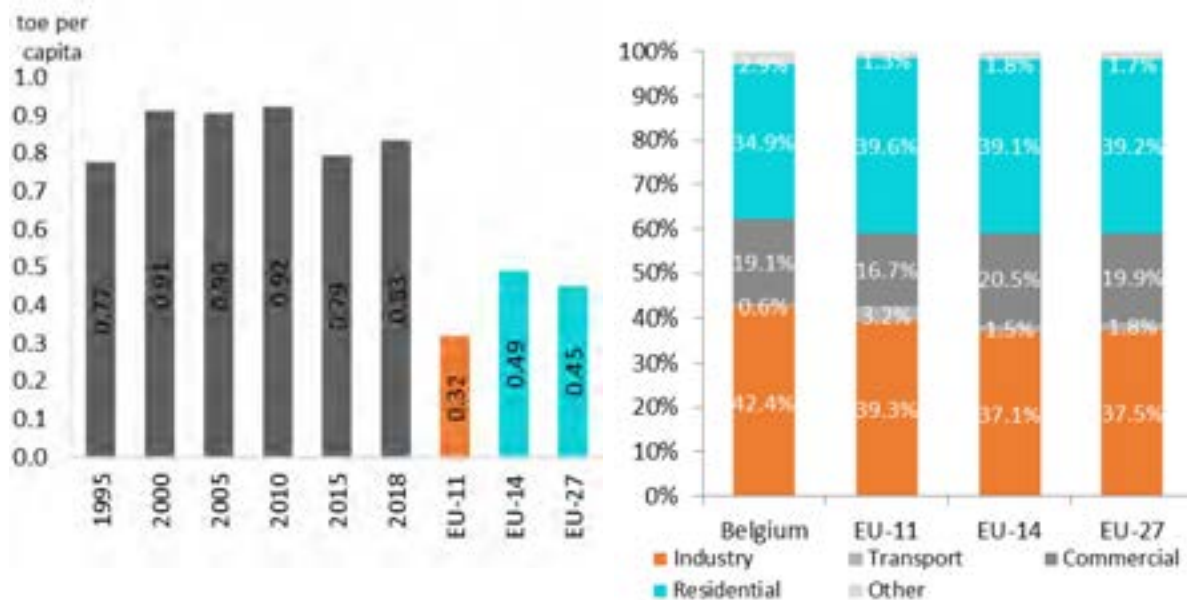
The structure of final gas consumption in Belgium in 2018 was characterized by high share of industry - 42.4% versus 37.1% in EU-14. The share of use of gas in transport, commercial and residential applications were lower than the averages for EU-14 countries.

When compared to EU-11 countries, Belgium was using relatively more gas industry than EU-11 countries - 42.4% versus 39.3%. The country was using less gas in transport - 0.6% versus 3.2%. On other hand, the share of gas used in commercial sector was higher than in EU-11 countries, 19.1% versus 16.7%. The residential use of gas represented 34.9% versus 39.6% in EU-11 countries.

Item 76: Final consumption of gas per capita in Belgium in 1995-2018 and gas final consumption by sectors in Belgium and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of gas per capita in Belgium (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Gas final consumption by sectors in Belgium and EU-11, EU-14 and EU-27 countries in 2018



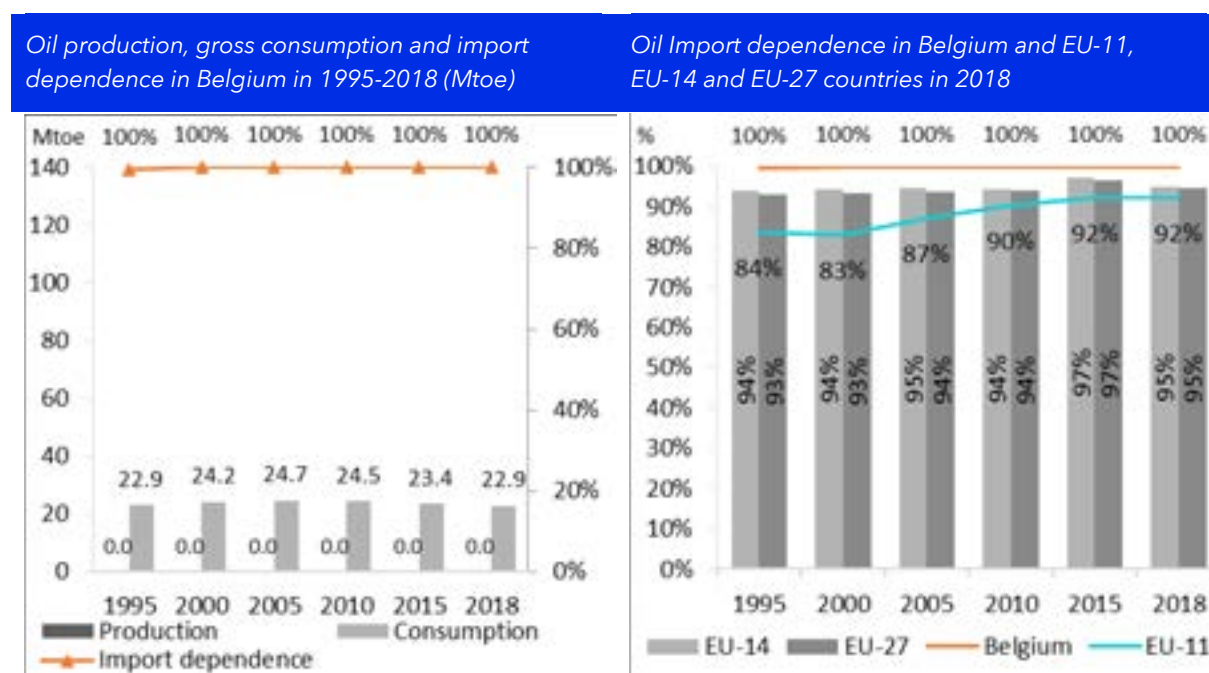
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Natural Gas G3000. Errors in summation to 100% are due to rounding

4.7 Overview of oil sector

The oil consumption of Belgium grew from 22.9 Mtoe in 1995 to 24.7 Mtoe in 2005 and then dropped back to 22.9 Mtoe. At the same time the national production remained null for the whole period. Therefore, the level of import dependency was high - 100%.

When compared to EU-14 and EU-27 average import dependency, the country had a higher import dependency of 100% versus 95% in EU-14 and EU-27 countries in 2018. At the same time, the import dependency of the country was also higher than EU-11 average - 100% versus 92%.

Item 77: Oil sector in Belgium



Source: Eurostat data for 2018, extracted in 2020. Detail references: Oil production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Import dependence above 100% has been rounded to 100%

The final consumption of oil per capita in Belgium decreased from 1.49 toe per capita in 1995 to 1.16 toe per capita in 2018. The level of final consumption per capita remained higher than the one for EU-11, EU-14 and EU-27.

Oil consumption was dominated by transport sector, but its share was lower than in EU-14 - 62.0% versus 74.7% in EU-14 countries. Relatively more oil was used in industry - 11.1% versus 7.4% and in commercial and residential sectors - 5.7% versus 3.6% and 18.5% versus 9.5%.

The relative consumption of oil in Belgium compared to EU-11 was lower in 2018 - 62.0% versus 82.7%. The use in industry was relatively higher - 11.1% versus 6.4%. At the same time commercial and residential sector were consuming relatively more oil in the country than EU-11 averages - 5.7% and 18.5% versus 1.4% and 2.4%.

Item 78: Final consumption of oil per capita in Belgium in 1995-2018 and oil final consumption by sectors in Belgium and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of oil per capita in Belgium (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Oil final consumption by sectors in Belgium and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Errors in summation to 100% are due to rounding

4.8 EU climate policy and its targets for Belgium

Belgium is subject to EU energy and climate regulations and therefore, specific targets were set and verified regarding greenhouse gas emission, share of energy from renewable energy sources and energy efficiency improvements (see Item 79)

Item 79: Energy and climate targets for Belgium for 2020 and 2030

| | Belgium 2020 targets | Belgium 2030 targets |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | EU wide target of 20% reduction from 1990 levels (14% from 2005 level) | EU wide target of 40% reduction from 1990 levels |
| Greenhouse gas emissions in ETS | EU wide target of 21% reduction from 2005 | EU wide target of 43% reduction from 2005 |
| National emission reduction targets in non-ETS - Effort Sharing Decision (ESD) | -15% in relation to their 2005 levels | - |
| National emission reduction targets in non-ETS - Effort Sharing Regulations (ESR) | - | -35% in relation to their 2005 levels |
| Share of energy from renewable energy sources | EU wide target of 20% energy from renewables | EU wide target of minimum 32% share for renewable energy |
| EU wide target of share of energy from renewable energy sources | EU wide target of 20% share of gross final energy consumption | EU wide target of 32% share of gross final energy consumption |
| National target of share of energy from renewable energy sources | 13% of gross final consumption | Not yet available |
| Improvement in energy efficiency | EU wide target of 20% improvement in energy efficiency | EU wide target of at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |
| Primary energy consumption | EU wide target < 1,483 Mtoe National target < 43.7 Mtoe | EU wide target of 1,273 Mtoe (< 1,128 Mtoe EU-27) National targets not available yet |
| Final energy consumption | EU wide target < 1,086 Mtoe National target < 32.5 Mtoe | EU wide target < 956 Mtoe (< 846 Mtoe EU-27) National targets not available yet |

Source: EU website

In following chapter, the overview of Belgium targets and performance are summarized.

4.8.1 Greenhouse gas emissions

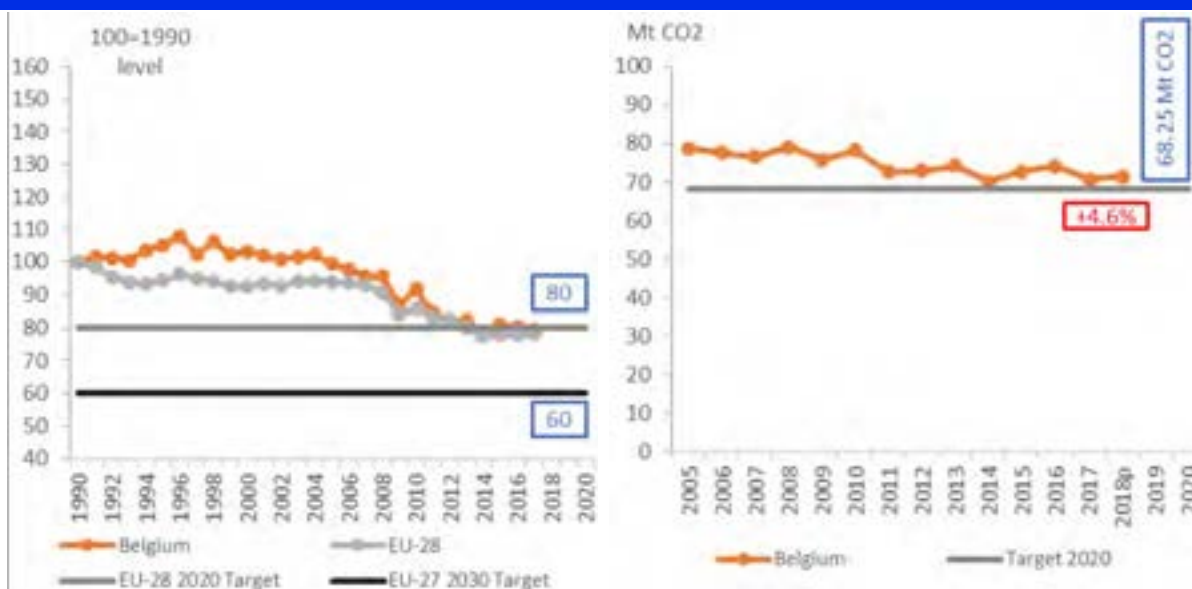
EU set a target for CO₂ reduction by 20% compared to 1990 level at EU level. Regardless the fact that the target was not binding for specific country, the level of CO₂ emission in Belgium was below EU wide target in 2018.

The non-ETS greenhouse gas emissions the binding national targets for Belgium was 68.25 Mt of CO₂ equivalent emissions. Comparing to 2018 provisional results the level of emissions exceeded the target by 4.6%.

Item 80: Energy efficiency target data for Belgium

Greenhouse gas emissions level in Belgium and EU-28, base year 1990, and EU 2020 target

Greenhouse gas emissions in Effort Sharing Decision (ESD) sectors



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Greenhouse gas emissions, base year 1990 [T2020_30], Greenhouse gas emissions in ESD sectors [T2020_35]

4.8.2 Renewable energy sources

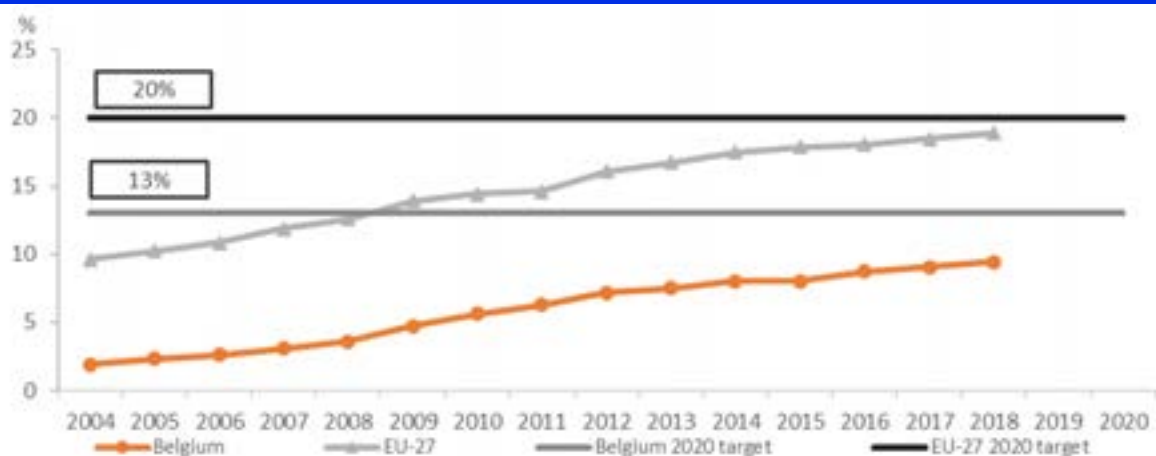
The following targets were set for Belgium regarding the share of energy from renewable energy sources in gross final energy consumption:

- a 20% share of gross final energy consumption by 2020,
- a 13% national target for share of energy from renewable sources in gross final consumption of energy in 2020.

The share of energy from renewable energy sources in Belgium was below EU wide and country specific targets in 2018.

Item 81: Share of energy from renewable energy sources in gross final energy consumption in Belgium

Share of energy from renewable energy sources in gross final energy consumption in Belgium in 2005-2018 and targets for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Share of energy from renewable sources [nrg_ind_ren]

4.8.3 Energy efficiency

The energy efficiency target set for Belgium were respectively:

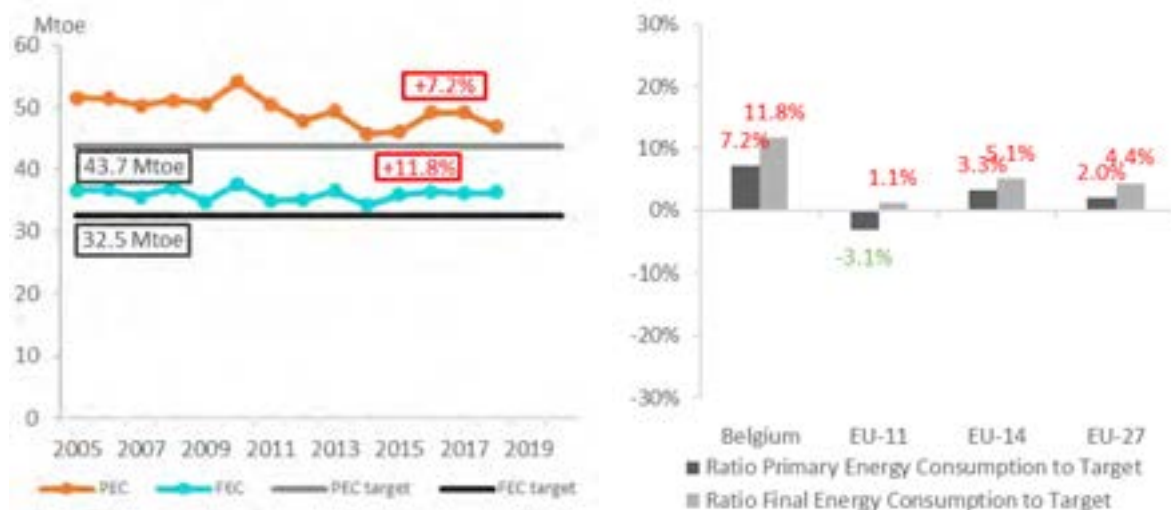
- Primary Energy Consumption in 2020: 43.7 Mtoe
- Final energy consumption in 2020: 32.5 Mtoe

Following the information provided in Item 82 the results for 2018 were above the targets in both criteria, respectively +7.2% of primary energy consumption and 11.8% of final energy consumption. This does not exclude Belgium to achieve the targets in 2020.

Item 82: Energy efficiency target data for Belgium

Primary energy consumption and final energy consumption in Belgium in 2005-2018 and targets for 2020

Ratio of primary energy consumption to target for 2020 and final energy consumption to target for 2020 in Belgium, EU-11, EU-14 and EU-27 in 2018



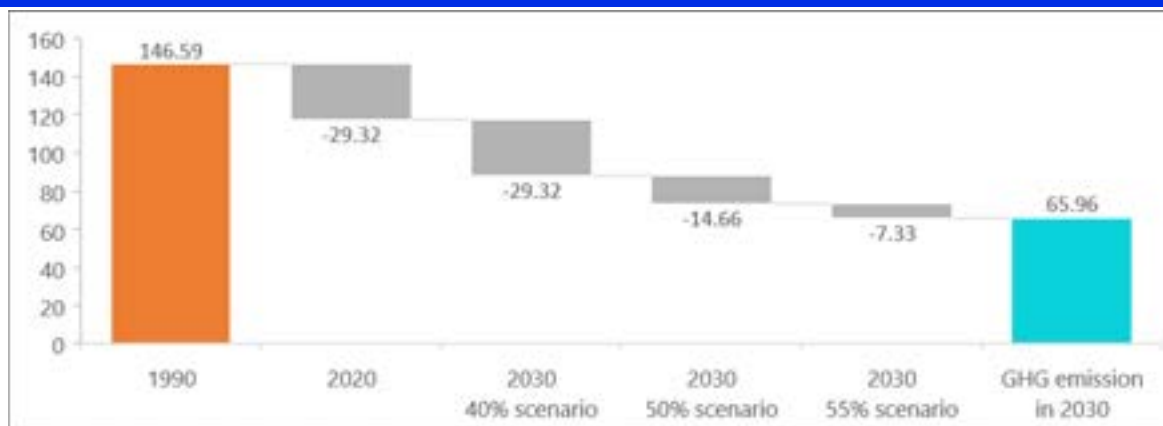
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Primary energy consumption - Primary energy consumption (Europe 2020-2030)(PEC2020-2030), final energy consumption - Final energy consumption (Europe 2020-2030) (FEC2020-2030). EU-11 and EU-14 data estimated based on Eurostat data

4.9 Review of potential impact of Green Deal propositions

At the current stage of discussions regarding the European Green Deal only partial information are available regarding the future targets. EU is proposing to increase the greenhouse gas emission reduction to 50% or 55% for 2030. This is a proposition included in the draft proposal of "Climate Law". Assuming the Belgium greenhouse gas emissions in 1990, an estimation of EU 2030 target emissions can be drafted. The 2020 target of 20% reduction resulted in 29.32 Mt CO₂ emission drop. Further increase of the target to 40% in 2030 require additional 29.32 Mt CO₂ reduction. If the 50% target proposed under European Green Deal is applied then additional 14.66 Mt CO₂ emission decrease is needed, or 21.99 Mt CO₂ decrease, if 55% target is adopted.

Item 83: Estimation regarding greenhouse gas emissions in Belgium under different scenarios (Mt CO₂)

Estimation regarding greenhouse gas emissions in Belgium under different scenarios (Mt CO₂)



Source: Eurostat data for 2018, extracted in 2020. Estimations delivered by the Author

Nevertheless, it is worth to highlight that, if the current structure of greenhouse gas emissions target is maintain, then the 50% target for 2030 is an EU wide target. It is not a binding element for specific countries. Country specific targets could be expected as per ESD and ESR but there is no way to anticipate the potential targets.

At the same time, the review of key EU regulations around climate and energy as:

- Emissions Trading System Directive;
- Effort Sharing Regulation;
- Land use, land use change and forestry Regulation;
- Energy Efficiency Directive;
- Renewable Energy Directive;
- CO₂ emissions performance standards for cars and vans
- Energy Taxation Directive

can bring some additional targets in area of share of energy from renewable energy sources and energy efficiency. For the moment, any estimation of potential targets is not available nor possible to estimate.



5 Denmark

5.1 General information

Denmark is the fourth smallest country within EU-14 group in terms of total country area and represents 1.4% of the area. At the same time, it is the 21st country in EU-27 with 1.0% of the area. It represents 1.7% of EU-14 population and 1.3% of EU-27 population, but 2.5% of its total nominal GDP of EU-14 and 2.2% of EU-27. Due the robust economic growth in 1995-2018 period, in 2018 Danish GDP per capita amounted to 129% of the whole EU average (129% in 1995).

Item 84: Denmark - key data



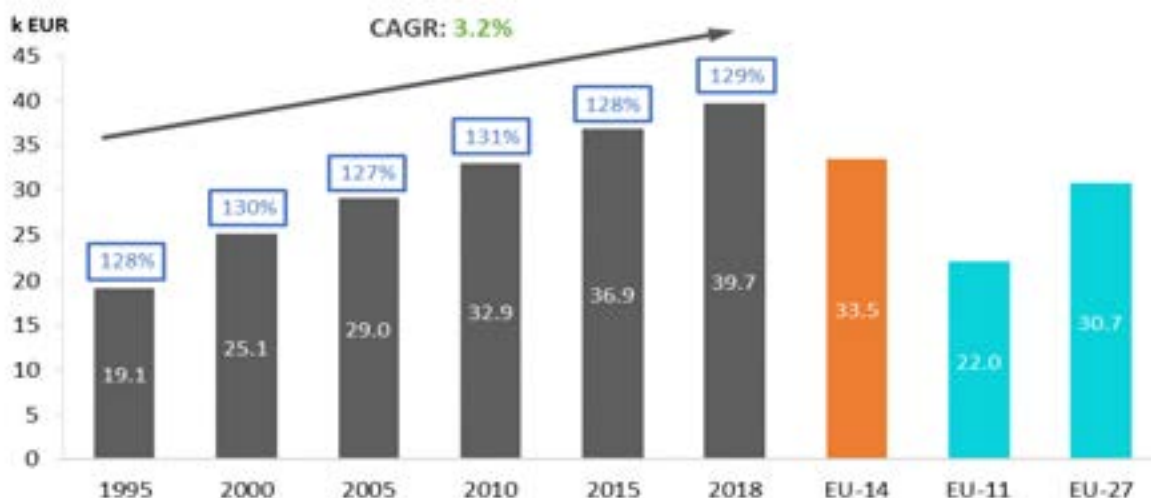
Key data

| | |
|------------------------------------------------------|--------|
| Population (M) | 5.8 |
| GDP per capita (EUR, nominal) | 53,430 |
| GDP per capita (EUR, PPS) | 39,670 |
| GDP as share of EU-14 | 2.5% |
| GDP as share of EU-27 | 2.2% |
| Energy intensity of the economy (kgoe per 1,000 EUR) | 84.1 |
| Greenhouse gas emissions (Mg per capita) | 8.3 |

Source: Eurostat data for 2018, extracted in 2020

With the compounded annual growth rate amounting to 3.2% Danish economy considerably grew in the period of 1995-2018 (see Item 85). Its GDP per capita was above EU-14 and EU-27 averages (equal to 119% and 129% of the respective averages). Its GDP per capita was also 180% of the average GDP per capita for EU-11 countries.

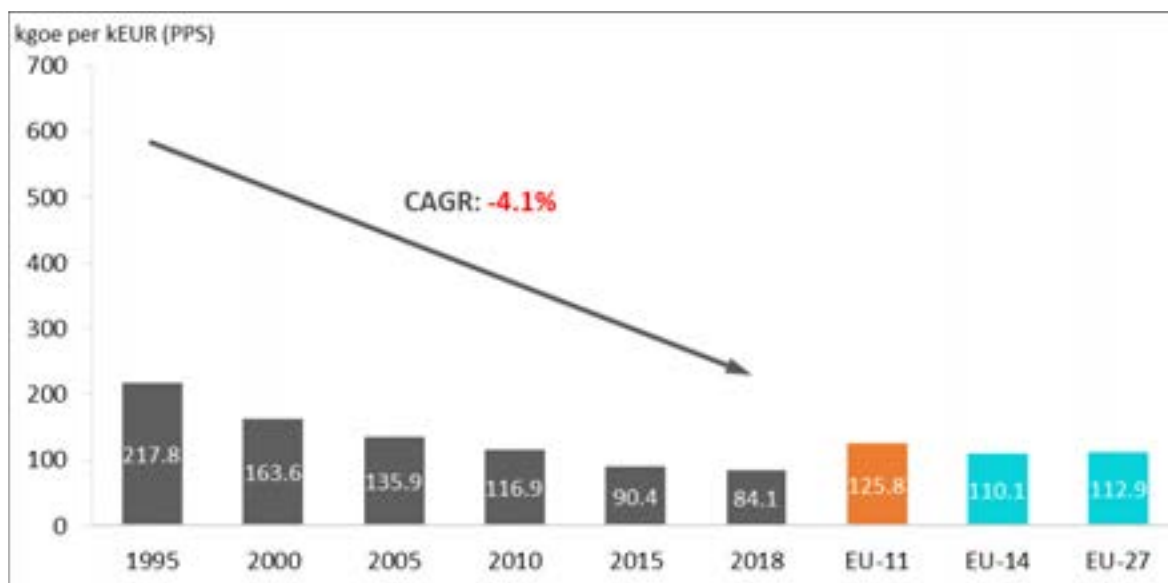
Item 85: GDP per capita in Denmark for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in 2018 (kEUR, PPS) and share of Denmark GDP per capita in relation to EU-27 average



Source: Eurostat data for 2018, extracted in 2020. Detail references: GDP per capita - Gross domestic product at market prices (B1GQ), Current prices, purchasing power standard per capita (CP_PPS_HAB)

The Danish economy energy intensity was about 84.1 kgoe per 1,000 EUR PPS in 2018, thanks to a decrease of the energy intensity indicator during the years 1995-2018. It dropped by 133.7 kgoe per 1,000 EUR PPS, i.e. it was reduced by about 61%. The energy intensity of Denmark in 2018 represented 67% and 75% of EU-14 and EU-27 averages. At the same time, it represented 76% of EU-11 average.

Item 86: Energy intensity of the economy in Denmark in 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)



Source: Eurostat data for 2018, extracted in 2020. Values for EU-11 and EU-14 were recalculated based on energy intensity and GDP data from Eurostat. Detail references: Energy intensity of GDP in purchasing power standards (PPS) - EI_GDP_PPS

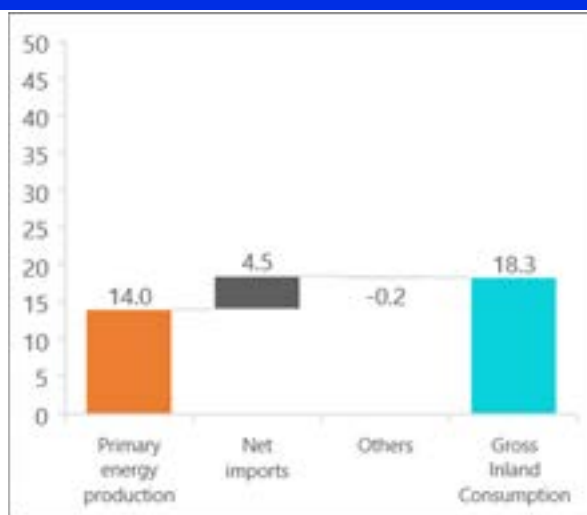
5.2 Energy balance of Denmark

The energy balance of Denmark in 2018 was presented in Item 87. The primary energy production was equal to 14.0 Mtoe in 2018. Net imports added 4.5 Mtoe to the balance. The total gross inland consumption accounted for 18.3 Mtoe. The level of import of energy to Belgium dropped in years 2000 below zero - the country became a net exporter of energy. After that, the import increased to the 4.5 Mtoe in 2018. The ratio of net import to energy needs also dropped from about 40% in 1995 to -40% in 2005 to increase later to about 25% in 2018.

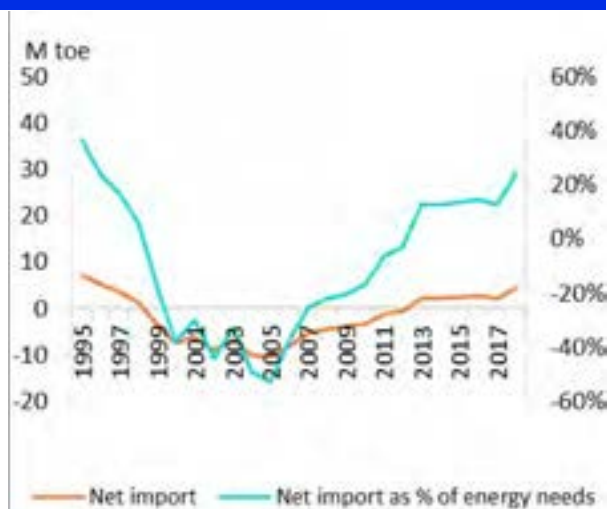
The primary energy production increased from 1995 to 2005 and then decreased to 2018. Gross energy consumption fluctuated around 20 Mtoe. National production was meeting 77% in 2018 of the country gross consumption but in years 1999-2012 the country was producing more energy than it was consuming.

Item 87: Energy balance in Denmark

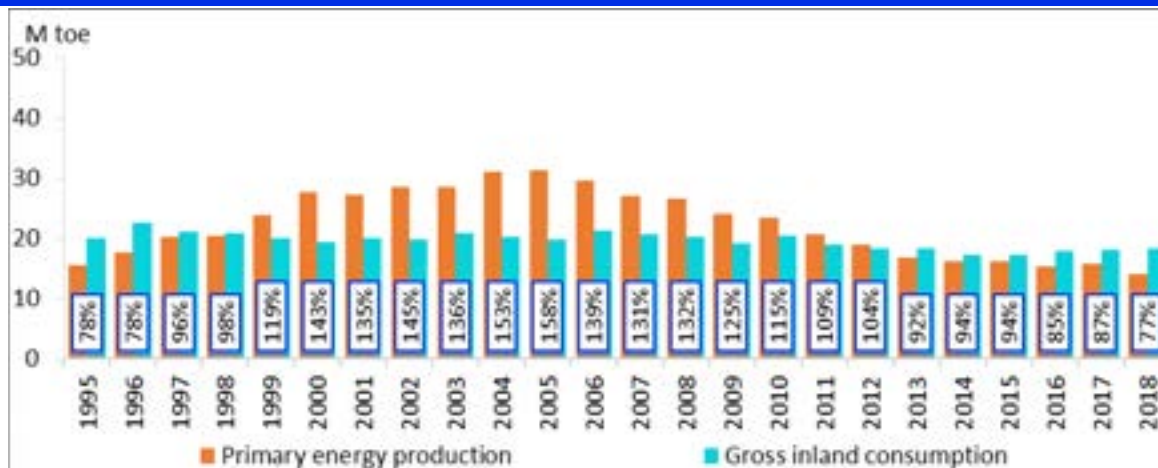
Energy balance in Denmark in 2018 (Mtoe)



Net import of energy in Denmark in 1995-2018 (Mtoe and as percentage of GIC)



Gross inland consumption, primary energy production (Mtoe) and ratio of primary energy production to gross inland consumption in 1995-2018 in Denmark (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Gross inland consumption - GIC. Net imports = Import (IMP) - Export (EXP), Other = Change in stock (STK-CHG) - International maritime bunkers (INTMARB)

The primary energy production in Denmark was dominated by oil (41%), gas (26%) and renewable energy sources (30%). The mix was completed by 3% share of other energy sources. Usage of solid fuels and nuclear energy was null.

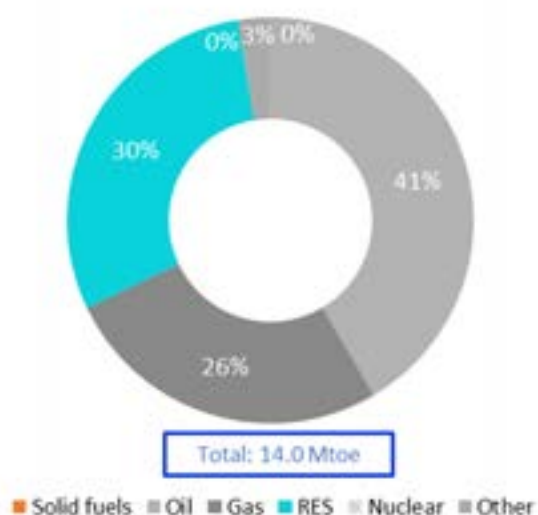
When compared to the European averages, Denmark was characterized by very high share of oil in the energy mix - 41% versus 4% EU-14 average and 5% EU-27 average. The share of gas in the Danish fuel mix was also higher than in EU-14 and EU-27 (26% versus 9% in EU-14 and EU-27), as well as use of gas (30% versus 38% and 34%). In opposite to EU averages Denmark was not using solid fuels and nuclear energy for primary energy production.

The comparison of Denmark to EU-11 averages was mainly characterized by much higher share of oil (41% versus 7%), higher share of gas (26% versus 9%) and higher share of RES

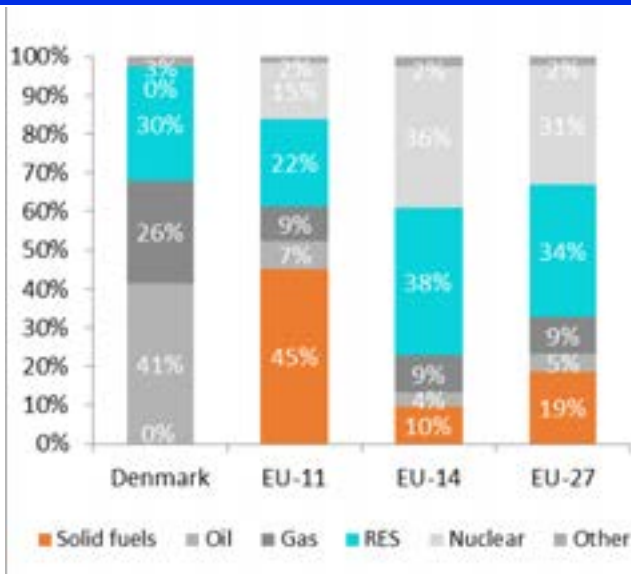
(30% versus 22%). At the same time there was not solid fuels and nuclear energy in use in Denmark for primary energy production versus 45% and 15% in EU-11 countries.

Item 88: Primary energy structure in Denmark

Primary energy structure in Denmark in 2018 (%)



Primary energy production structure in Denmark in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H) , Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

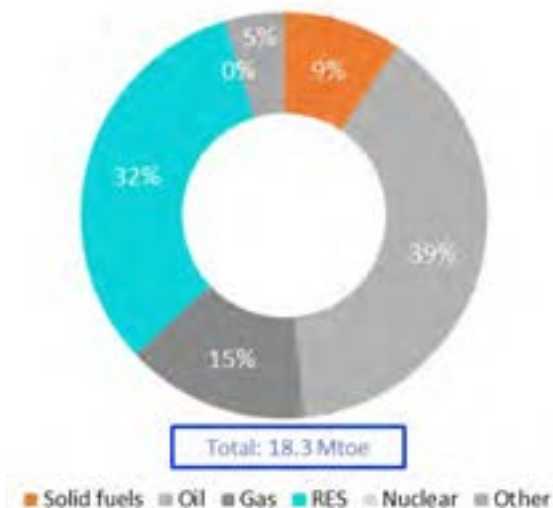
Gross inland consumption of energy in Denmark was dominated by oil (39%), renewable energy sources (32%) and gas (15%). The mix was completed by 9% of solid fuels and 5% of other energy sources.

Comparing to European averages gross inland consumption of energy in Denmark was marked by low share of solid fuels (9% versus 11% in EU-14 and 14% in EU-27). The share of oil was higher in Denmark (39%) than in EU-14 (35%) and EU-27 (34%) whereas the share of gas was lower (15% versus 23% and 22% in EU-14 and EU-27). Denmark was characterized by much higher share of renewable energy sources in the mix - 32% versus 16% and 15% in EU-14 and EU-27 respectively, and lack of nuclear energy in the mix (versus 14% in EU-14 and 13% in EU-27).

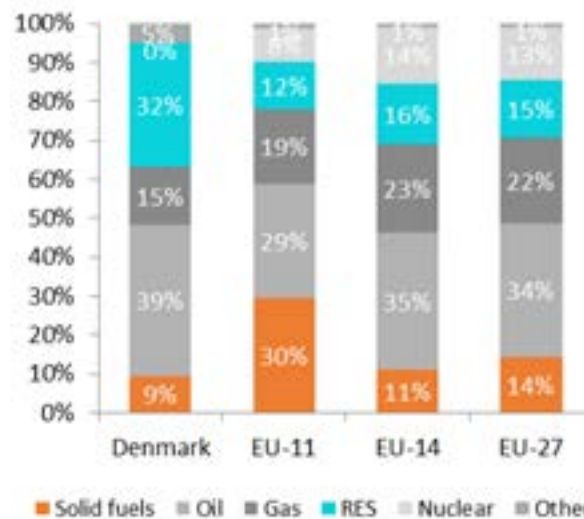
When compared to EU-11 the main difference was around much lower share of solid fuels consumption in Denmark (9% versus 30% in EU-11) and higher share of renewable energy sources (32% versus 12%). The share of oil use in Denmark was also higher than in EU-11 countries (39% versus 29% respectively). The share of gas was lower in Denmark than in EU-11 - 15% versus 19%. EU-11 average gross final consumption includes nuclear energy at 8%. Denmark was not using nuclear energy.

Item 89: Gross inland consumption structure in Denmark

Gross inland consumption structure in Denmark in 2018 (%)



Gross inland consumption structure in Denmark in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gross inland consumption – GIC, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion)(O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear – Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

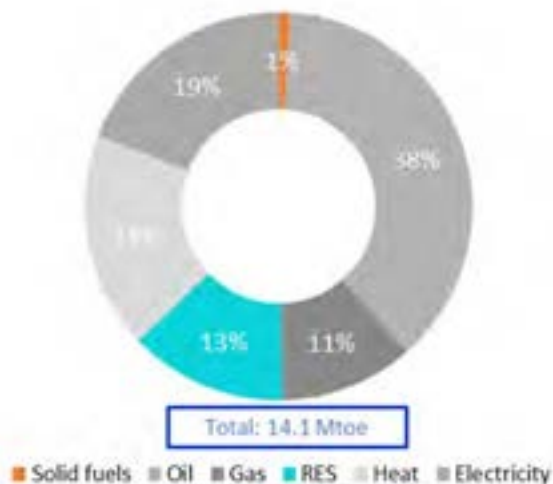
The final energy consumption in Denmark was dominated by oil (38%), followed by electricity (19%), heat (18%), renewable energy sources (13%) and gas (11%). The mix was completed by solid fuels (1%).

The sectoral final energy consumption in Denmark was characterized by lower share of industrial and the same share of transport sectors than in EU-14 and EU-27 (17% and 31% versus 26% and 31% in EU-14 and EU-27). The share of commercial and public services was lower in final energy consumption in Denmark (14%) than in EU-14 (15%) and equal to the one in and EU-27 (14%).

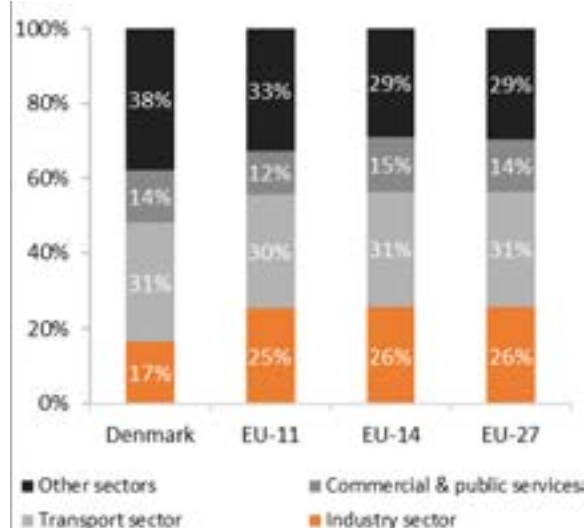
When compared to EU-11 Denmark similar conclusions as related to EU-14 and EU-27 can be drawn.

Item 90: Final energy consumption structure in Denmark

Final energy consumption structure in Denmark in 2018 (%)



Final energy consumption structure in Denmark in 2018 in comparison with EU-11, EU-14, and EU-27 averages



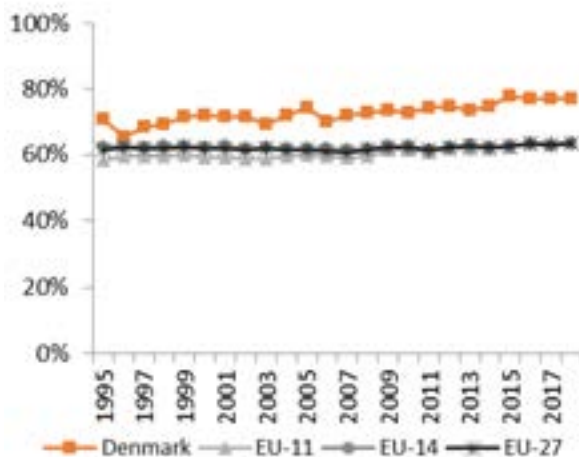
Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Heat (H8000), Electricity (E7000), Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial & public services - FC_OTH_CP_E, Other - FC_OTH_E-FC_OTH_CP_E. Errors in summation to 100% are due to rounding

Danish final energy consumption to gross inland consumption ratio which measure energy efficiency was higher than the averages for EU-11, EU-14 and EU-27. It increased over last 23 years.

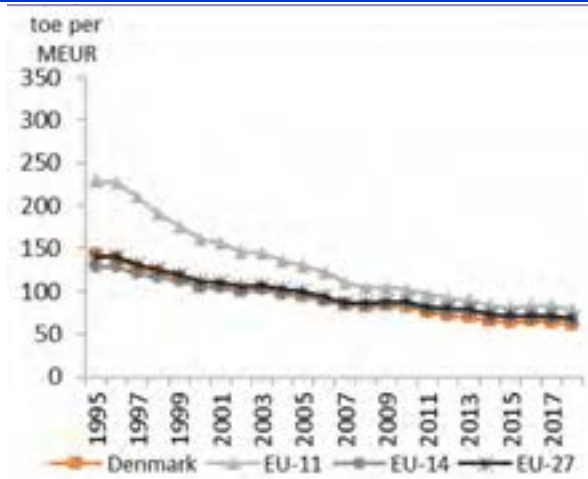
Simultaneously, a decrease of energy volume associated with generating gross domestic product was noticed in line with the averages for EU-14 and EU-27 averages.

Item 91: Final energy consumption in Denmark in relation to selected indicators

Final energy consumption to gross inland consumption ratio in Denmark in 1995-2018 (%)



Final energy consumption to gross domestic product ratio in Denmark in 1995-2018 in comparison with EU-11, EU-14, and EU-27 averages (toe per M EUR)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final energy consumption - FEC, Gross inland consumption - GIC, Gross Domestic Product - Gross domestic product at market prices B1GQ, Current prices - CP-MEUR

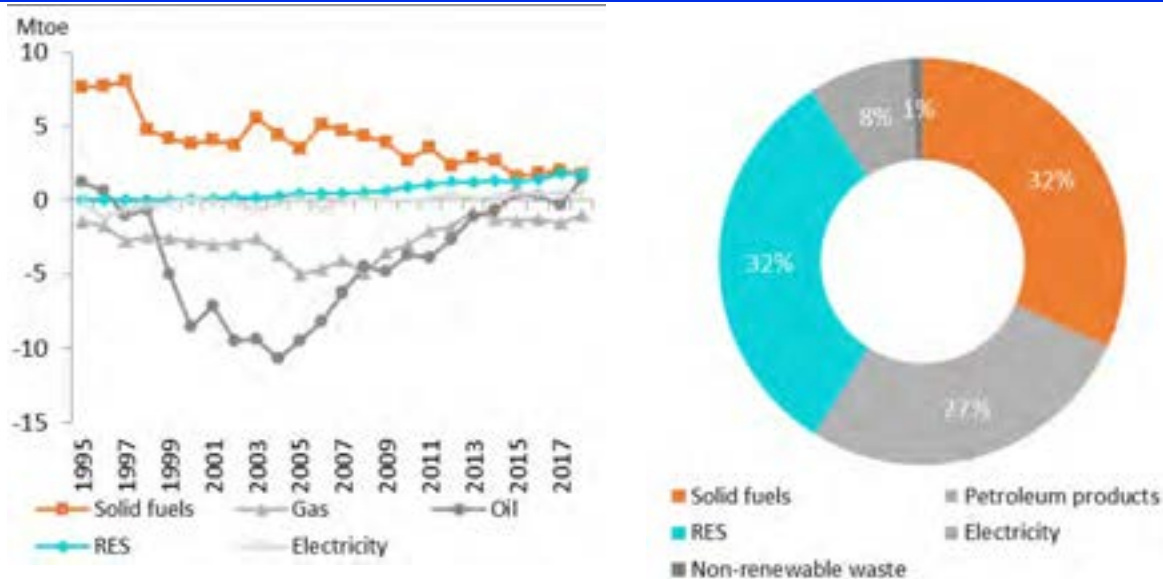
Net import of energy to Denmark by fuels was characterized by a decrease of solid fuels imports and an increase of renewable energy source import. Up to 2005 Denmark net import of gas and oil was decreasing and was negative (i.e. Denmark was an exporter).

The import structure of energy to Denmark was dominated by solid fuels (32%), oil (27%) and renewable energy sources (32%). The imports were completed by 8% of electricity and 1% of non-renewable waste.

Item 92: Net import of energy in Denmark

Net import of energy by fuel in 1995-2018 (Mtoe)

Net import structure in 2018 (% only fuels for which import is greater than export)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Electricity (E7000). Errors in summation to 100% are due to rounding

Solid fuels were imported to Denmark mainly from Russia (68%), South Africa (19%), Colombia (9%) and several other countries.

Main oil importers to Denmark were Norway (40%), Russia (15%), United States (11%) and Sweden (9%). The remaining 25% were imported from various locations.

Denmark was importing gas mainly from Norway (75%) and Germany (25%).

Electricity was mainly imported from Germany (38%), Norway (32%) and Sweden (30%).

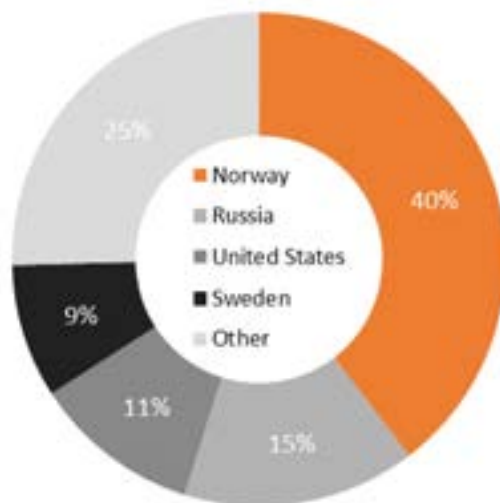
Item 93: Foreign fuel suppliers

Foreign suppliers of solid fuels in Denmark in 2018 (%)



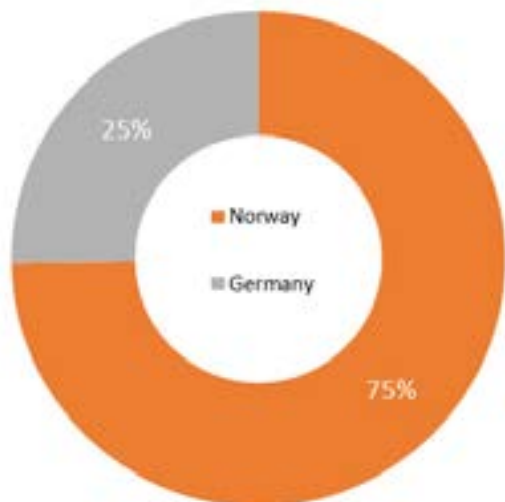
Total: 1.8 Mtoe

Foreign suppliers of crude oil in Denmark in 2018(%)



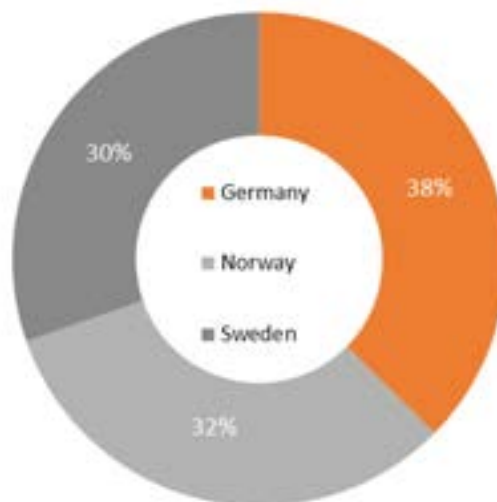
Total: 11.0 Mtoe

Foreign suppliers of gas in Denmark in 2018 (%)



Total: 0.3 Mtoe

Foreign suppliers of electricity in Denmark in 2018 (%)



Total: 1.3 Mtoe

Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fossil fuels - C000X0350-0370, Gas - Natural gas (G3000), Oil - Oil and petroleum products (excluding biofuel portion) (O4000XBIO), Electricity - E7000. Errors in summation to 100% are due to rounding

5.3 Greenhouse gas emissions

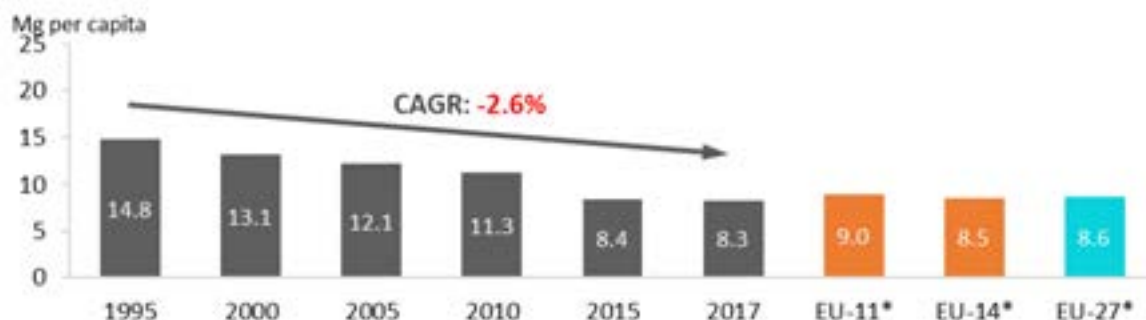
Between 1995-2017 greenhouse gases emissions in Denmark were decreased - from over 69.2 Mt CO₂ in 1995 to 47.6 Mt CO₂ in 2017. Consequently average emissions per capita decreased to 8.3 Mg CO₂ per capita in 2017 (from 14.8 Mg CO₂ per capita in 1995), which was lower higher comparing to EU-14 and EU-27 averages (8.5 Mg CO₂ per capita and 8.6 Mg CO₂ per capita, respectively), and also lower than in EU-11 (9.0 Mg CO₂ per capita)

The reduction of GHG emissions occurred in all sector except transport where it increased by 9.4% in 23 years. Most significant reduction were observed in energy industries (65%).

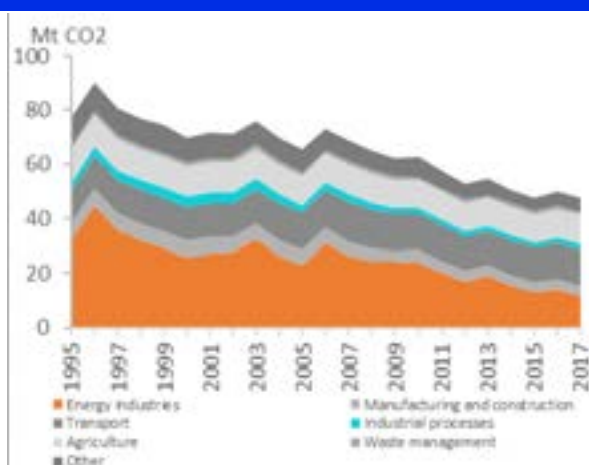
Comparing to EU-11, EU-14 and EU-27 countries, Denmark was characterized by higher share of emissions from transport (28% versus 17%, 23% and 21%). Share of emissions from energy industries was lower, the same for manufacturing and construction sectors, industrial processes, and waste management.

Item 94: Greenhouse gas emissions in Denmark

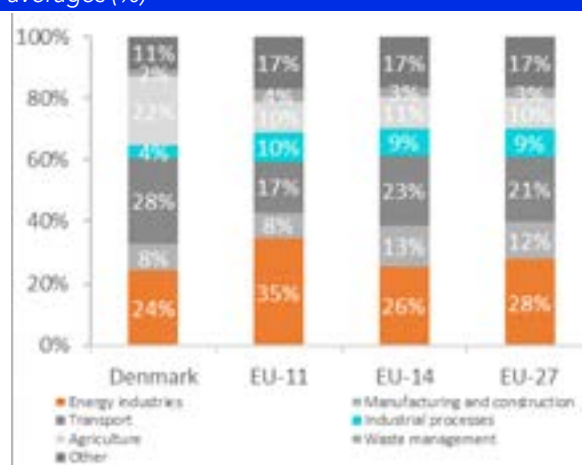
Greenhouse gas emissions per capita in Denmark in 1995-2017 in comparison with EU-11, EU-14 and EU-27 averages in 2017 (Mg per capita)



Greenhouse gas emissions in Denmark by sectors in 1995-2017 (Mt CO₂)



Greenhouse gas emissions in Denmark by sectors in 2017 in comparison with EU-11, EU-14 and EU-27 averages (%)



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - * values for EU-11, EU-14 and EU-27 recalculated by the Author; Energy industry - Fuel combustion in energy industries (CRF1A1), Manufacturing and construction - Fuel combustion in manufacturing industries and construction (CRF1A2), Transport - Fuel combustion in transport (CRF1A3), Industrial processes - Industrial processes and product use (CRF2), Agriculture - Agriculture (CRF3), Waste management - Waste management (CRF5), Other = Other fuel combustion sectors (CRF1A4)+ Other fuel combustion sectors n.e.c. (CRF1A5) + Fuels - fugitive emissions (CRF1B)+Other sectors (CRF6); Total GHG emissions equal to All sectors (excluding LULUCF and memo items) (CRF1-6X4_MEMO) i.e. emission from all sectors excluding Land use, land use change, and

forestry (LULUCF), Transport and storage of CO₂ (memo item), International aviation (memo item), International navigation (memo item), Multilateral operations (memo item), Biomass - CO₂ emissions (memo item). Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. Errors in summation to 100% are due to rounding

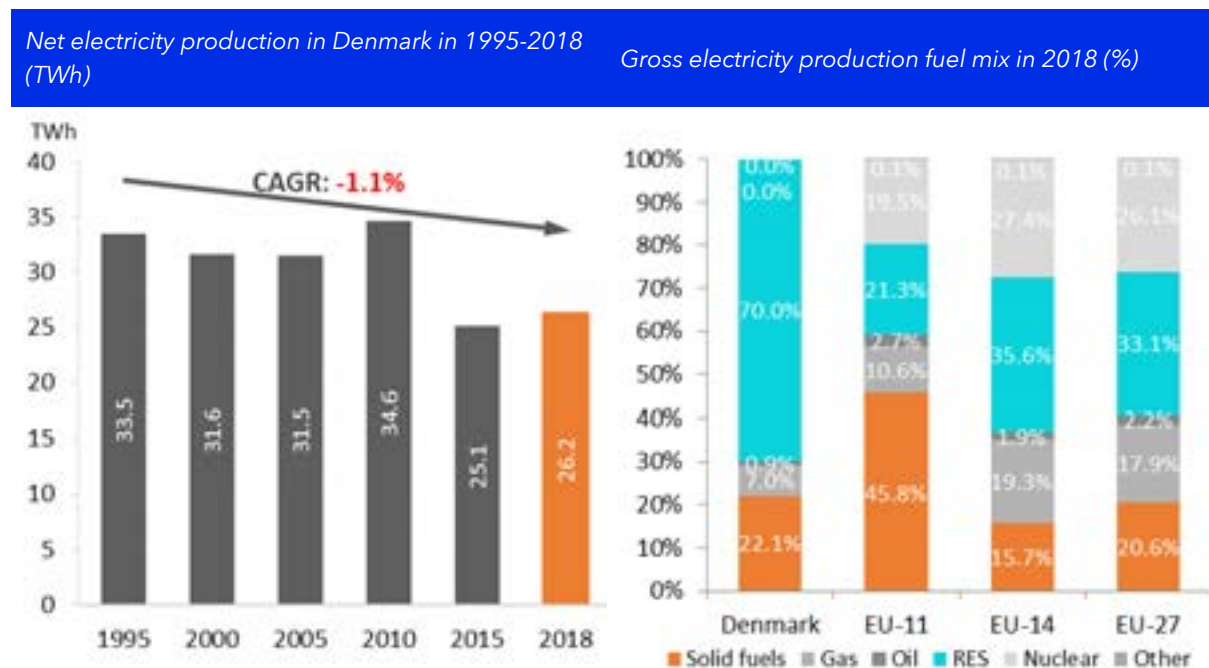
5.4 Overview of electricity sector

Item 95 presents electricity production and the current fuel mix of Denmark. Over last 23 years net electricity production decreased from 33.5 TWh in 1995 to 26.2 TWh in 2018 (CAGR -1.1%). As visible, net electricity production represented 1.2% of EU-14 total electricity production, which was lower compared to Danish GDP share of 2.5%.

The Danish fuel mix was dominated by renewable energy sources with shares of 70.0%. The mix was completed by 22.1% of solid fuels and small shares of gas (7.0%) and oil (0.9%). Compared to EU-14 and EU-27 countries, Denmark had a much bigger share of renewable energy sources in its energy mix and it also had a higher share of solid fuels (22.1% versus 15.7% and 20.6%). On other hand, the country produced relatively less electricity from gas and oil, respectively 7.0% and 0.9%.

When compared to EU-11 average fuel mix one can notice much higher share of renewable energy sources used in Denmark than in EU-11 (70.0% versus 21.3%) and significantly lower use of solid fuels (22.1% versus 45.8%). The share of gas was lower in Denmark (7.0% versus 10.6%), the same as the share of oil (0.9% versus 2.7%). Denmark was not using nuclear energy for electricity generation in opposite to EU-11 and EU-14 averages where the share of nuclear was 19.5% and 27.4% respectively.

Item 95: Net electricity production and gross electricity production fuel mix in Denmark



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Electricity Production - NEP, Gross Electricity Production - GEP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear

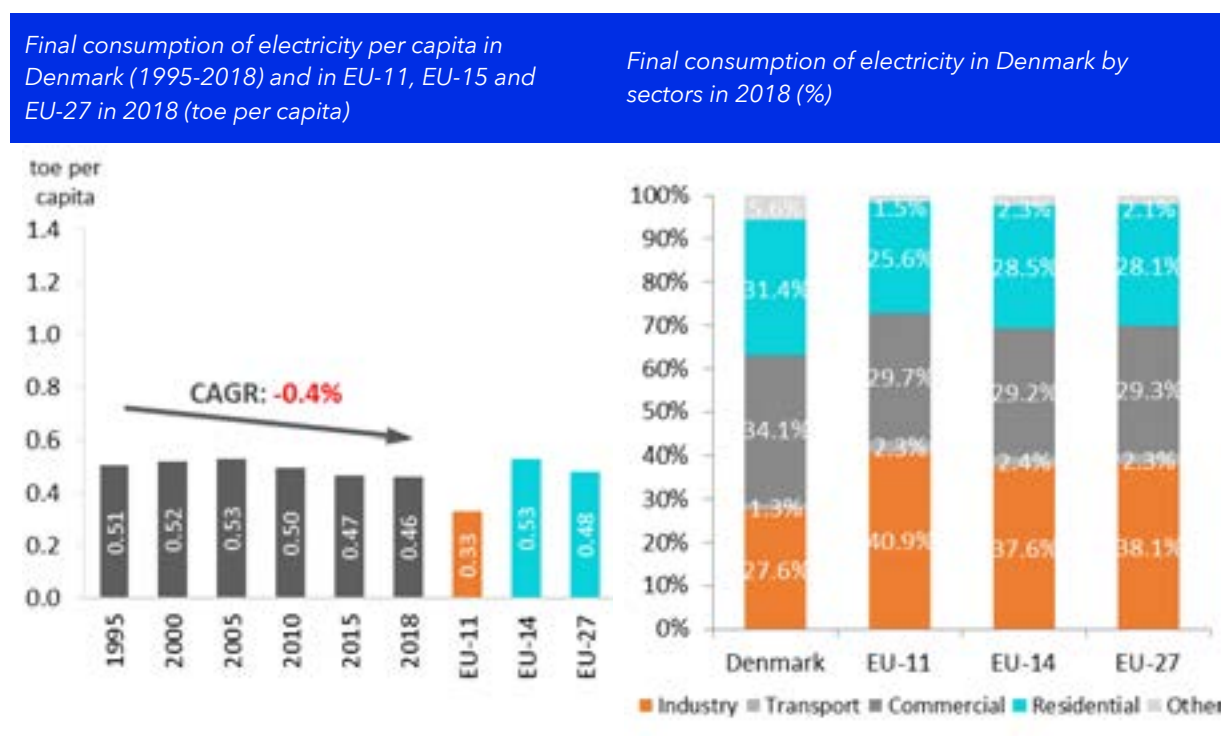
= Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

In Item 96 the evolution of final per capita consumption of electricity and its breakdown by economic sector is presented. In recent years final consumption of electricity in Denmark decreased (CAGR in the period of 1995-2019 was around -0.4%) and its level was lower compared to EU-14 and EU-27 countries. Danish final energy consumption per capita represented 87.1% of EU-14 level and 95.5% of EU-27 level.

The structure of final electricity consumption in Denmark was dominated by residential and commercial sectors (31.4% and 34.1% versus 28.5% and 29.2% in EU-14 countries). Relatively less energy was used in transport (1.3% versus 2.4%) and less in industry (27.6% versus 37.6%).

Denmark was consuming relatively more electricity in residential sector than EU-11 countries (31.4% versus 25.6%) and commercial one (34.1% versus 29.7%). At the same time, it used relatively less electricity in industry and transport (27.6% and 1.3% versus 40.9% and 2.3%).

Item 96: Final consumption of electricity in Denmark



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Electricity E7000. Errors in summation to 100% are due to rounding

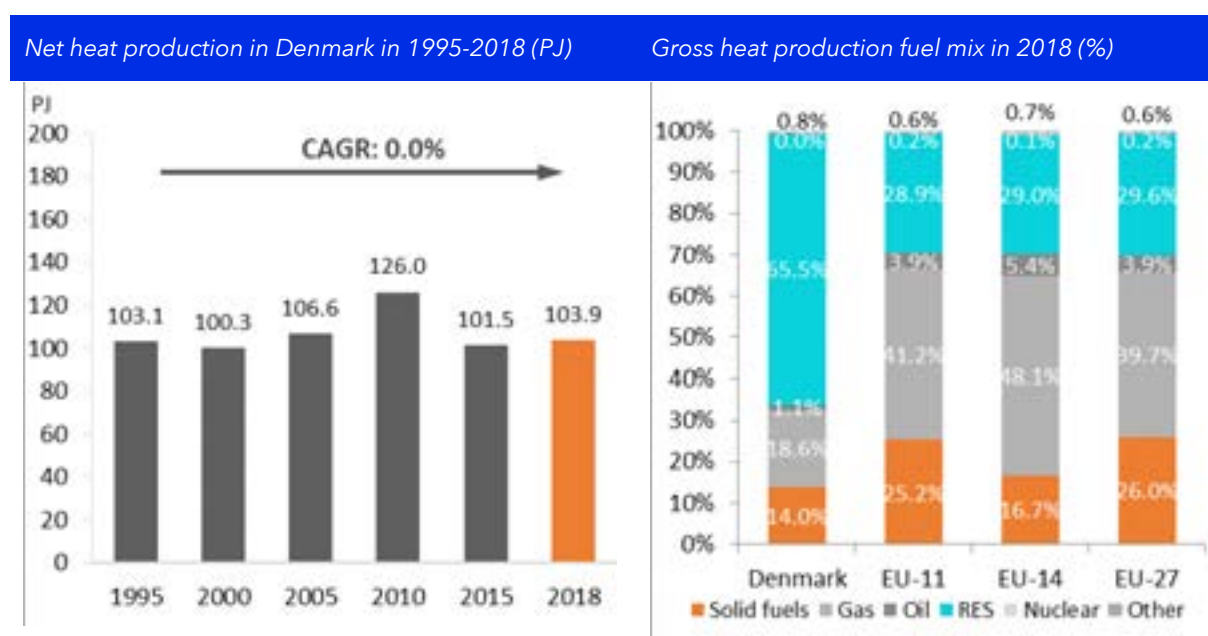
5.5 Overview of heat sector

Item 97 presents heat production and the current fuel mix of Denmark. Over last 23 years net heat production increased from 103.1 PJ in 1995 to 103.9 PJ in 2018 (CAGR <0.1%).

The Danish fuel mix of heat production was dominated by renewable energy sources with share of 65.5% and gas with share of 18.6%. The mix was completed by 14.0% of solid fuels and 1.1% of oil. Compared to EU-14 and EU-27 countries, Denmark had a much bigger share of renewable energy sources in its heat production mix. On other hand, the country produced relatively less heat from solid fuels and oil, respectively 14.0% and 1.1%. The share of gas was also lower - 18.6% versus 48.1% in EU-14. Denmark did not use nuclear energy for heat production where some heat was produced in nuclear facilities in EU-14 countries (0.1%).

When compared to EU-11 average fuel mix one can notice much higher share of renewable energy sources used in Denmark than in EU-11 (65.5% versus 28.9%) and significantly lower use of solid fuels (14.0% versus 25.2%). The share of gas was lower in Denmark (18.6% versus 41.2%) as well as the share of oil (1.1% versus 3.9%). Denmark was not using nuclear energy for heat generation in opposite to EU-11 where the share of nuclear was 0.2%.

Item 97: Net heat production and gross electricity production fuel mix in Denmark



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Heat Production - NHP, Gross Heat Production - GHP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

Item 98 presents final heat consumption per capita and its breakdown by sectors.

The per capita demand for heat in Denmark increased from 0.43 toe per capita in 1995 to 0.44 toe per capita in 2018. As a result, within the 23 years analyzed, heat consumption per capita increased at CAGR of 0.1%. The heat consumption remained higher than the

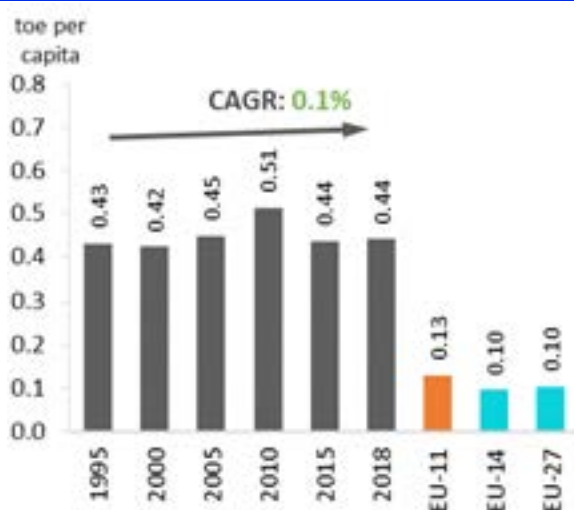
averages for EU-11, EU-14 and EU-27, respectively 0.13 toe per capita, 0.10 toe per capita and 0.10 toe per capita.

The structure of final consumption of heat in Denmark was characterized by higher share of commercial (30.3% compared to 21.3% in EU-14) and higher residential usage (65.2% compared to 40.1% in EU-14). The share of industry in heat consumption was lower than the averages (3.1% compared to 37.9% in EU-14).

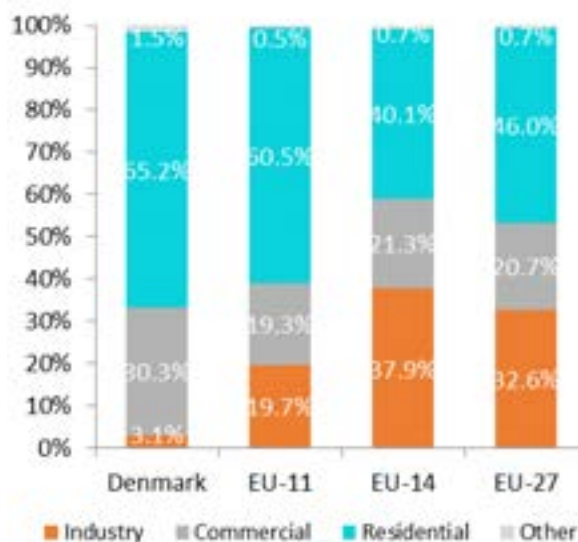
In relation to EU-11 countries, the structure of final heat consumption in Denmark was characterized by higher share of residential sector (65.2% versus 60.5%) and higher share of commercial sector (30.3% versus 19.3%). The industrial use of heat consumed 3.1% of it in Denmark whereas 19.7% in EU-11.

Item 98: Final consumption of heat in Denmark

Final consumption of heat per capita in Denmark (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)



Final consumption of heat in Denmark by sectors in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Heat H8000. Errors in summation to 100% are due to rounding

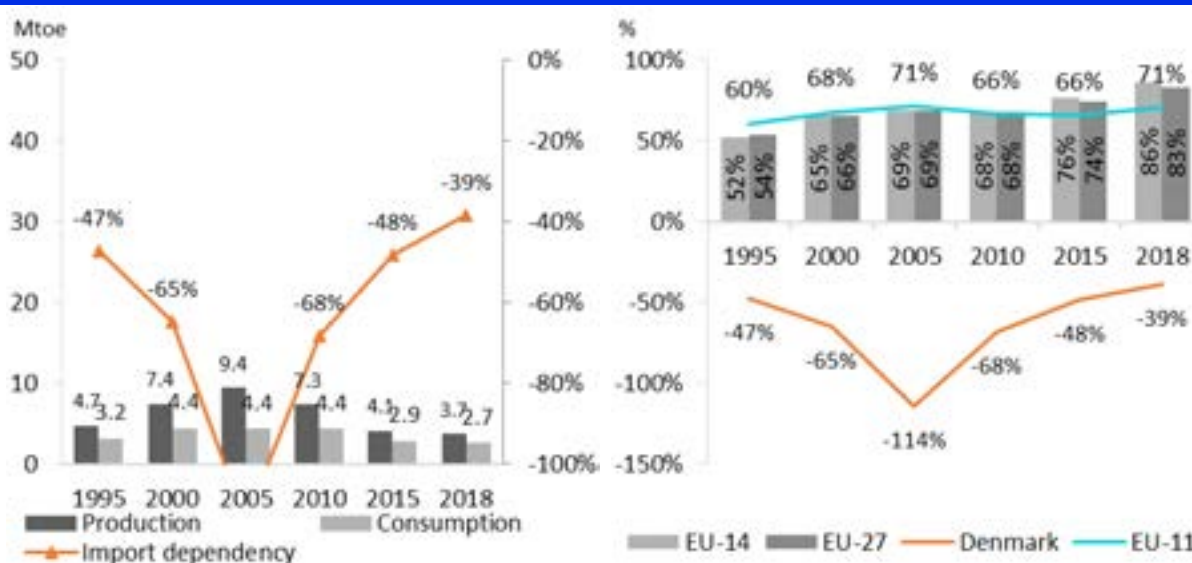
5.6 Overview of gas sector

Denmark consumed 2.7 Mtoe of gas in 2018. It increased from 3.2 Mtoe in 1995 to 4.4 Mtoe in 2010 and then decreased. National production accounted for 3.7 Mtoe and it decreased since 2005 from 9.4 Mtoe to the current value. Denmark was not a net importer of gas in 2018. The country was exporting gas and therefore, its dependency on import was negative. Therefore, in 2018 the country was less dependent on import than EU-11, EU-14 and EU-27 average values.

Item 99: Gas sector in Denmark

Gas production, gross consumption and import dependence in Denmark in 1995-2018 (Mtoe)

Gas Import dependence in Denmark and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gas production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Natural Gas G3000

The final consumption of gas per capita in Denmark decreased from 0.32 toe per capita to 0.27 toe per capita over past 23 years. This value was lower than the average values for EU-14, EU-11 and EU-27 countries.

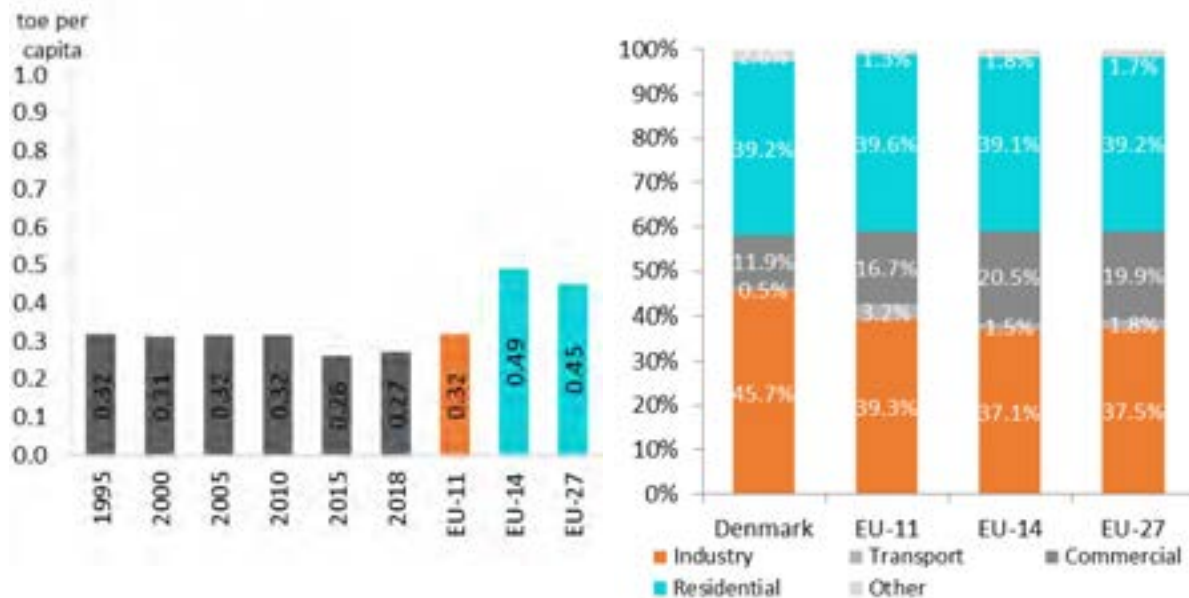
The structure of final gas consumption in Denmark in 2018 was characterized by high share of industry - 45.7% versus 37.1% in EU-14. The share of use of gas in transport and commercial sector were lower but residential use of gas represented more than in EU-14 countries, 39.2% versus 39.1%.

When compared to EU-11 countries, Denmark was using relatively more gas industry than EU-11 countries - 45.7% versus 39.3%. The country was using more gas in transport - 0.5% versus 3.2%. The share of gas used in commercial and residential sectors were lower than in EU-11 countries, 11.9 versus 16.7% and 39.2% versus 39.6% respectively.

Item 100: Final consumption of gas per capita in Denmark in 1995-2018 and gas final consumption by sectors in Denmark and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of gas per capita in Denmark (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Gas final consumption by sectors in Denmark and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Natural Gas G3000. Errors in summation to 100% are due to rounding

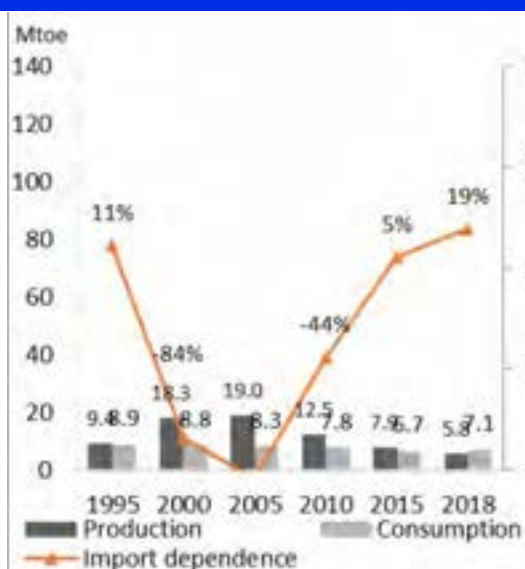
5.7 Overview of oil sector

The oil consumption of Denmark dropped from 8.9 Mtoe in 1995 to 7.1 Mtoe in 2018. At the same time the national production dropped from 9.4 Mtoe to 5.8 Mtoe. Therefore, the level of import dependency was fluctuating. In 1995 Denmark was an importer of oil. In next year it became an exporter and in 2015 it became again importer.

When compared to EU-14 and EU-27 average import dependency, the country had a lower import dependency of 19% versus 95% in EU-14 and EU-27 countries. At the same time, the import dependency of the country was lower than EU-11 average - 19% versus 92%.

Item 101: Oil sector in Denmark

Oil production, gross consumption and import dependence in Denmark in 1995-2018 (Mtoe)



Oil Import dependence in Denmark and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Oil production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Import dependence above 100% has been rounded to 100%

The final consumption of oil per capita in Denmark decreased from 1.27 toe per capita in 1995 to 0.91 toe per capita in 2018. The level of final consumption per capita remained higher than the one for EU-11, EU-14 and EU-27.

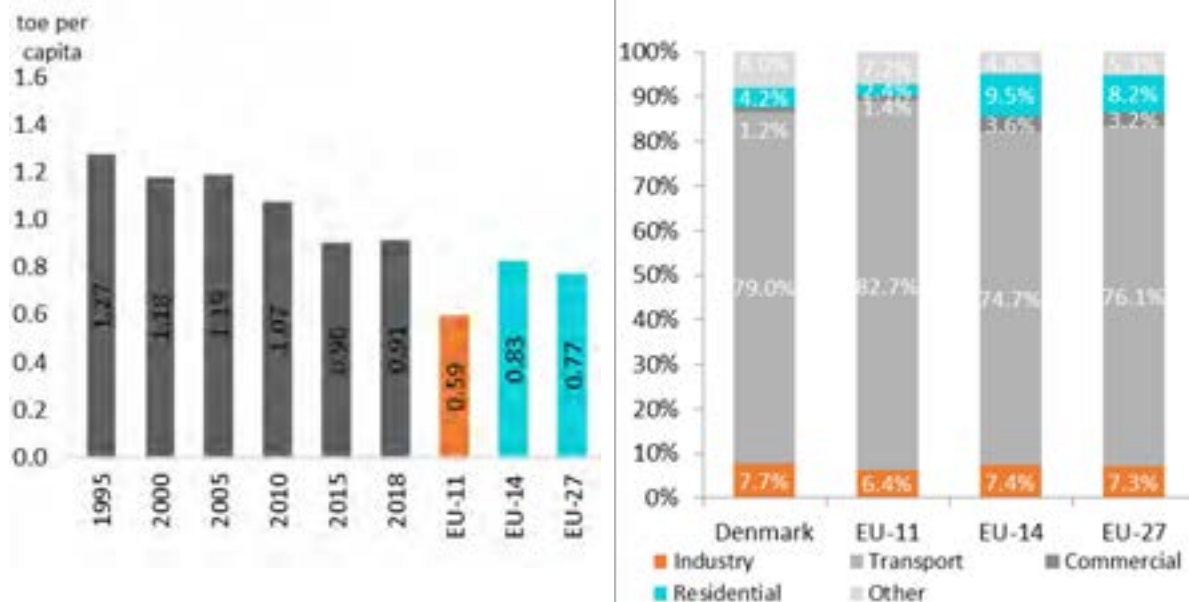
Oil consumption was dominated by transport sector - 79.0% versus 74.7% in EU-14 countries. Relatively more oil was used in industry - 7.7% versus 7.4%. The residential and commercial use of oil were lower than EU-14 average - 4.2% versus 9.5% and 1.2% versus 3.6%.

The relative consumption of oil in Denmark compared to EU-11 was lower in 2018 - 79.0% versus 82.7%. The use in industry was relatively higher - 7.7% versus 6.4%, the same as in residential sector - 4.2% versus 2.4%. The commercial sector was consuming relatively less oil in the country than EU-11 averages - 1.2% versus 1.4%.

Item 102: Final consumption of oil per capita in Denmark in 1995-2018 and oil final consumption by sectors in Denmark and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of oil per capita in Denmark (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Oil final consumption by sectors in Denmark and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Errors in summation to 100% are due to rounding

5.8 EU climate policy and its targets for Denmark

Denmark is subject to EU energy and climate regulations and therefore, specific targets were set and verified regarding greenhouse gas emission, share of energy from renewable energy sources and energy efficiency improvements (see Item 103).

Item 103: Energy and climate targets for Denmark for 2020 and 2030

| | Denmark 2020 targets | Denmark 2030 targets |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | EU wide target of 20% reduction from 1990 levels (14% from 2005 level) | EU wide target of 40% reduction from 1990 levels |
| Greenhouse gas emissions in ETS | EU wide target of 21% reduction from 2005 | EU wide target of 43% reduction from 2005 |
| National emission reduction targets in non-ETS - Effort Sharing Decision (ESD) | -20% in relation to their 2005 levels | - |
| National emission reduction targets in non-ETS - Effort Sharing Regulations (ESR) | - | -39% in relation to their 2005 levels |
| Share of energy from renewable energy sources | EU wide target of 20% energy from renewables | EU wide target of minimum 32% share for renewable energy |
| EU wide target of share of energy from renewable energy sources | EU wide target of 20% share of gross final energy consumption | EU wide target of 32% share of gross final energy consumption |
| National target of share of energy from renewable energy sources | 30% of gross final consumption | Not yet available |
| Improvement in energy efficiency | EU wide target of 20% improvement in energy efficiency | EU wide target of at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |
| Primary energy consumption | EU wide target < 1,483 Mtoe National target < 17.4 Mtoe | EU wide target of 1,273 Mtoe (< 1,128 Mtoe EU-27) National targets not available yet |
| Final energy consumption | EU wide target < 1,086 Mtoe National target < 14.4 Mtoe | EU wide target < 956 Mtoe (< 846 Mtoe EU-27) National targets not available yet |

Source: EU website

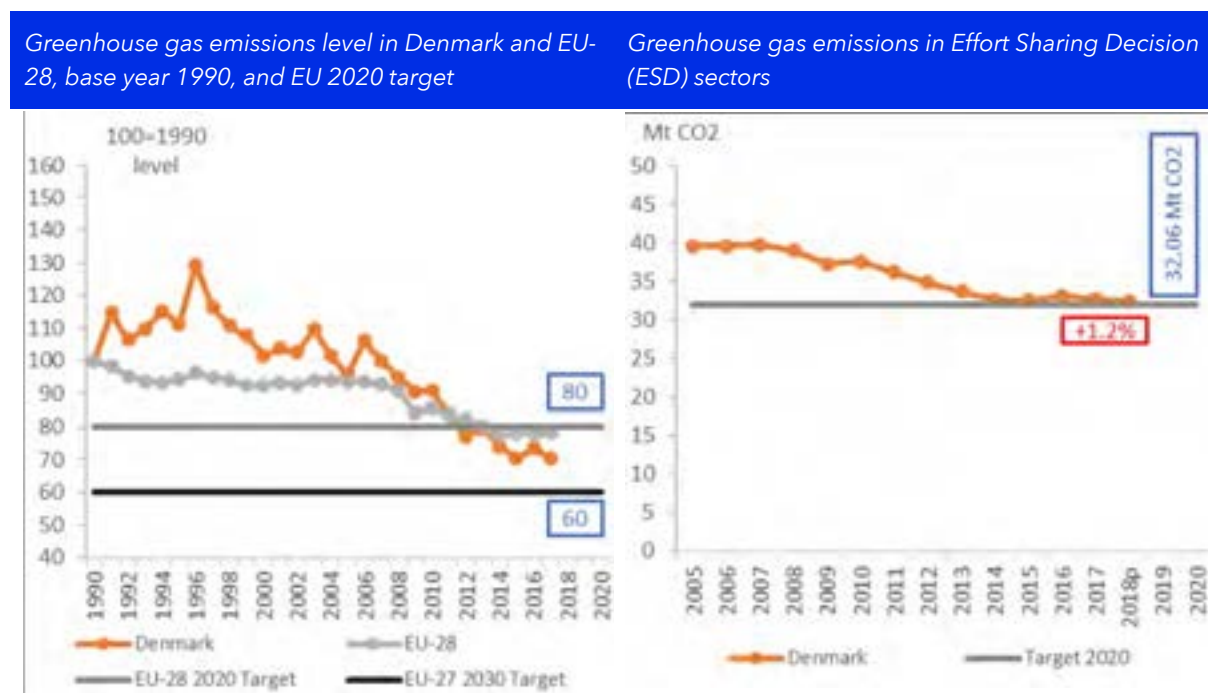
In following chapter, the overview of Denmark targets and performance are summarized.

5.8.1 Greenhouse gas emissions

EU set a target for CO₂ reduction by 20% compared to 1990 level at EU level. Regardless the fact that the target was not binding for specific country, the level of CO₂ emission in Denmark was below EU wide target in 2018.

The non-ETS greenhouse gas emissions the binding national targets for Denmark was 32.06 Mt of CO₂ equivalent emissions. Comparing to 2018 provisional results the level of emissions exceeds the target by 1.2%.

Item 104: Energy efficiency target data for Denmark



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Greenhouse gas emissions, base year 1990 [T2020_30], Greenhouse gas emissions in ESD sectors [T2020_35]

5.8.2 Renewable energy sources

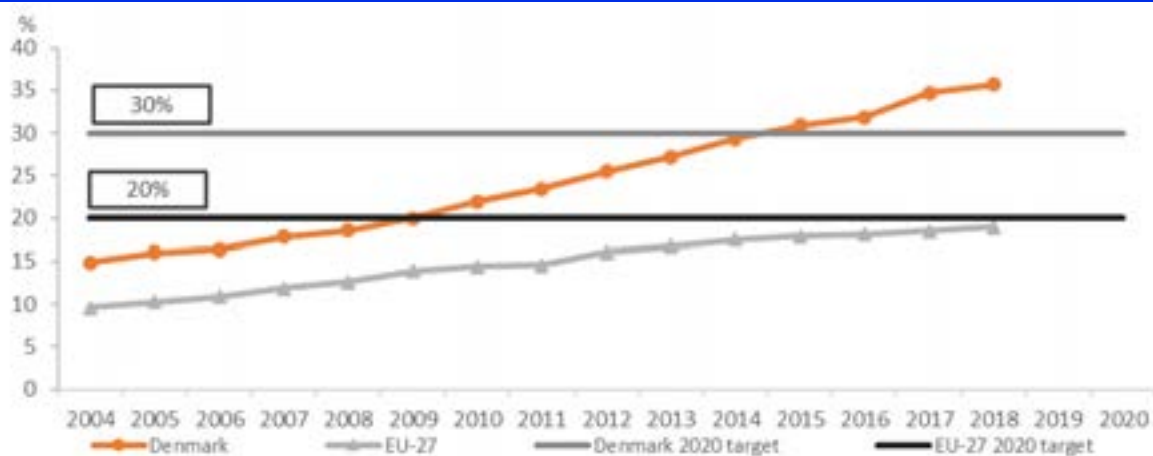
The following targets were set for Denmark regarding the share of energy from renewable energy sources in gross final energy consumption:

- a 20% share of gross final energy consumption by 2020,
- a 30% national target for share of energy from renewable sources in gross final consumption of energy in 2020.

The share of energy from renewable energy sources in Denmark was below EU wide and country specific targets in 2018.

Item 105: Share of energy from renewable energy sources in gross final energy consumption in Denmark

Share of energy from renewable energy sources in gross final energy consumption in Denmark in 2005-2018 and targets for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Share of energy from renewable sources [nrg_ind_ren]

5.8.3 Energy efficiency

The energy efficiency target set for Denmark were respectively:

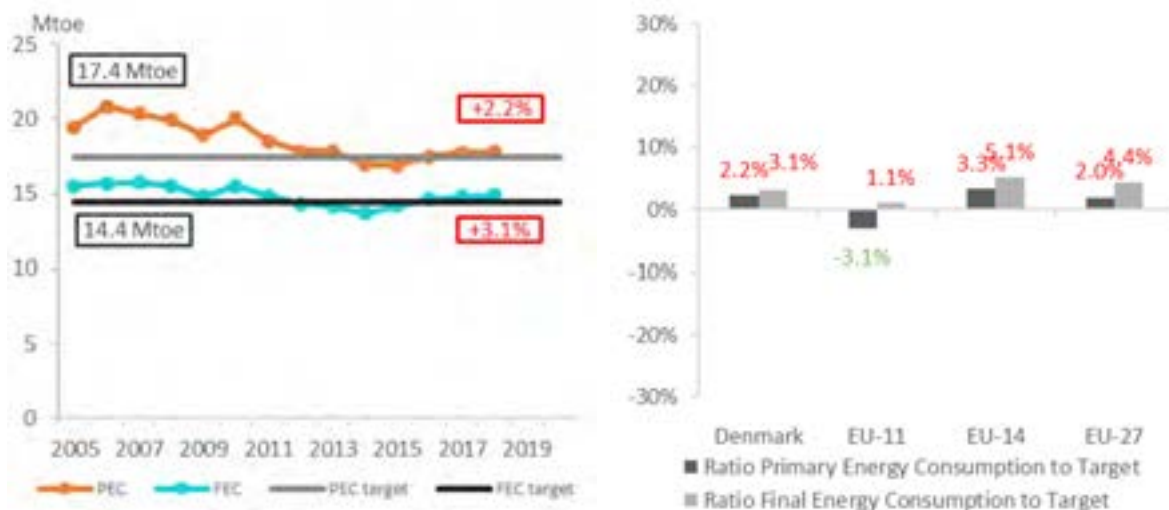
- Primary Energy Consumption in 2020: 17.4 Mtoe
- Final energy consumption in 2020: 14.4 Mtoe

Following the information provided in Item 106 the results for 2018 were above the targets in both criteria, respectively +2.2% of primary energy consumption and 3.1% of final energy consumption. This does not exclude Denmark to achieve the targets in 2020.

Item 106: Energy efficiency target data for Denmark

Primary energy consumption and final energy consumption in Denmark in 2005-2018 and targets for 2020

Ratio of primary energy consumption to target for 2020 and final energy consumption to target for 2020 in Denmark, EU-11, EU-14 and EU-27 in 2018



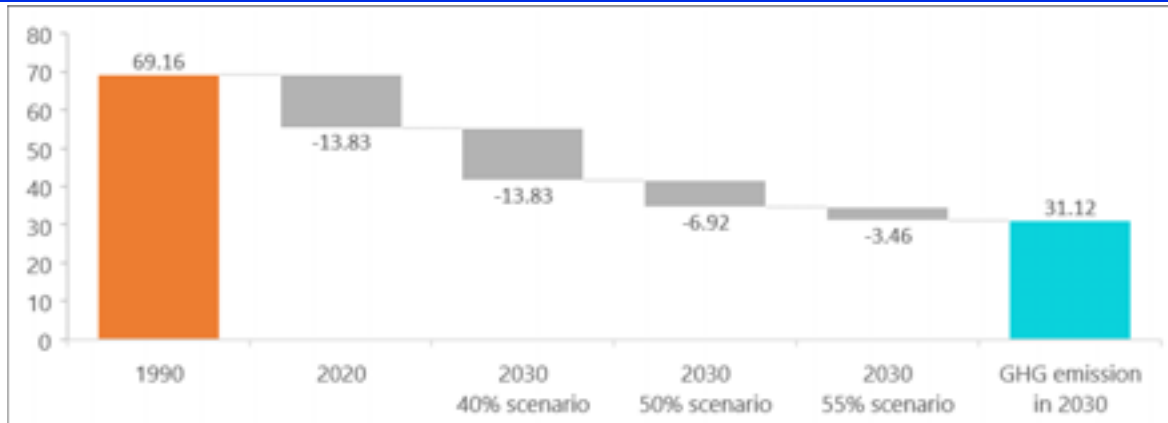
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Primary energy consumption - Primary energy consumption (Europe 2020-2030) (PEC2020-2030), final energy consumption - Final energy consumption (Europe 2020-2030) (FEC2020-2030). EU-11 and EU-14 data estimated based on Eurostat data

5.9 Review of potential impact of Green Deal propositions

At the current stage of discussions regarding the European Green Deal only partial information are available regarding the future targets. EU is proposing to increase the greenhouse gas emission reduction to 50% or 55% for 2030. This is a proposition included in the draft proposal of "Climate Law". Assuming the Denmark greenhouse gas emissions in 1990, an estimation of EU 2030 target emissions can be drafted. The 2020 target of 20% reduction resulted in 13.83 Mt CO₂ emission drop. Further increase of the target to 40% in 2030 require additional 13.83Mt CO₂ reduction. If the 50% target proposed under European Green Deal is applied then additional 6.92 Mt CO₂ emission decrease is needed, or 10.38 Mt CO₂ decrease, if 55% target is adopted.

Item 107: Estimation regarding greenhouse gas emissions in Denmark under different scenarios (Mt CO₂)

Estimation regarding greenhouse gas emissions in Denmark under different scenarios (Mt CO₂)



Source: Eurostat data for 2018, extracted in 2020. Estimations delivered by the Author

Nevertheless, it is worth to highlight that, if the current structure of greenhouse gas emissions target is maintain, then the 50% target for 2030 is an EU wide target. It is not a binding element for specific countries. Country specific targets could be expected as per ESD and ESR but there is no way to anticipate the potential targets.

At the same time, the review of key EU regulations around climate and energy as:

- Emissions Trading System Directive;
- Effort Sharing Regulation;
- Land use, land use change and forestry Regulation;
- Energy Efficiency Directive;
- Renewable Energy Directive;
- CO₂ emissions performance standards for cars and vans
- Energy Taxation Directive

can bring some additional targets in area of share of energy from renewable energy sources and energy efficiency. For the moment, any estimation of potential targets is not available nor possible to estimate.



6 Finland

6.1 General information

Finland is the fifth biggest country within EU-14 group in terms of total country area and represents 11.0% of the area. At the same time, it is the 5th country in EU-27 with 8.0% of the area. It represents 1.6% of EU-14 population and 1.2% of EU-27 population, but 1.9% of its total nominal GDP of EU-14 and 1.7% of EU-27. Due the robust economic growth in 1995-2018 period, in 2018 Finish GDP per capita amounted to 111% of the whole EU average (110% in 1995).

Item 108: Finland - key data



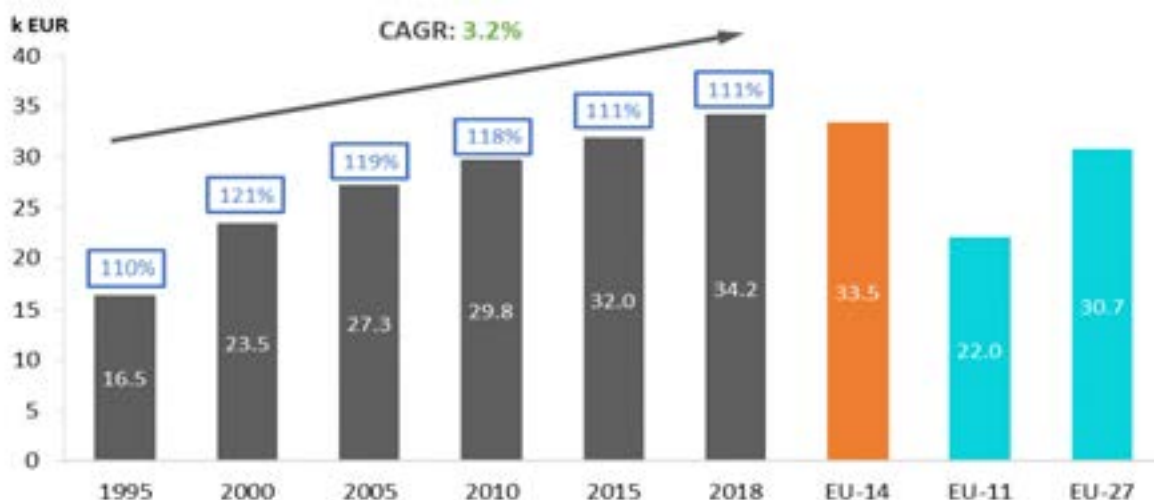
Key data

| | |
|------------------------------------------------------|--------|
| Population (M) | 5.5 |
| GDP per capita (EUR, nominal) | 42,350 |
| GDP per capita (EUR, PPS) | 34,230 |
| GDP as share of EU-14 | 1.9% |
| GDP as share of EU-27 | 1.7% |
| Energy intensity of the economy (kgoe per 1,000 EUR) | 190.3 |
| Greenhouse gas emissions (Mg per capita) | 10.0 |

Source: Eurostat data for 2018, extracted in 2020

With the compounded annual growth rate amounting to 3.2% Finish economy considerably grew in the period of 1995-2018 (see Item 109). Its GDP per capita was above EU-14 and EU-27 averages (equal to 102% and 111% of the respective averages). Its GDP per capita was also 156% of the average GDP per capita for EU-11 countries.

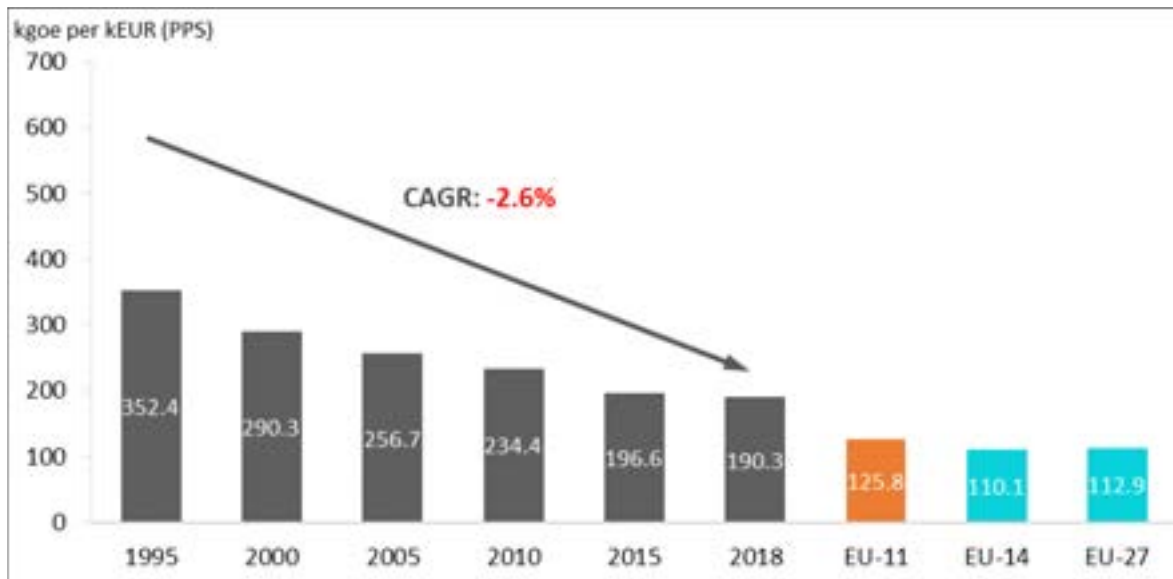
Item 109: GDP per capita in Finland for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in 2018 (kEUR, PPS) and share of Finland GDP per capita in relation to EU-27 average



Source: Eurostat data for 2018, extracted in 2020. Detail references: GDP per capita - Gross domestic product at market prices (B1GQ), Current prices, purchasing power standard per capita (CP_PPS_HAB)

The Finish economy energy intensity was about 190.3 kgoe per 1,000 EUR PPS in 2018, thanks to a decrease of the energy intensity indicator during the years 1995-2018. It dropped by 162.2 kgoe per 1,000 EUR PPS, i.e. it was reduced by about 46%. The energy intensity of Finland in 2018 were 151% and 169% of EU-14 and EU-27 averages. At the same time, it represented 173% of EU-11 average.

Item 110: Energy intensity of the economy in Finland in 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)



Source: Eurostat data for 2018, extracted in 2020. Values for EU-11 and EU-14 were recalculated based on energy intensity and GDP data from Eurostat. Detail references: Energy intensity of GDP in purchasing power standards (PPS) - EI_GDP_PPS

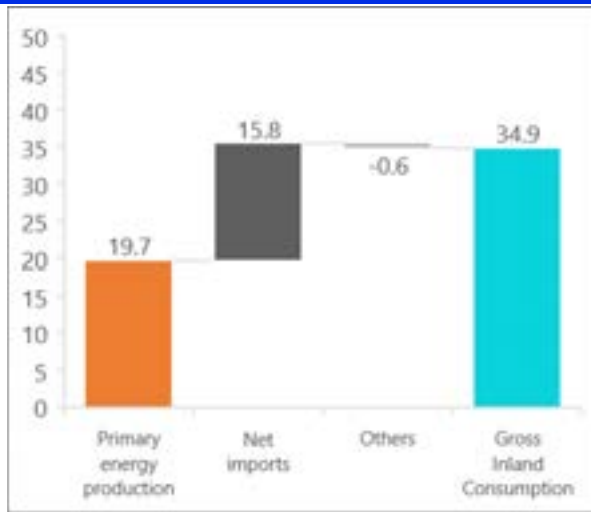
6.2 Energy balance of Finland

The energy balance of Finland in 2018 is presented in Item 111. The primary energy production was equal to 19.7 Mtoe in 2018. Net imports added 15.8 Mtoe to the balance. The total gross inland consumption accounted for 34.9 Mtoe. The level of import of energy to Finland grew slowly during up to 2003 and then decreased. At the same time the level of net import reported to the energy needs was following the same pattern.

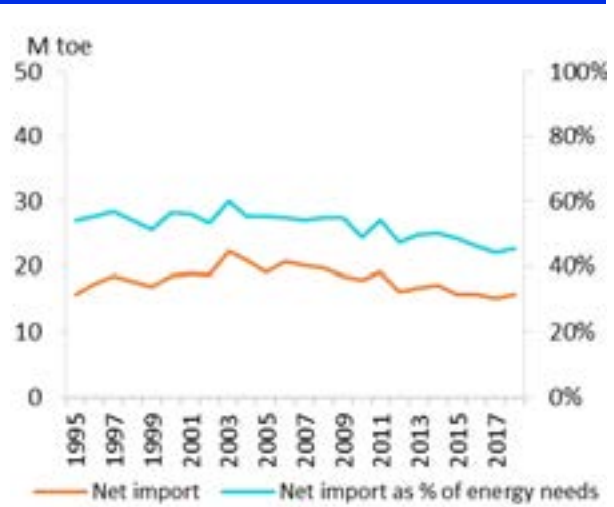
The primary energy production increased over past 23 years, as well as gross energy consumption. National production was meeting only 56% of the country gross consumption and this factor increased over last 23 years from 45%.

Item 111: Energy balance in Finland

Energy balance in Finland in 2018 (Mtoe)



Net import of energy in Finland in 1995-2018 (Mtoe and as percentage of GIC)



Gross inland consumption, primary energy production (Mtoe) and ratio of primary energy production to gross inland consumption in 1995-2018 in Finland (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Gross inland consumption - GIC. Net imports = Import (IMP) - Export (EXP), Other = Change in stock (STK-CHG) - International maritime bunkers (INTMARB)

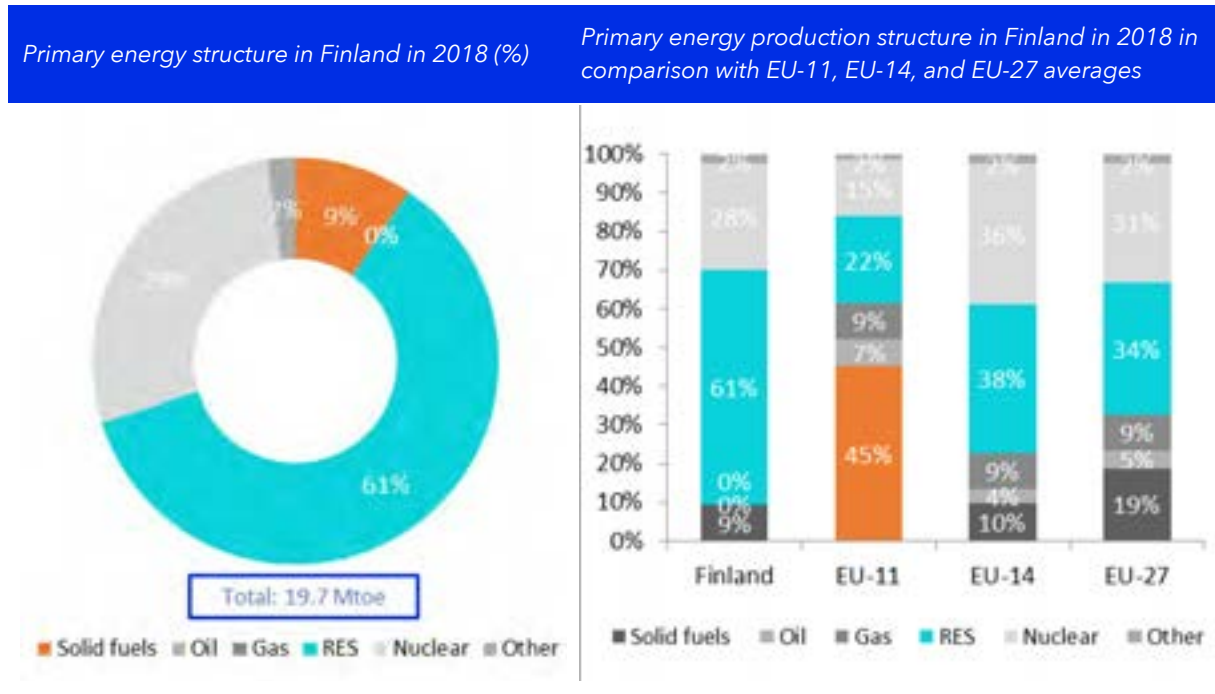
The primary energy production in Finland was dominated by renewable energy sources. About 61% of the total production comes from it. The mix was completed by 28% share of nuclear energy and 9% of solid fuels. Usage of gas and oil was null.

When compared to the European averages, Finland was characterized by very high share of renewable energy sources in the energy mix - 61% versus 38% EU-14 average and 34% EU-27 average. The share of nuclear in the Finnish fuel mix was a little lower than in EU-14 and EU-27 (28% versus 36% and 31% in EU-14 and EU-27). At the same time, the share of solid fuels use was lower in Finland - 9% versus 10% in EU-14 and 19% in EU-27. In opposite to EU averages Finland was not using gas and oil for primary energy production.

The comparison of Finland to EU-11 averages was mainly characterized by much higher share of RES (61% versus 22%), lack of oil and gas use in Finland (versus 7% and 9% in

EU-11) and lower share of solid fuels (9% versus 15% in EU-11). The share of nuclear was higher in Finland - 28% versus 15% in EU-11.

Item 112: Primary energy structure in Finland



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H) , Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

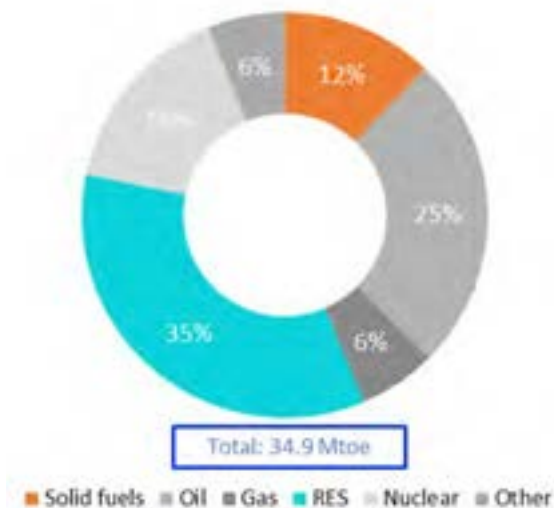
Gross inland consumption of energy in Finland was dominated by renewable energy sources (35%), oil (25%), nuclear energy 16% and solid fuels (12%). The mix was completed by 6% of gas and 6% of other energy sources.

Comparing to European averages gross inland consumption of energy in Finland was marked by higher share of solid fuels than in EU-14 but lower than in EU-27 (8% versus 11% in EU-14 and 14% in EU-27). The share of oil was lower in Finland (25%) than in EU-14 (35%) and EU-27 (34%) whereas the share of gas was much lower (6% versus 23% and 22%). Finland was characterized by much higher share of renewable energy sources in the mix - 35% versus 16% and 15% in EU-14 and EU-27 respectively, and little higher share of nuclear energy in the mix (16% versus 14% in EU-14 and 13% in EU-27).

When compared to EU-11 the main difference was around much lower share of solid fuels consumption in Finland (12% versus 30% in EU-11) and higher share of renewable energy sources (35% versus 12%). The share of gas and oil use in Finland were lower than in EU-11 countries (25% versus 29% and 6% versus 19% respectively). EU-11 average gross final consumption included nuclear energy at 8% whereas it was 16% in Finland.

Item 113: Gross inland consumption structure in Finland

Gross inland consumption structure in Finland in 2018 (%)



Gross inland consumption structure in Finland in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gross inland consumption - GIC, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

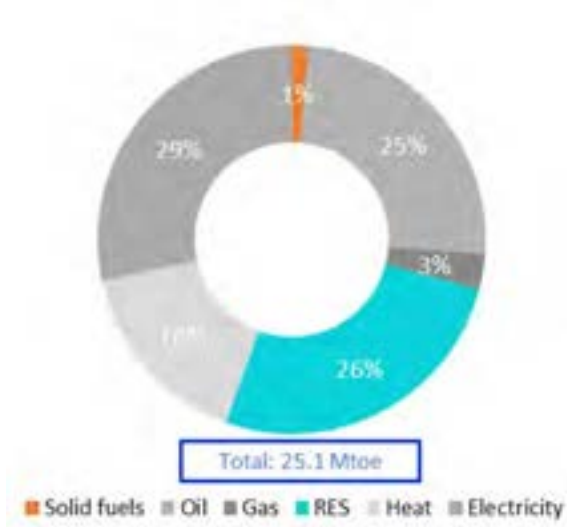
The final energy consumption in Finland was dominated by electricity (29%), followed by renewable energy sources (26%), oil (25%) and heat (16%). The mix was completed by solid fuels (1%) and gas (3%).

The sectoral final energy consumption in Finland was characterized by higher share of industrial but lower of transport sectors than in EU-14 and EU-27 (44% and 17% versus 26% and 31% in EU-14 and EU-27). The share of commercial and public services was lower in final energy consumption in Finland (12%) than in EU-14 (15%) and EU-27 (14%).

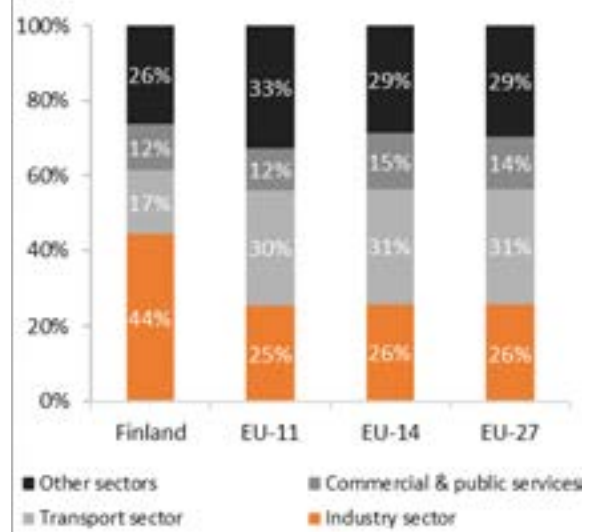
When compared to EU-11 Finland similar conclusions as related to EU-14 and EU-27 can be drawn.

Item 114: Final energy consumption structure in Finland

Final energy consumption structure in Finland in 2018 (%)



Final energy consumption structure in Finland in 2018 in comparison with EU-11, EU-14, and EU-27 averages



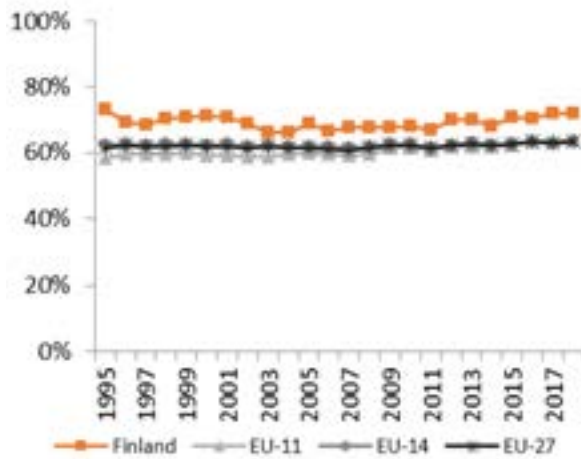
Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Heat (H8000), Electricity (E7000), Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial & public services - FC_OTH_CP_E, Other - FC_OTH_E-FC_OTH_CP_E. Errors in summation to 100% are due to rounding

Finland's final energy consumption to gross inland consumption ratio, which measures energy efficiency, was higher than the averages for EU-11, EU-14, and EU-27. This situation remained stable for the last 23 years.

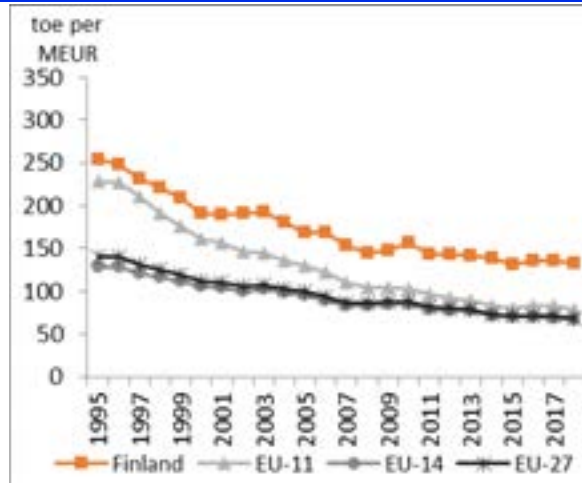
Simultaneously, a decrease in energy volume associated with generating gross domestic product was observed, but the ratio remained higher than the averages for EU-11, EU-14, and EU-27.

Item 115: Final energy consumption in Finland in relation to selected indicators

Final energy consumption to gross inland consumption ratio in Finland in 1995-2018 (%)



Final energy consumption to gross domestic product ratio in Finland in 1995-2018 in comparison with EU-11, EU-14, and EU-27 averages (toe per M EUR)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final energy consumption - FEC, Gross inland consumption - GIC, Gross Domestic Product - Gross domestic product at market prices B1GQ, Current prices - CP-MEUR

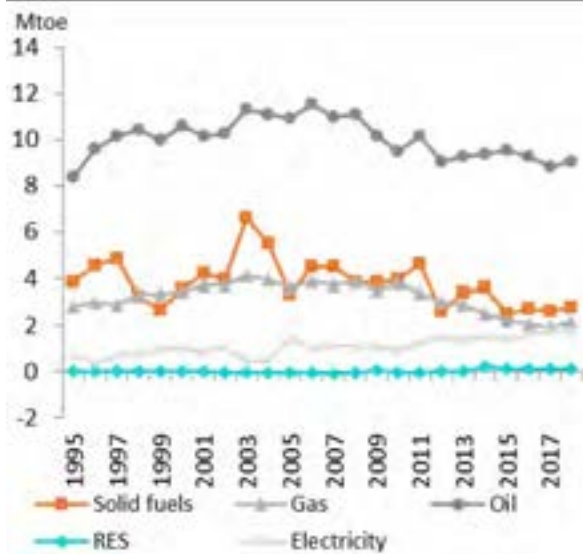
Net import of energy to Finland by fuels was characterized by a decrease of solid fuels imports, oil, and gas. The import of electricity was increasing for past 23 years.

The import structure of energy to Belgium was dominated by oil (57%), solid fuels (17%) and gas (24%). The imports were completed by 11% of electricity and 1% of renewable energy sources.

Item 116: Net import of energy in Finland

Net import of energy by fuel in 1995-2018 (Mtoe)

Net import structure in 2018 (% only fuels for which import is greater than export)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Electricity (E7000). Errors in summation to 100% are due to rounding

Solid fuels were imported to Finland mainly from Russia (63%), United States (14%), Canada (14%) and several other countries.

Main oil importers to Finland were Russia (70%), Norway (11%), Sweden (10%) and Denmark (1%). The remaining 7% were imported from various locations.

Finland was importing gas mainly from Russia (95%), Norway (3%) and Netherlands (2%).

Electricity was mainly imported from Sweden (60%), Russia (35%), Estonia (4%) and Norway (1%).

Item 117: Foreign fuel suppliers

Foreign suppliers of solid fuels in Finland in 2018 (%) Foreign suppliers of crude oil in Finland in 2018(%)



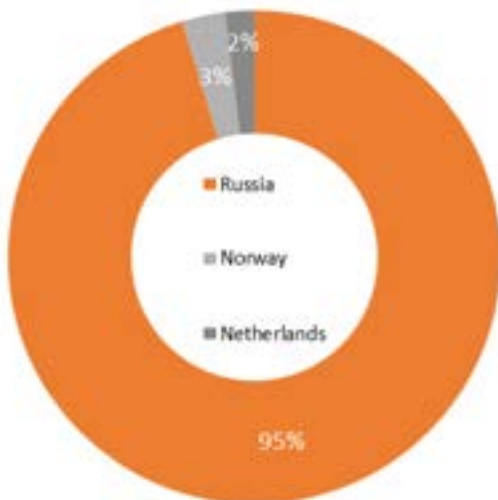
Total: 2.9 Mtoe



Total: 18.0 Mtoe

Foreign suppliers of gas in Finland in 2018 (%)

Foreign suppliers of electricity in Finland in 2018 (%)



Total: 2.2 Mtoe



Total: 1.9 Mtoe

Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fossil fuels - C000X0350-0370, Gas - Natural gas (G3000), Oil - Oil and petroleum products (excluding biofuel portion) (O4000XBIO), Electricity - E7000. Errors in summation to 100% are due to rounding

6.3 Greenhouse gas emissions

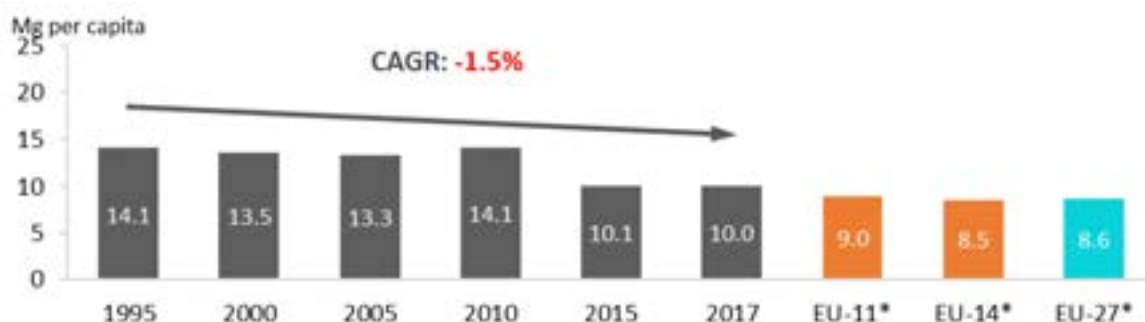
Between 1995-2017 greenhouse gases emissions in Finland were decreased - from over 71.1 Mt CO₂ in 1995 to 55.3 Mt CO₂ in 2017. Consequently, average emissions per capita decreased to 10.0 Mg CO₂ per capita in 2017 (from 14.1 Mg CO₂ per capita in 1995), which was higher comparing to EU-14 and EU-27 averages (8.5 Mg CO₂ per capita and 8.6 Mg CO₂ per capita, respectively), and also higher than in EU-11 (9.0 Mg CO₂ per capita)

There were some noteworthy changes in the Finish structure of greenhouse gas emissions over the period considered. The significance of waste management and manufacturing and construction sectors emissions dropped swiftly by 59% and 45%, as well as emissions from energy industries 27%. On other hand, transport emissions and industrial processes gained in importance increasing by 1% and 17% respectively.

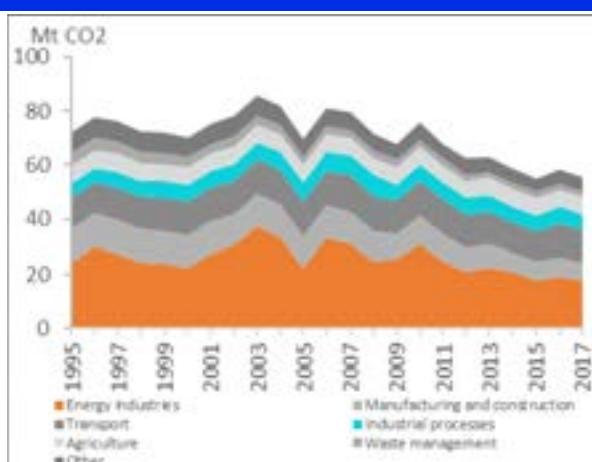
Comparing to EU-11, EU-14 and EU-27 countries, Finland was characterized by high share of emissions from transport and energy industries. The shares of emissions from other sectors were similar as the European averages.

Item 118: Greenhouse gas emissions in Finland

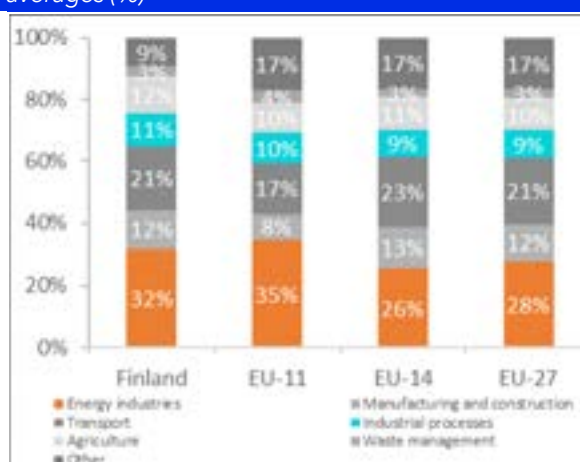
Greenhouse gas emissions per capita in Finland in 1995-2017 in comparison with EU-11, EU-14 and EU-27 averages in 2017 (Mg per capita)



Greenhouse gas emissions in Finland by sectors in 1995-2017 (Mt CO₂)



Greenhouse gas emissions in Finland by sectors in 2017 in comparison with EU-11, EU-14 and EU-27 averages (%)



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - * values for EU-11, EU-14 and EU-27 recalculated by the Author; Energy industry - Fuel combustion in energy industries (CRF1A1), Manufacturing and construction - Fuel combustion in manufacturing industries and construction (CRF1A2), Transport - Fuel combustion in transport (CRF1A3), Industrial processes - Industrial processes and product use (CRF2), Agriculture - Agriculture (CRF3), Waste management - Waste management (CRF5), Other = Other fuel combustion sectors (CRF1A4)+ Other fuel combustion sectors n.e.c. (CRF1A5) + Fuels

- fugitive emissions (CRF1B)+Other sectors (CRF6); Total GHG emissions equal to All sectors (excluding LULUCF and memo items) (CRF1-6X4_MEMO) i.e. emission from all sectors excluding Land use, land use change, and forestry (LULUCF), Transport and storage of CO₂ (memo item), International aviation (memo item), International navigation (memo item), Multilateral operations (memo item), Biomass - CO₂ emissions (memo item). Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. Errors in summation to 100% are due to rounding

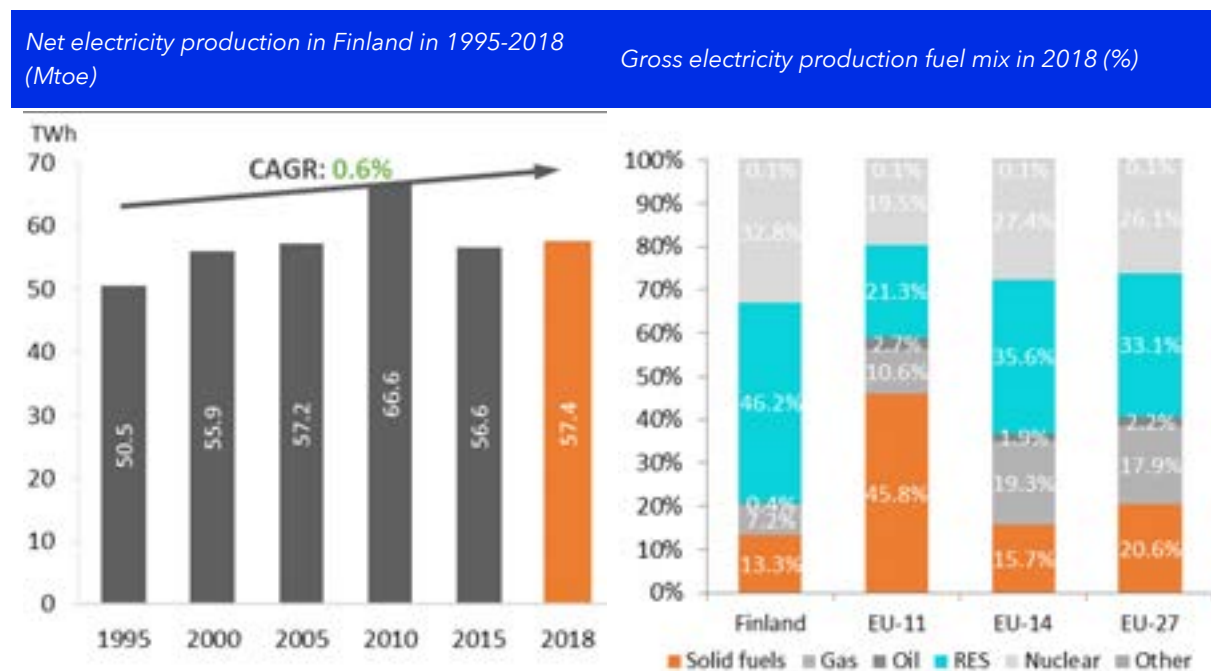
6.4 Overview of electricity sector

Item 119 presents electricity production and the current fuel mix of Finland. Over last 23 years net electricity production increased from 50.5 TWh in 1995 to 57.4 TWh in 2018 (CAGR 0.6%). As visible, net electricity production represents 2.7% of EU-14 total electricity production, which was higher compared to Finish GDP share of 1.9%.

The Finish fuel mix was dominated by renewable energy sources and nuclear energy with shares of 46.2% and 32.8% respectively. The mix was completed by 13.3% of solid fuels and small shares of gas (7.2%) and oil (0.2%). Compared to EU-14 and EU-27 countries, Finland had a much bigger share of nuclear energy and renewable energy sources in its energy mix. On other hand, the country produced relatively less electricity from solid fuels, gas, and oil, respectively 13.3%, 7.2% and 0.4%.

When compared to EU-11 average fuel mix one can notice much higher share of nuclear energy and renewable energy sources used in Finland than in EU-11 (32.8% and 46.2% versus 19.5% and 21.3%) and significantly lower use of solid fuels (13.3% versus 45.8%). The shares of gas and oil were lower (7.2% and 0.4% versus 10.6% and 2.7%). Finland was more relaying on renewable energy sources than EU-11 countries with a share of 46.2% versus 21.3% in EU-11.

Item 119: Net electricity production and gross electricity production fuel mix in Finland



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Electricity Production - NEP, Gross Electricity Production - GEP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000),

Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

In Item 120 the evolution of final per capita consumption of electricity and its breakdown by economic sector is presented. In recent years final consumption of electricity in Finland increased (CAGR in the period of 1995-2019 was around 0.7%) and its level was higher compared to EU-14 and EU-27 countries. Finish final energy consumption per capita represented 243.3% of EU-14 level and 266.6% of EU-27 level.

The structure of final electricity consumption in Finland was dominated by industry (47.7% versus 37.6% in EU-14 countries). Relatively less energy was used in transport (1.0% versus 2.4%) and less in commercial and residential sectors (22.0% and 27.5% versus 29.2% and 28.5%).

Finland was consuming relatively more electricity in industry sector than EU-11 countries (47.7% versus 40.9%) and less in transport (1.0% versus 2.3%). At the same time, it used relatively more electricity in residential and less in commercial sectors (27.5% and 22.0% versus 25.6% and 29.7%).

Item 120: Final consumption of electricity in Finland

Final consumption of electricity per capita in Finland (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Final consumption of electricity in Finland by sectors in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Electricity E7000. Errors in summation to 100% are due to rounding

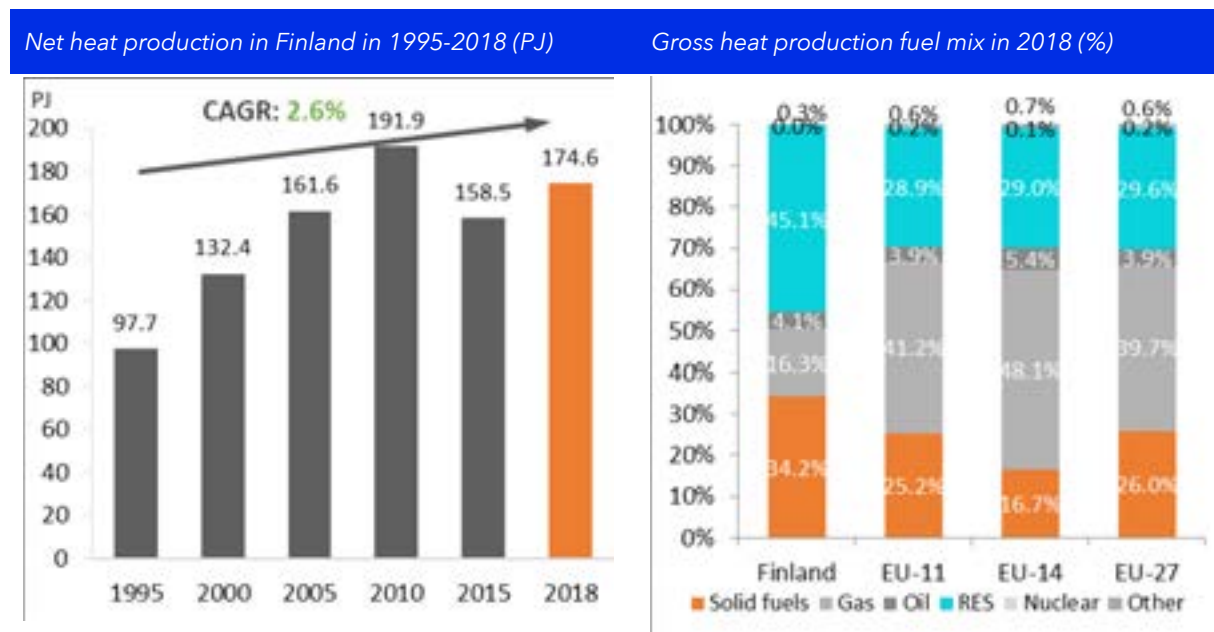
6.5 Overview of heat sector

Item 121 presents heat production and the current fuel mix of Finland. Over last 23 years net heat production increased from 97.7 PJ in 1995 to 174.6 PJ in 2018 (CAGR 2.6%).

The Finland fuel mix of heat production was dominated by renewable energy sources with share of 45.1% and solid fuels with share of 34.2%. The mix was completed by 16.3% of gas and 4.1% of oil. Compared to EU-14 and EU-27 countries, Finland had a much bigger share of renewable energy sources and solid fuels in its heat production mix. On other hand, the country produced relatively less heat from gas and oil, respectively 16.3% and 4.1%. Finland use of heat produced from nuclear energy was lower than 0.1%.

When compared to EU-11 average fuel mix one can notice much higher share of renewable energy sources used in Finland than in EU-11 (45.1% versus 28.9%) and significantly higher use of solid fuels (34.2% versus 25.2%). The share of gas was lower in Finland (16.3% versus 41.2%) as well as the share of oil (4.1% versus 3.9%). Finland production of heat from nuclear energy was lower than 0.1%.

Item 121: Net heat production and gross electricity production fuel mix in Finland



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Heat Production - NHP, Gross Heat Production - GHP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

Item 122 presents final heat consumption per capita and its breakdown by sectors.

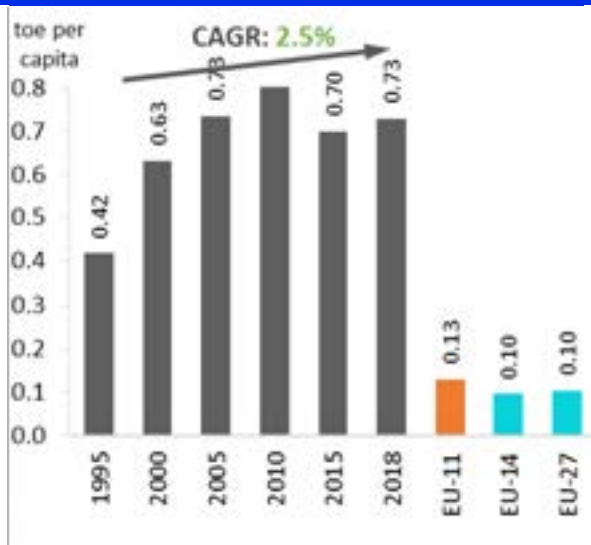
The per capita demand for heat in Finland increased from 0.42 toe per capita in 1995 to 0.73 toe per capita in 2018. As a result, within the 23 years analyzed, heat consumption per capita increased at CAGR of 2.5%. The heat consumption remained higher than the averages for EU-11, EU-14 and EU-27, respectively 0.13 toe per capita, 0.10 toe per capita and 0.10 toe per capita.

The structure of final consumption of heat in Finland was characterized by higher share of commercial sector (27.0% compared to 21.3% in EU-14) and the same share of residential usage (40.1% compared to 40.1% in EU-14). The share of industry in heat consumption was lower than the averages (31.7% compared to 37.9% in EU-14).

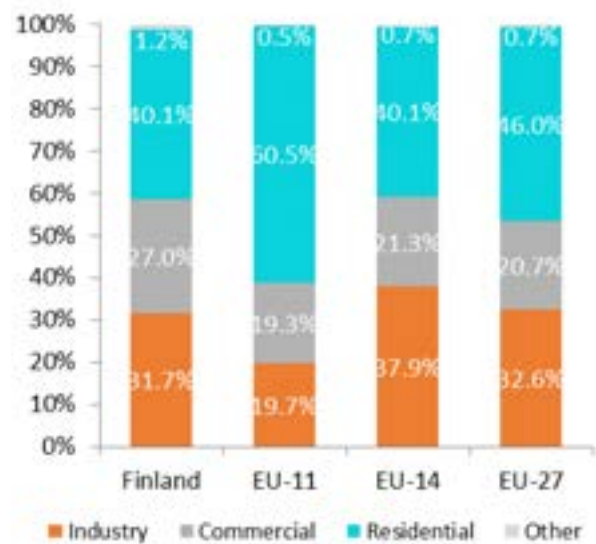
In relation to EU-11 countries, the structure of final heat consumption in Finland was characterized by lower share of residential sector (40.1% versus 60.5%) and higher share of commercial sector (27.0% versus 19.3%). The industrial use of heat consumed 31.7% of it in Finland whereas 19.7% in EU-11.

Item 122: Final consumption of heat in Finland

Final consumption of heat per capita in Finland (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)



Final consumption of heat in Finland by sectors in 2018 (%)



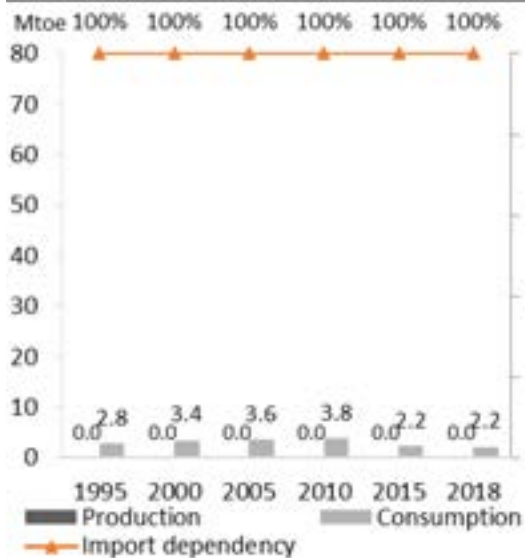
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Heat H8000. Errors in summation to 100% are due to rounding

6.6 Overview of gas sector

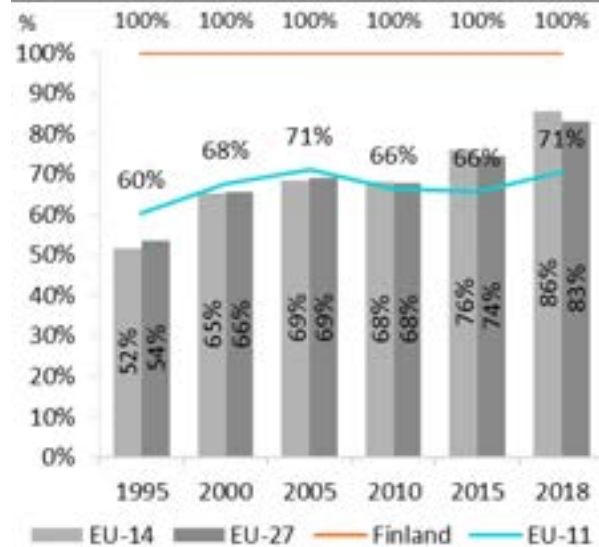
Finland consumed 2.2 Mtoe of gas in 2018. It increased from 2.8 Mtoe 1995 to 3.8 Mtoe in 2010 and then decreased. The national production of gas was null. The remaining part of gas was imported. The country dependency on import was equal to 100% over past 23 years. In 2018 the country was more dependent on import than EU-11, EU-14 and EU-27 average values.

Item 123: Gas sector in Finland

Gas production, gross consumption and import dependence in Finland in 1995-2018 (Mtoe)



Gas Import dependence in Finland and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gas production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Natural Gas G3000

The final consumption of gas per capita in Finland decreased from 0.20 toe per capita to 0.11 toe per capita over past 23 years. This value was lower than the average values for EU-14, EU-11 and EU-27 countries.

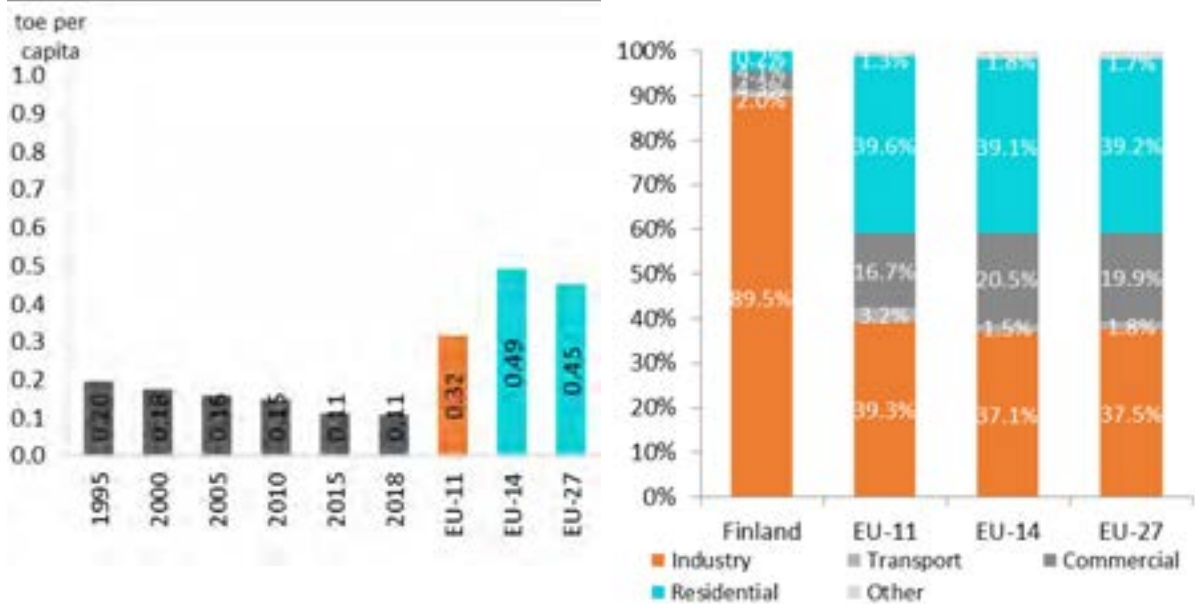
The structure of final gas consumption in Finland in 2018 was characterized by high share of industry - 89.5% versus 37.1% in EU-14. The share of use of gas in transport, commercial and residential applications were lower than the averages for EU-14 countries.

When compared to EU-11 countries, Finland was using relatively more gas industry than EU-11 countries - 89.5% versus 39.3%. The country was using less gas in all other sectors than EU-11 averages were.

Item 124: Final consumption of gas per capita in Finland in 1995-2018 and gas final consumption by sectors in Finland and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of gas per capita in Finland (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Gas final consumption by sectors in Finland and EU-11, EU-14 and EU-27 countries in 2018



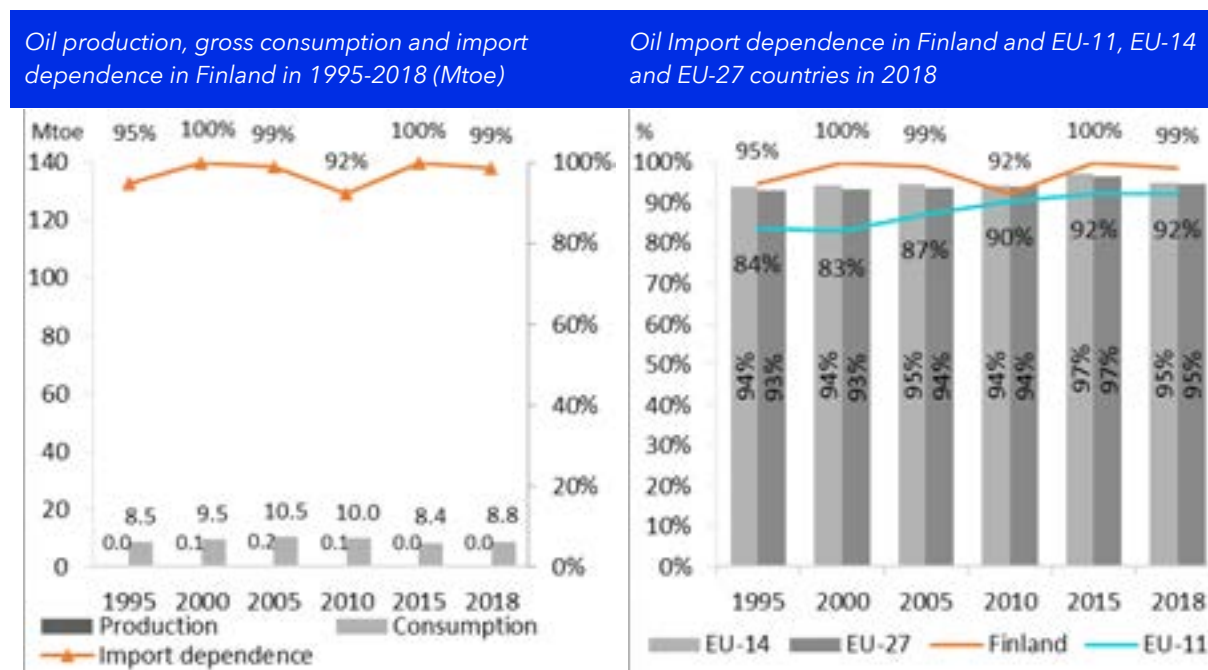
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Natural Gas G3000. Errors in summation to 100% are due to rounding

6.7 Overview of oil sector

The oil consumption of Finland grew from 8.5 Mtoe in 1995 to 8.8 Mtoe in 2018. At the same time the national production remained null. Therefore, the level of import dependency was high - between 92% and 100%.

When compared to EU-14 and EU-27 average import dependency, the country had a higher import dependency of 99% versus 95% in EU-14 and EU-27 countries. At the same time, the import dependency of the country was higher than EU-11 average - 99% versus 92%.

Item 125: Oil sector in Finland



Source: Eurostat data for 2018, extracted in 2020. Detail references: Oil production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Import dependence above 100% has been rounded to 100%

The final consumption of oil per capita in Finland decreased from 1.45 toe per capita in 1995 to 1.13 toe per capita in 2018. The level of final consumption per capita remained higher than the one for EU-11, EU-14 and EU-27.

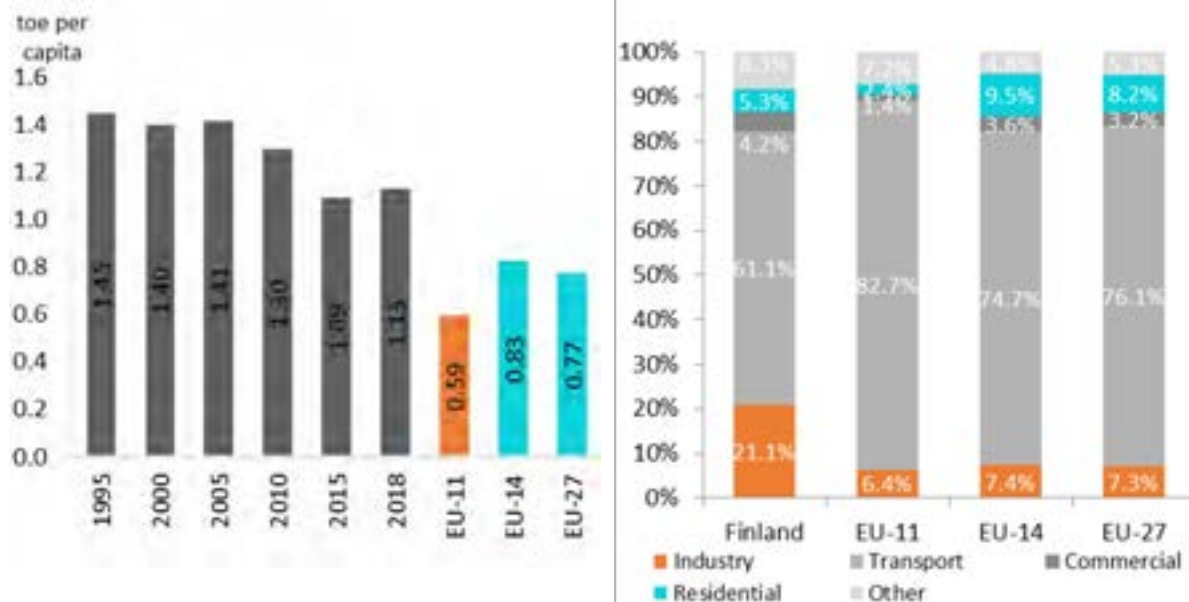
Oil consumption was dominated by transport sector, but its share was lower than EU-14 average - 61.1% versus 74.7% in EU-14 countries. Relatively more oil was used in industry - 21.1% versus 7.4% and in commercial sector - 4.2% versus 3.6%. The residential use of oil was lower than EU-14 average - 5.3% versus 9.5%.

The relative consumption of oil in Finland compared to EU-11 was lower in 2018 - 61.1% versus 82.7%. The use in industry was relatively higher - 21.1% versus 6.4%. At the same time commercial and residential sector were consuming relatively more oil in the country than EU-11 averages - 4.2% and 5.3% versus 1.4% and 2.4%.

Item 126: Final consumption of oil per capita in Finland in 1995-2018 and oil final consumption by sectors in Finland and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of oil per capita in Finland (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Oil final consumption by sectors in Finland and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Errors in summation to 100% are due to rounding

6.8 EU climate policy and its targets for Finland

Finland is subject to EU energy and climate regulations and therefore, specific targets were set and verified regarding greenhouse gas emission, share of energy from renewable energy sources and energy efficiency improvements (see Item 127).

Item 127: Energy and climate targets for Finland for 2020 and 2030

| | Finland 2020 targets | Finland 2030 targets |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | EU wide target of 20% reduction from 1990 levels (14% from 2005 level) | EU wide target of 40% reduction from 1990 levels |
| Greenhouse gas emissions in ETS | EU wide target of 21% reduction from 2005 | EU wide target of 43% reduction from 2005 |
| National emission reduction targets in non-ETS - Effort Sharing Decision (ESD) | -16% in relation to their 2005 levels | - |
| National emission reduction targets in non-ETS - Effort Sharing Regulations (ESR) | - | -39% in relation to their 2005 levels |
| Share of energy from renewable energy sources | EU wide target of 20% energy from renewables | EU wide target of minimum 32% share for renewable energy |
| EU wide target of share of energy from renewable energy sources | EU wide target of 20% share of gross final energy consumption | EU wide target of 32% share of gross final energy consumption |
| National target of share of energy from renewable energy sources | 38% of gross final consumption | Not yet available |
| Improvement in energy efficiency | EU wide target of 20% improvement in energy efficiency | EU wide target of at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |
| Primary energy consumption | EU wide target < 1,483 Mtoe National target < 35.9 Mtoe | EU wide target of 1,273 Mtoe (< 1,128 Mtoe EU-27) National targets not available yet |
| Final energy consumption | EU wide target < 1,086 Mtoe National target < 26.7 Mtoe | EU wide target < 956 Mtoe (< 846 Mtoe EU-27) National targets not available yet |

Source: EU website

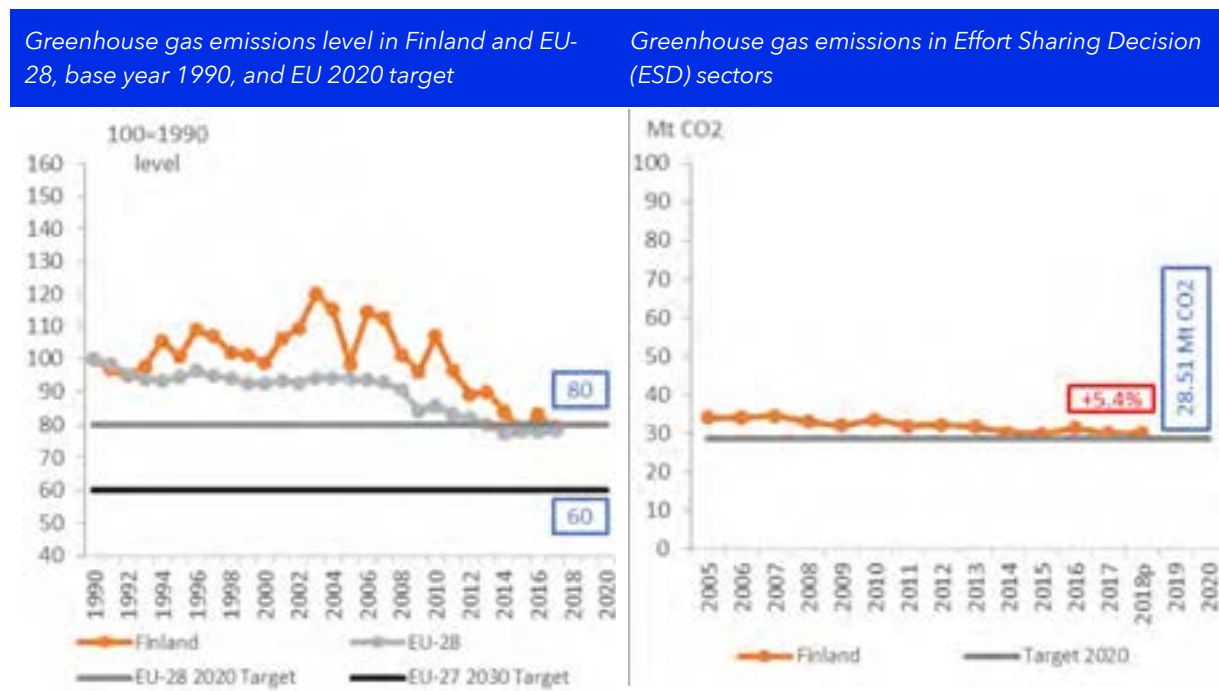
In following chapter, the overview of Finland targets and performance are summarized.

6.8.1 Greenhouse gas emissions

EU set a target for CO₂ reduction by 20% compared to 1990 level at EU level. Regardless the fact that the target was not binding for specific country, the level of CO₂ emission in Finland was below EU wide target in 2018.

The non-ETS greenhouse gas emissions the binding national targets for Finland was 28.51 Mt of CO₂ equivalent emissions. Comparing to 2018 provisional results the level of emissions exceeded the target by 5.4% in 2018.

Item 128: Energy efficiency target data for Finland



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Greenhouse gas emissions, base year 1990 [T2020_30], Greenhouse gas emissions in ESD sectors [T2020_35]

6.8.2 Renewable energy sources

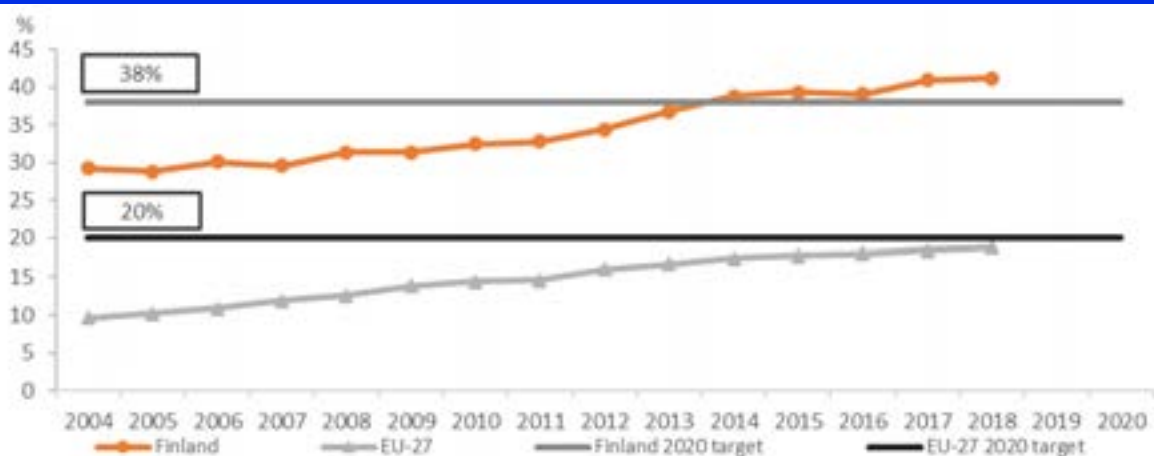
The following targets were set for Finland regarding the share of energy from renewable energy sources in gross final energy consumption:

- a 20% share of gross final energy consumption by 2020,
- a 38% national target for share of energy from renewable sources in gross final consumption of energy in 2020.

The share of energy from renewable energy sources in Finland was below EU wide and country specific targets in 2018.

Item 129: Share of energy from renewable energy sources in gross final energy consumption in Finland

Share of energy from renewable energy sources in gross final energy consumption in Finland in 2005-2018 and targets for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Share of energy from renewable sources [nrg_ind_ren]

6.8.3 Energy efficiency

The energy efficiency target set for Finland were respectively:

- Primary Energy Consumption in 2020: 35.9 Mtoe
- Final energy consumption in 2020: 26.7 Mtoe

Following the information provided in Item 130 the results for 2018 were below the targets in both criteria, respectively -8.8% of primary energy consumption and -3.2% of final energy consumption. This gives great chances to Finland to achieve the targets in 2020.

Item 130: Energy efficiency target data for Finland

Primary energy consumption and final energy consumption in Finland in 2005-2018 and targets for 2020

Ratio of primary energy consumption to target for 2020 and final energy consumption to target for 2020 in Finland, EU-11, EU-14 and EU-27 in 2018



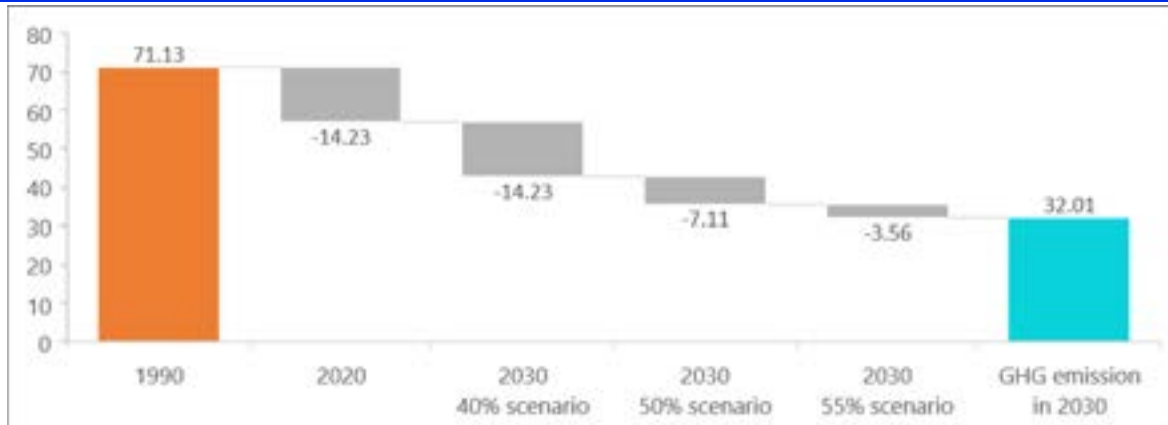
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Primary energy consumption - Primary energy consumption (Europe 2020-2030)(PEC2020-2030), final energy consumption - Final energy consumption (Europe 2020-2030) (FEC2020-2030). EU-11 and EU-14 data estimated based on Eurostat data

6.9 Review of potential impact of Green Deal propositions

At the current stage of discussions regarding the European Green Deal only partial information are available regarding the future targets. EU is proposing to increase the greenhouse gas emission reduction to 50% or 55% for 2030. This is a proposition included in the draft proposal of "Climate Law". Assuming the Finland greenhouse gas emissions in 1990, an estimation of EU 2030 target emissions can be drafted. The 2020 target of 20% reduction resulted in 14.23 Mt CO₂ emission drop. Further increase of the target to 40% in 2030 require additional 14.23 Mt CO₂ reduction. If the 50% target proposed under European Green Deal is applied then additional 7.11 Mt CO₂ emission decrease is needed, or 10.67 Mt CO₂ decrease, if 55% target is adopted.

Item 131: Estimation regarding greenhouse gas emissions in Finland under different scenarios (Mt CO₂)

Estimation regarding greenhouse gas emissions in Finland under different scenarios (Mt CO₂)



Source: Eurostat data for 2018, extracted in 2020. Estimations delivered by the Author

Nevertheless, it is worth to highlight that, if the current structure of greenhouse gas emissions target is maintain, then the 50% target for 2030 is an EU wide target. It is not a binding element for specific countries. Country specific targets could be expected as per ESD and ESR but there is no way to anticipate the potential targets.

At the same time, the review of key EU regulations around climate and energy as:

- Emissions Trading System Directive;
- Effort Sharing Regulation;
- Land use, land use change and forestry Regulation;
- Energy Efficiency Directive;
- Renewable Energy Directive;
- CO₂ emissions performance standards for cars and vans
- Energy Taxation Directive

can bring some additional targets in area of share of energy from renewable energy sources and energy efficiency. For the moment, any estimation of potential targets is not available nor possible to estimate.



7 France

7.1 General information

France is the biggest country within EU-14 group in terms of total country area and represents 20.7% of the area. At the same time, it is the biggest country in EU-27 with 15.1% of the area. It represents 19.6% of EU-14 population and 15.0% of EU-27 population, but 19.5% of its total nominal GDP of EU-14 and 17.4% of EU-27. Despite the robust economic growth in 1995-2018 period, in 2018 French GDP per capita amounted to 104% of the whole EU average (117% in 1995).

Item 132: France - key data



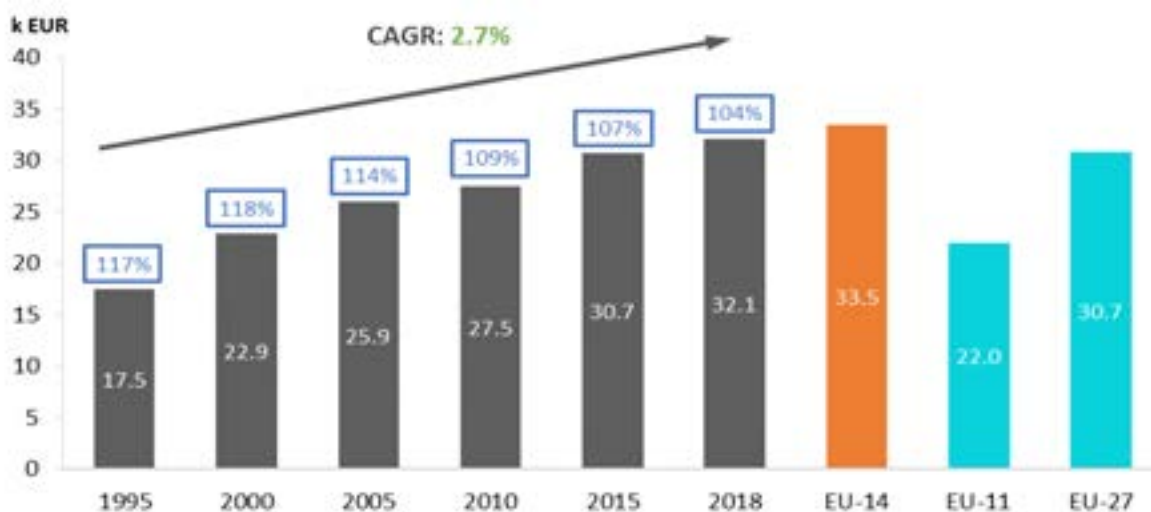
Key data

| | |
|------------------------------------------------------|--------|
| Population (M) | 66.9 |
| GDP per capita (EUR, nominal) | 34,980 |
| GDP per capita (EUR, PPS) | 32,070 |
| GDP as share of EU-14 | 19.5% |
| GDP as share of EU-27 | 17.4% |
| Energy intensity of the economy (kgoe per 1,000 EUR) | 121.5 |
| Greenhouse gas emissions (Mg per capita) | 6.9 |

Source: Eurostat data for 2018, extracted in 2020

With the compounded annual growth rate amounting to 2.7% French economy considerably grew in the period of 1995-2018 (see Item 133). Its GDP per capita was below EU-14 but above EU-27 averages (equal to 96% and 104% of the respective averages). Its GDP per capita was also 146% of the average GDP per capita for EU-11 countries.

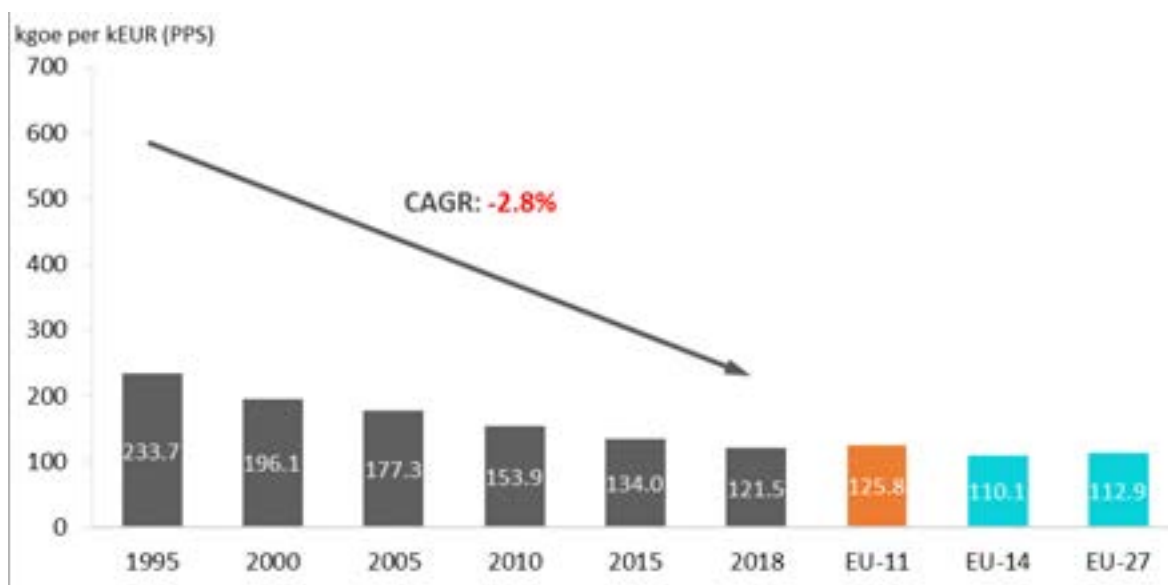
Item 133: GDP per capita in France for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in 2018 (kEUR, PPS) and share of France GDP per capita in relation to EU-27 average



Source: Eurostat data for 2018, extracted in 2020. Detail references: GDP per capita - Gross domestic product at market prices (B1GQ), Current prices, purchasing power standard per capita (CP_PPS_HAB)

The French economy energy intensity was about 121.5 kgoe per 1,000 EUR PPS in 2018, thanks to a decrease of the energy intensity indicator during the years 1995-2018. It dropped by 112.2 kgoe per 1,000 EUR PPS, i.e. it was reduced by about 46%. The energy intensity of France in 2018 represented 97% and 108% of EU-14 and EU-27 averages. At the same time, it represented 110% of EU-11 average.

Item 134: Energy intensity of the economy in France in 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)



Source: Eurostat data for 2018, extracted in 2020. Values for EU-11 and EU-14 were recalculated based on energy intensity and GDP data from Eurostat. Detail references: Energy intensity of GDP in purchasing power standards (PPS) - EI_GDP_PPS

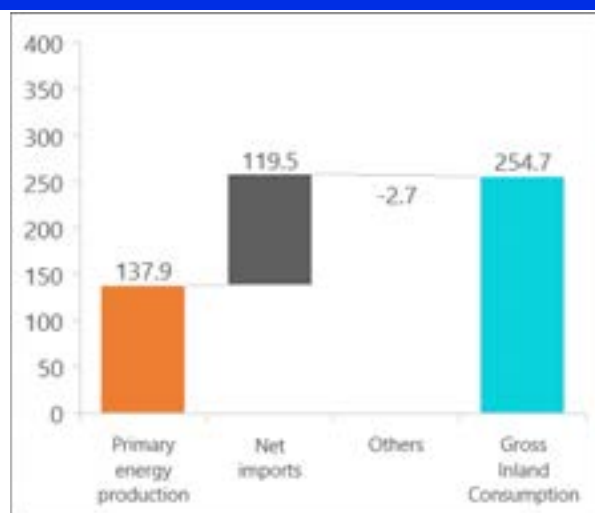
7.2 Energy balance of France

The energy balance of France in 2018 is presented in Item 135Item 39. The primary energy production was equal to 137.9 Mtoe in 2018. Net imports added 119.5 Mtoe to the balance. The total gross inland consumption accounted for 254.7 Mtoe. The level of import of energy to France grew slowly up to 2005 and then was decreased. At the same time the level of net import reported to the energy needs remains stable.

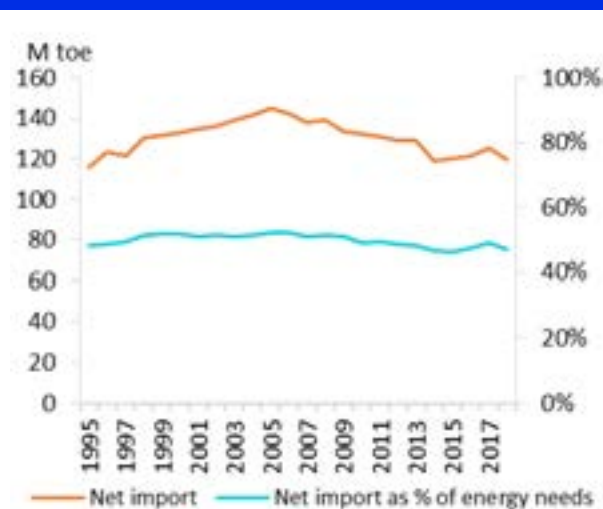
The primary energy production increased over past 23 years, as well as gross energy consumption. National production was meeting only 54% of the country gross consumption and this factor increased over last 23 years from 52%.

Item 135: Energy balance in France

Energy balance in France in 2018 (Mtoe)



Net import of energy in France in 1995-2018 (Mtoe and as percentage of GIC)



Gross inland consumption, primary energy production (Mtoe) and ratio of primary energy production to gross inland consumption in 1995-2018 in France (%)



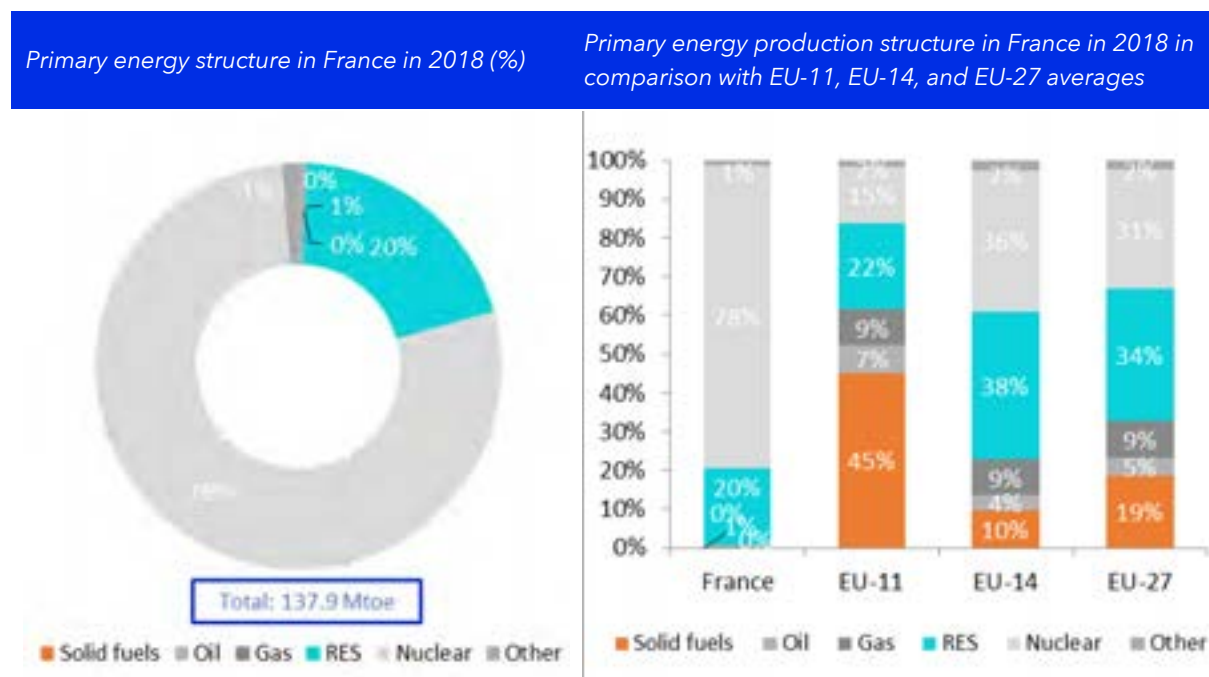
Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Gross inland consumption - GIC. Net imports = Import (IMP) - Export (EXP), Other = Change in stock (STK-CHG) - International maritime bunkers (INTMARB)

The primary energy production in France was dominated by nuclear energy. About 78% of the total production came from it. The mix was completed by 20% share of renewable energy sources, 1% share of oil and 1% of other sources in the mix. Solid fuels were not in use, where gas use was marginal.

When compared to the European averages, France was characterized by very high share of nuclear energy in the energy mix - 78% versus 36% EU-14 average and 31% EU-27 average. The share of renewable energy sources in the French fuel mix was a lower than in EU-14 and EU-27 (20% versus 38% and 34% in EU-14 and EU-27). At the same time, the share of gas and oil were higher in EU-14 and EU-27. In opposite to EU averages France was not using solid fuels and use of gas in primary energy production was negligible.

The comparison of France to EU-11 averages was mainly characterized by much higher share of nuclear energy (78% versus 22%), lack of solid fuels use in France (versus 45% in EU-11) and practical absence of gas in the energy mix (9% in EU-11). The shares of oil in France was lower than EU-11 (1% versus 7%), as well as share of RES (20% versus 22% in EU-11).

Item 136: Primary energy structure in France



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H) , Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

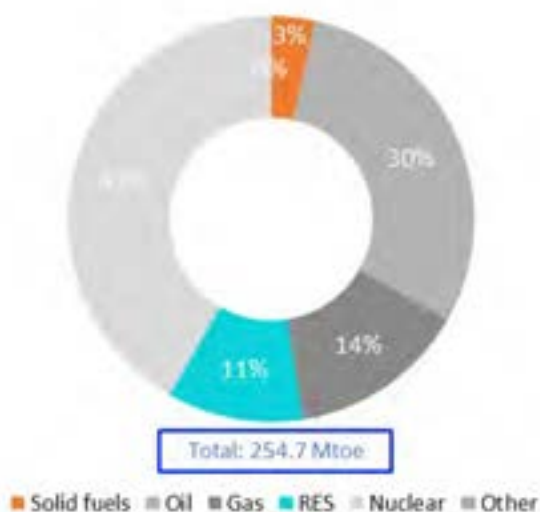
Gross inland consumption of energy in France was dominated by nuclear energy (42%), oil (30%), gas (14%) and renewable energy sources (11%). The mix was completed by 3% of solid fuels.

Comparing to European averages gross inland consumption of energy in France was marked by low share of solid fuels (3% versus 11% in EU-14 and 14% in EU-27). The share of oil was lower in France (30%) than in EU-14 (35%) and EU-27 (34%) as well as the share of gas (11% versus 23% and 22% in EU-14 and EU-27). France was characterized by much higher share of nuclear energy in the mix - 42% versus 14% and 13% in EU-14 and EU-27, respectively. The share of renewable energy sources was lower in France than the European averages - 11% versus 16% and 15% in EU-14 and EU-27.

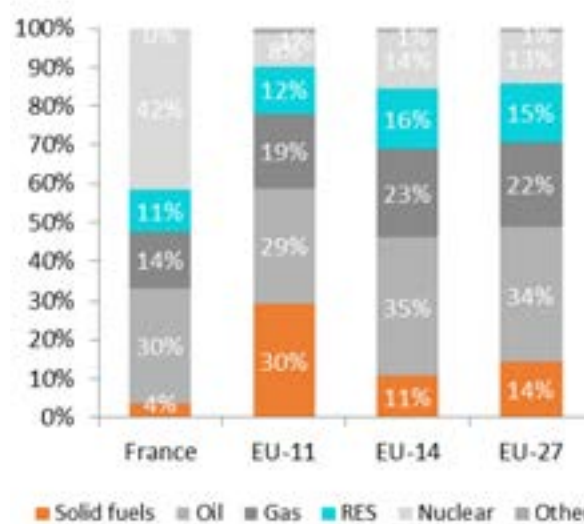
When compared to EU-11 the main difference was around much lower share of solid fuels consumption in France (4% versus 30% in EU-11) and higher share of nuclear energy (42% versus 8%). The share of oil use in France was higher than in EU-11 countries (30% versus 29%) whereas the shares of gas and RES were lower (14% versus 19% and 11% versus 12%).

Item 137: Gross inland consumption structure in France

Gross inland consumption structure in France in 2018 (%)



Gross inland consumption structure in France in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gross inland consumption – GIC, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion)(O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear – Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

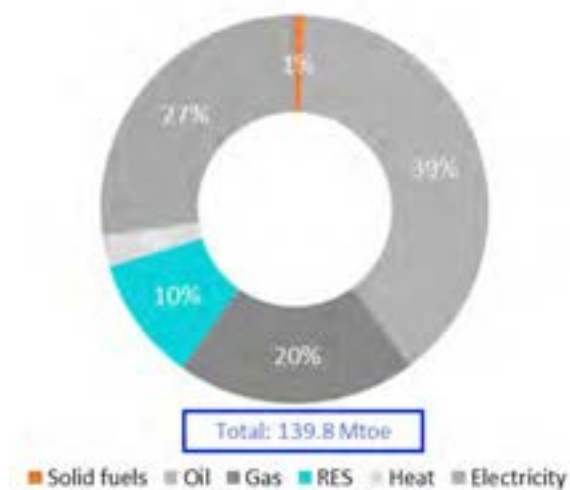
The final energy consumption in France was dominated by oil (39%), followed by electricity (27%), gas (20%) and renewable energy sources (10%). The mix was completed by heat (3%) and solid fuels (1%).

The sectoral final energy consumption in France was characterized by lower share of industrial but higher of transport sectors than in EU-14 and EU-27 (19% and 32% versus 26% and 31% in EU-14 and EU-27). The share of commercial and public services was higher in final energy consumption in France (17%) than in EU-14 (15%) and EU-27 (14%).

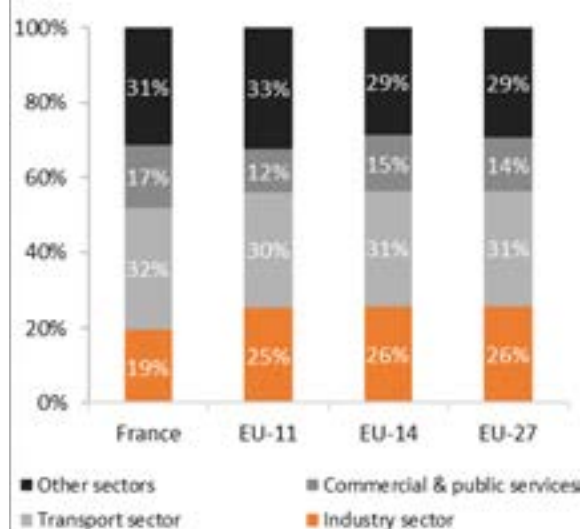
When compared to EU-11 France similar conclusions as related to EU-14 and EU-27 can be drawn.

Item 138: Final energy consumption structure in France

Final energy consumption structure in France in 2018 (%)



Final energy consumption structure in France in 2018 in comparison with EU-11, EU-14, and EU-27 averages



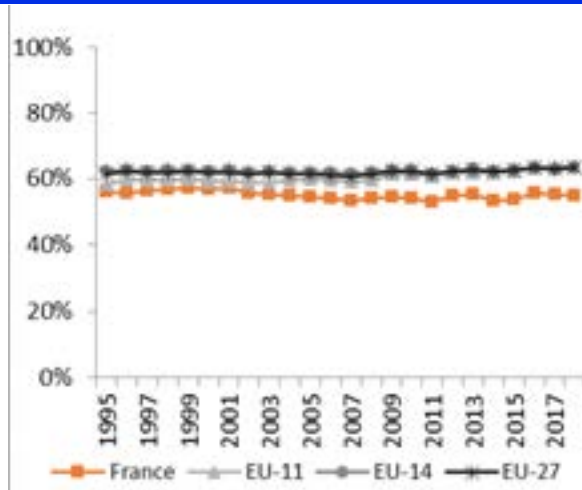
Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Heat (H8000), Electricity (E7000), Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial & public services - FC_OTH_CP_E, Other - FC_OTH_E-FC_OTH_CP_E. Errors in summation to 100% are due to rounding

French final energy consumption to gross inland consumption ratio which measure energy efficiency was lower than the averages for EU-11, EU-14 and EU-27.

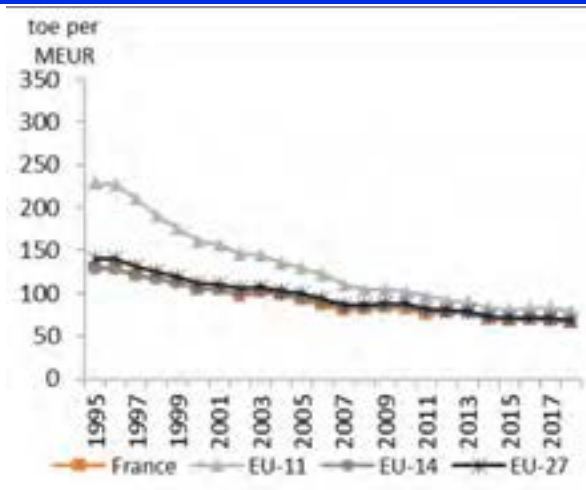
Simultaneously, a decrease of energy volume associated with generating gross domestic product was noticed in line with the averages for EU-14 and EU-27 averages.

Item 139: Final energy consumption in France in relation to selected indicators

Final energy consumption to gross inland consumption ratio in France in 1995-2018 (%)



Final energy consumption to gross domestic product ratio in France in 1995-2018 in comparison with EU-11, EU-14, and EU-27 averages (toe per M EUR)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final energy consumption - FEC, Gross inland consumption - GIC, Gross Domestic Product - Gross domestic product at market prices B1GQ, Current prices - CP-MEUR

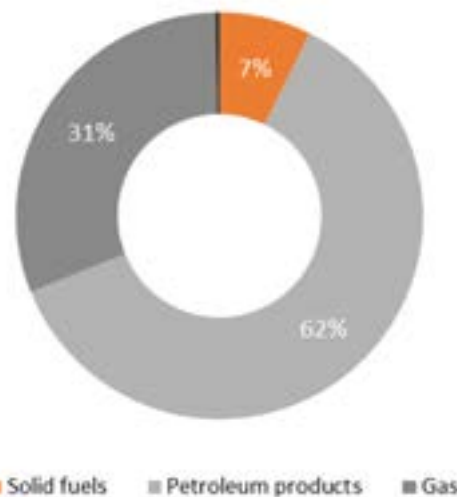
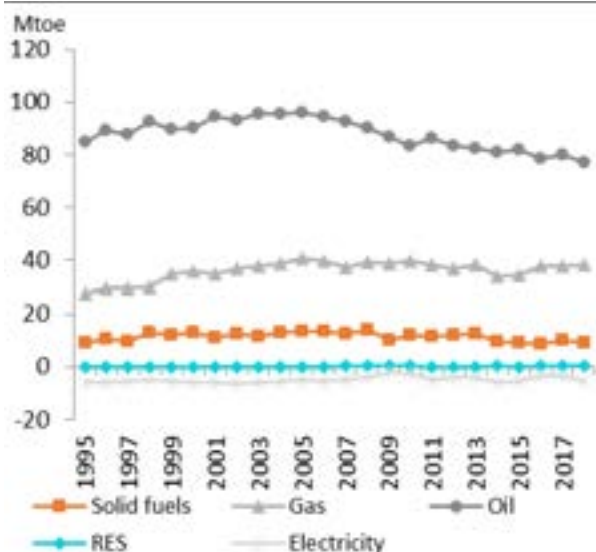
Net import of energy to France by fuels was characterized by a decrease of oil imports and an increase of gas import. The level of solid fuels import remained stable as well as the import of electricity, which was negative (France was exporting electricity).

The import structure of energy to France was dominated by oil (62%) and gas (31%). The imports were completed by 7% of solid fuels.

Item 140: Net import of energy in France

Net import of energy by fuel in 1995-2018 (Mtoe)

Net import structure in 2018 (% , only fuels for which import is greater than export)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Electricity (E7000). Errors in summation to 100% are due to rounding

Solid fuels were imported to France mainly from Russia (31%), Australia (28%), USA (14%) and several other countries.

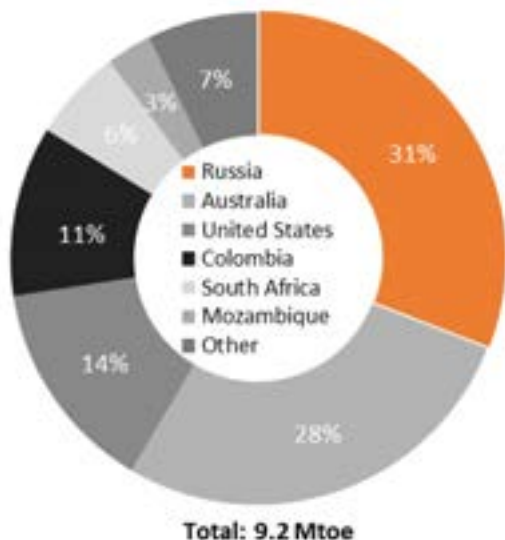
Main oil importers to France were Russia (14%), Saudi Arabia (14%), Kazakhstan (8%) and Algeria (7%). The remaining 57% were imported from various locations.

France was importing gas mainly from Norway (31%), Russia (20%), Algeria (13%) and Nigeria (12%). The remaining 9% were supplied from different locations and the origin of 11% of import was not specified.

Electricity as mainly imported from Switzerland (31%), Spain (25%), Germany (19%), Belgium (16%), Italy (6%) and United Kingdom (3%).

Item 141: Foreign fuel suppliers

Foreign suppliers of solid fuels in France in 2018 (%) Foreign suppliers of crude oil in France in 2018(%)



Foreign suppliers of gas in France in 2018 (%)

Foreign suppliers of electricity in France in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fossil fuels - C000X0350-0370, Gas - Natural gas (G3000), Oil - Oil and petroleum products (excluding biofuel portion) (O4000XBIO), Electricity - E7000. Errors in summation to 100% are due to rounding

7.3 Greenhouse gas emissions

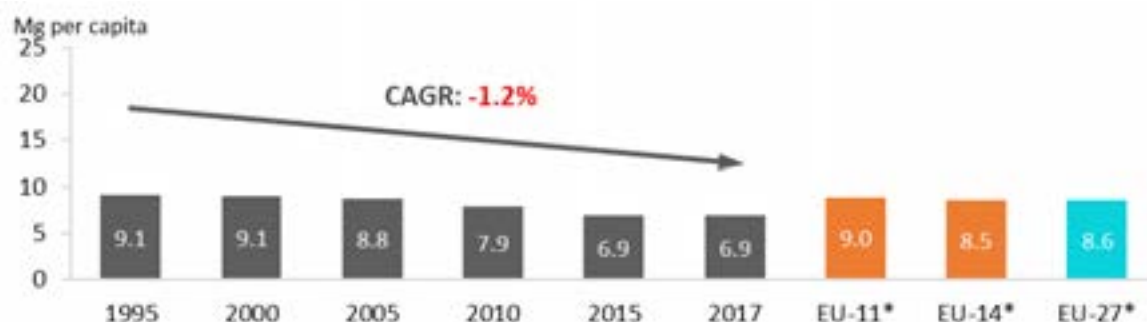
Between 1995-2017 greenhouse gases emissions in France were decreased - from over 548.1 Mt CO₂ in 1995 to 464.6 Mt CO₂ in 2017. Consequently average emissions per capita decreased to 6.9 Mg CO₂ per capita in 2017 (from 9.1 Mg CO₂ per capita in 1995), which was lower comparing to EU-14 and EU-27 averages (8.5 Mg CO₂ per capita and 8.6 Mg CO₂ per capita, respectively), and also lower than in EU-11 (9.0 Mg CO₂ per capita)

There were some noteworthy changes in the French structure of greenhouse gas emissions over the period considered. The significance of manufacturing and construction and industrial processes sectors emissions dropped swiftly by 36% and 31%, as well as emissions from energy industries 11%. On other hand, transport emissions industrial processes gained in importance increasing by 1.5%.

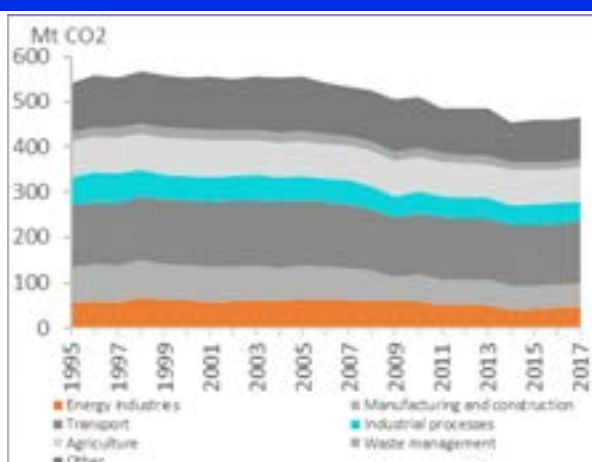
Comparing to EU-11, EU-14 and EU-27 countries, France was characterized by higher share of emissions from transport (29% versus 17%, 23% and 21%). The shares of emissions from industrial sector and manufacturing and constructions were lower in France.

Item 142: Greenhouse gas emissions in France

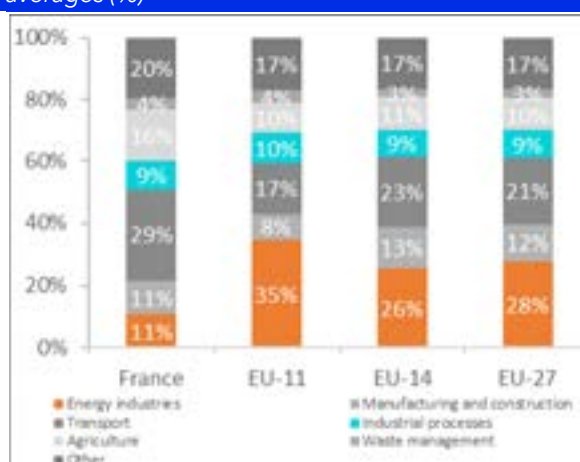
Greenhouse gas emissions per capita in France in 1995-2017 in comparison with EU-11, EU-14 and EU-27 averages in 2017 (Mg per capita)



Greenhouse gas emissions in France by sectors in 1995-2017 (Mt CO₂)



Greenhouse gas emissions in France by sectors in 2017 in comparison with EU-11, EU-14 and EU-27 averages (%)



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - * values for EU-11, EU-14 and EU-27 recalculated by the Author; Energy industry - Fuel combustion in energy industries (CRF1A1), Manufacturing and construction - Fuel combustion in manufacturing industries and construction (CRF1A2), Transport - Fuel combustion in transport (CRF1A3), Industrial processes - Industrial processes and product use (CRF2), Agriculture - Agriculture (CRF3), Waste management - Waste management (CRF5), Other = Other fuel combustion sectors (CRF1A4)+ Other fuel combustion sectors n.e.c. (CRF1A5) + Fuels

- fugitive emissions (CRF1B)+Other sectors (CRF6); Total GHG emissions equal to All sectors (excluding LULUCF and memo items) (CRF1-6X4_MEMO) i.e. emission from all sectors excluding Land use, land use change, and forestry (LULUCF), Transport and storage of CO₂ (memo item), International aviation (memo item), International navigation (memo item), Multilateral operations (memo item), Biomass - CO₂ emissions (memo item). Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. Errors in summation to 100% are due to rounding

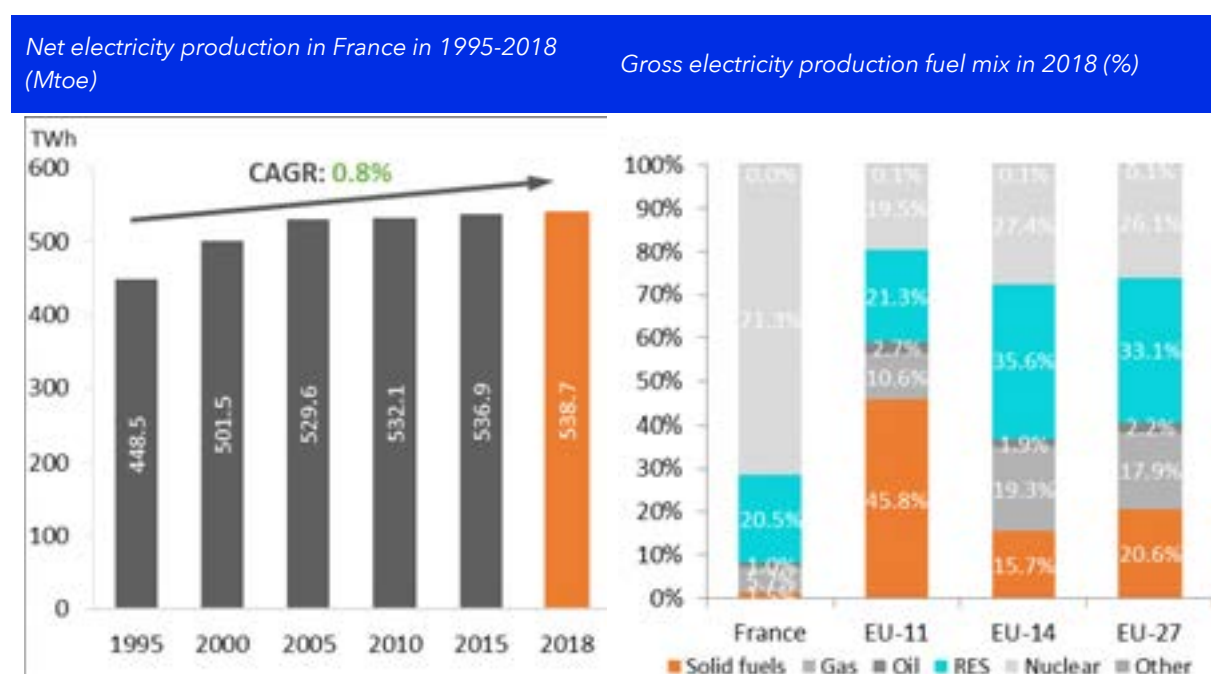
7.4 Overview of electricity sector

Item 143 presents electricity production and the current fuel mix of France. Over last 23 years net electricity production increased from 448.5 TWh in 1995 to 538.2 TWh in 2018 (CAGR 0.8%). As visible, net electricity production represented 25.0% of EU-14 total electricity production, which was higher compared to French GDP share of 19.5%.

The French fuel mix was dominated by nuclear energy and renewable energy sources with shares of 71.3% and 20.5% respectively. The mix was completed by 5.7% of gas and small shares of solid fuels (1.5%) and oil (1.0%). Compared to EU-14 and EU-27 countries, France had a much bigger share of nuclear energy in its energy mix. On other hand, the country produced relatively less electricity from solid fuels, gas, oil, and renewable energy sources, respectively 1.5%, 5.7%, 1.0% and 20.5%.

When compared to EU-11 average fuel mix one can notice much higher share of nuclear energy used in France than in EU-11 (71.3% versus 19.5%) and significantly lower use of solid fuels, gas and oil (1.5, 5.7% and 1.0% versus 45.8%, 10.6% and 2.7%). The share of renewable energy sources was lower (20.5% versus 21.3%).

Item 143: Net electricity production and gross electricity production fuel mix in France



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Electricity Production - NEP, Gross Electricity Production - GEP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear

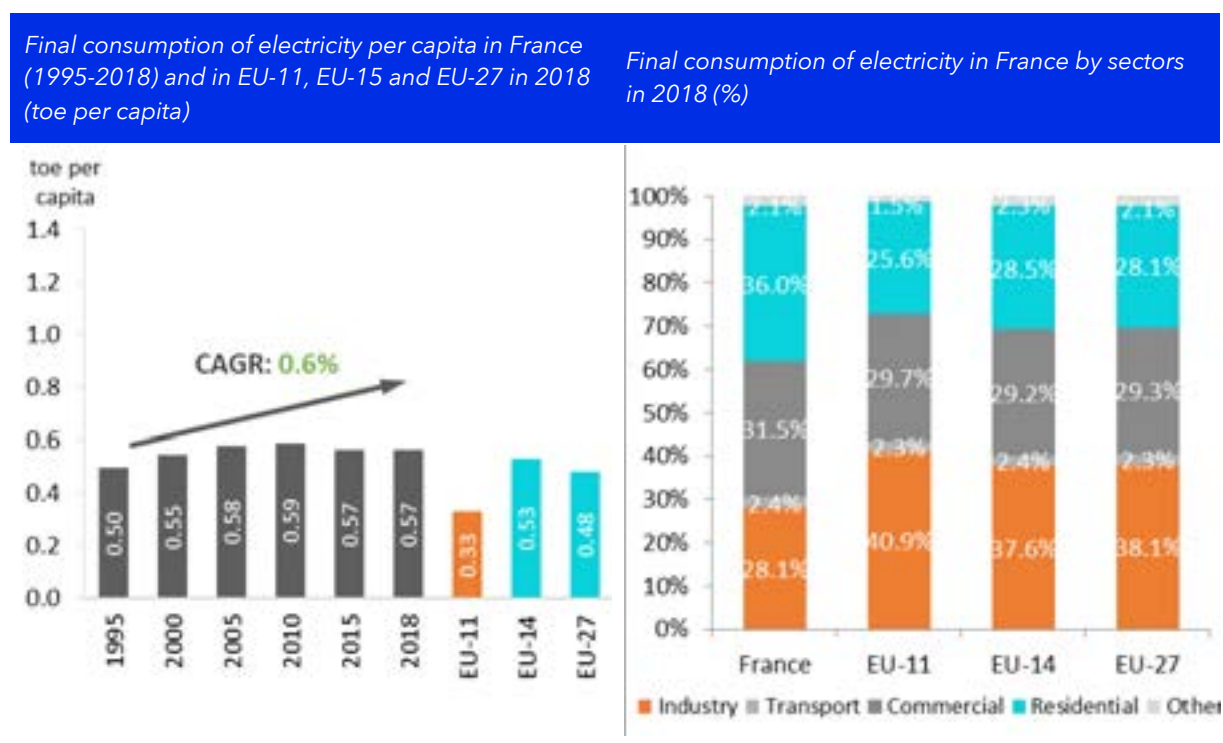
= Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

In Item 144 the evolution of final per capita consumption of electricity and its breakdown by economic sector is presented. In recent years final consumption of electricity in France increased (CAGR in the period of 1995-2019 was around 0.6%) and its level was higher compared to EU-14 and EU-27 countries. French final energy consumption per capita represented 106.6% of EU-14 level and 116.9% of EU-27 level.

The structure of final electricity consumption in France was dominated by residential (36.0% versus 28.5% in EU-14 countries) and commercial sectors (31.5% versus 29.2% in EU-14 countries). Relatively the same energy was used in transport (2.4% and less in industry (28.1% versus 37.6%).

France was consuming relatively more electricity in residential sector than EU-11 countries (36.0% versus 25.6%) and commercial one (31.5% versus 29.7%). At the same time, it used relatively more electricity in transport (2.4% versus 2.3%) and relatively less in industry (28.1% versus 40.9%).

Item 144: Final consumption of electricity in France



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Electricity E7000. Errors in summation to 100% are due to rounding

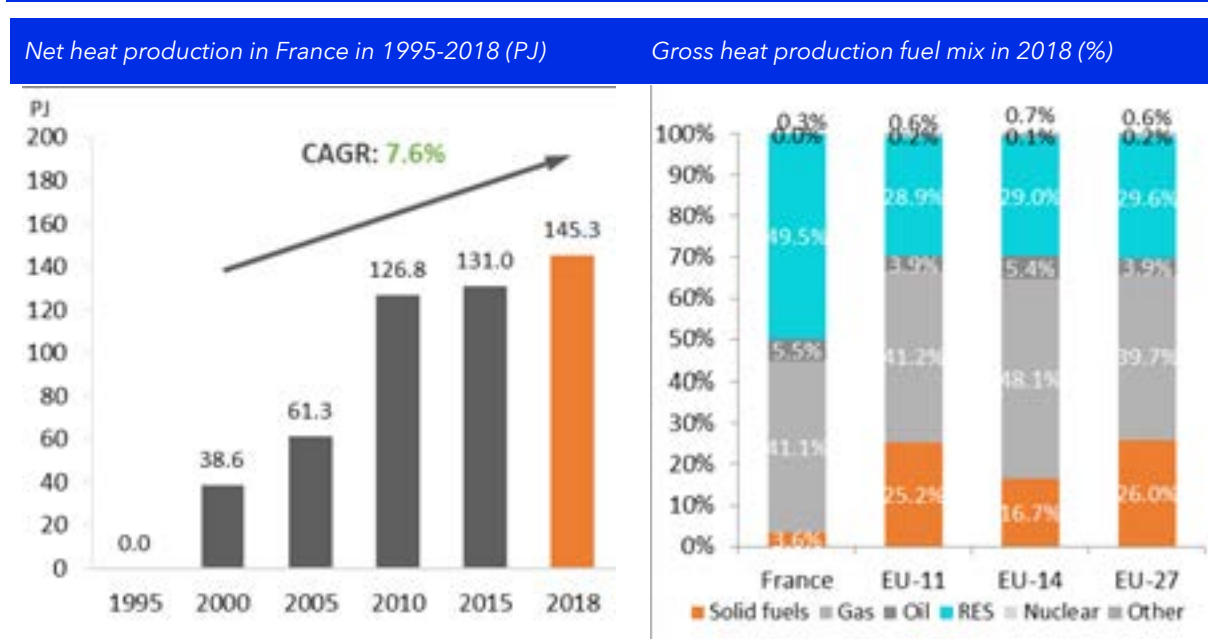
7.5 Overview of heat sector

Item 145 presents heat production and the current fuel mix of France. Over last 23 years net heat production increased from <0.1 PJ in 1995 to 145.3 PJ in 2018 (CAGR 7.6%).

The French fuel mix of heat production was dominated by renewable energy sources with share of 49.5% and gas with share of 41.1%. The mix was completed by 3.6% of solid fuels and 5.5% of oil. Compared to EU-14 and EU-27 countries, France had a much bigger share of renewable energy sources in its heat production mix. On other hand, the country produced relatively less heat from solid fuels but more from oil, respectively 3.6% and 5.5%. The share of gas was also lower – 41.1% versus 48.1% in EU-14. France did not use nuclear energy for heat production where some heat was produced in nuclear facilities in EU-14 countries (0.1%).

When compared to EU-11 average fuel mix one can notice much higher share of renewable energy sources used in France than in EU-11 (49.5% versus 28.9%) and significantly lower use of solid fuels (3.6% versus 25.2%). The share of gas was lower in France (41.1% versus 41.2%) but the share of oil was higher (5.5% versus 3.9%). France was not using nuclear energy for heat generation in opposite to EU-11 where the share of nuclear was 0.2%.

Item 145: Net heat production and gross electricity production fuel mix in France



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Heat Production - NHP, Gross Heat Production - GHP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

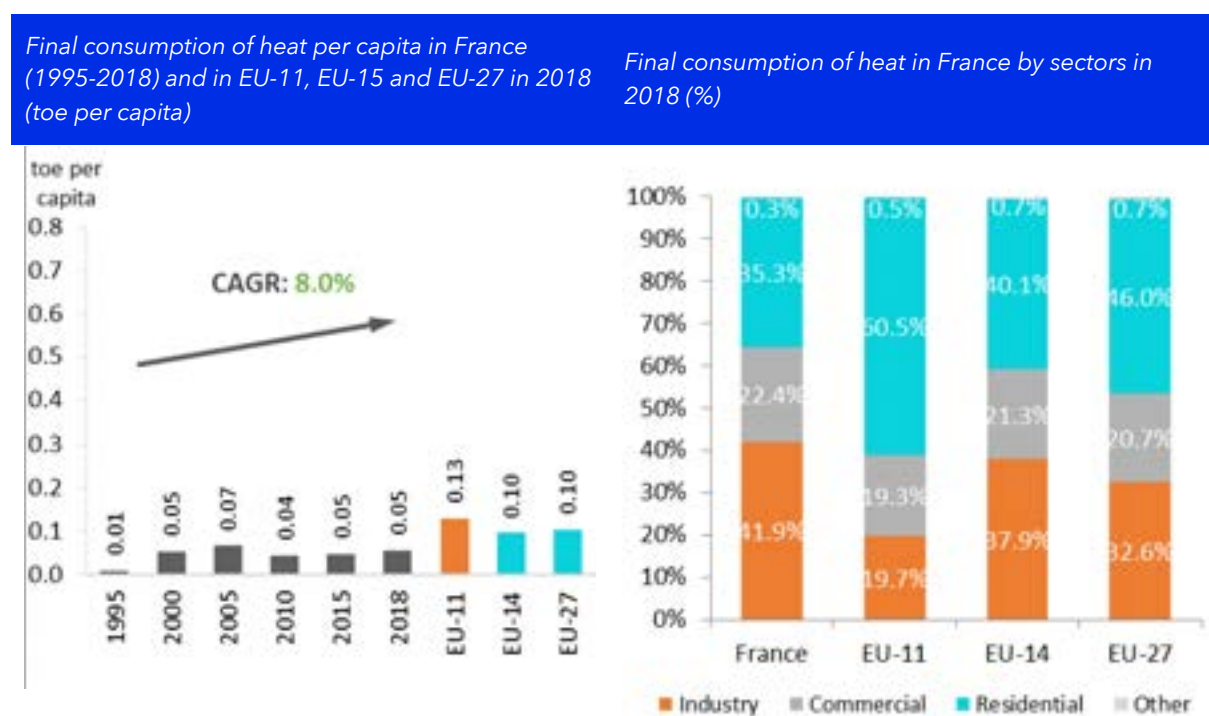
Item 147 presents final heat consumption per capita and its breakdown by sectors.

The per capita demand for heat in France increased from 0.01 toe per capita in 1995 to 0.05 toe per capita in 2018. As a result, within the 23 years analyzed, heat consumption per capita increased at CAGR of 8.0%. The heat consumption remained lower than the averages for EU-11, EU-14 and EU-27, respectively 0.13 toe per capita, 0.10 toe per capita and 0.10 toe per capita.

The structure of final consumption of heat in France was characterized by higher share of commercial sector (22.4% compared to 21.3% in EU-14) and lower residential usage (35.3% compared to 40.1% in EU-14). The share of industry in heat consumption was higher than the averages (41.9% compared to 37.9% in EU-14).

In relation to EU-11 countries, the structure of final heat consumption in France was characterized by lower share of residential sector (35.3% versus 60.5%) and higher share of commercial sector (22.4% versus 19.3%). The industrial use of heat consumed 41.9% of it in France whereas 19.7% in EU-11.

Item 146: Final consumption of heat in France

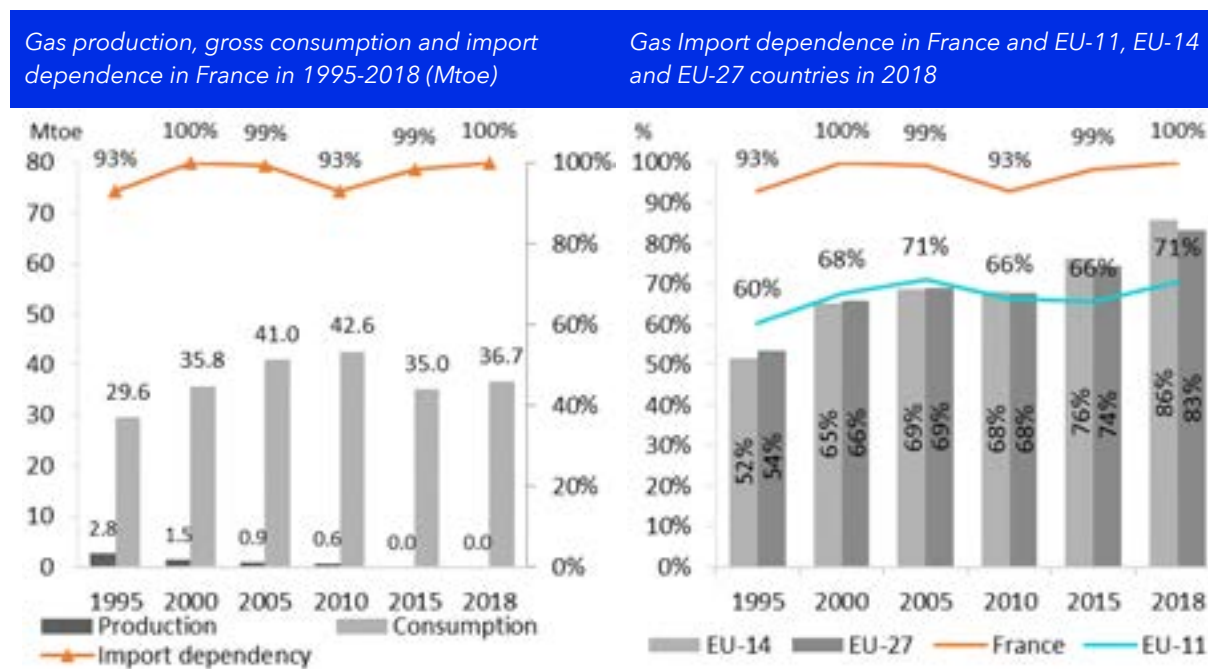


Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Heat H8000. Errors in summation to 100% are due to rounding

7.6 Overview of gas sector

France consumed 36.7 Mtoe of gas in 2018. It increased from 29.6 Mtoe in 1995 to 42.6 Mtoe in 2010 and then decreased. National production accounted for <0.1 Mtoe and it decreased over past 23 years from 2.8 Mtoe to the current value. The remaining part of gas was imported. The country dependency on import was fluctuating from 93% to 100% over past 23 years. In 2018 the country was more dependent on import than EU-11, EU-14 and EU-27 average values.

Item 147: Gas sector in France



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gas production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Natural Gas G3000

The final consumption of gas per capita in France decreased from 0.44 toe per capita to 0.42 toe per capita over past 23 years. This value was lower than the average values for EU-14 and EU-27 countries, but higher than the one for EU11 countries.

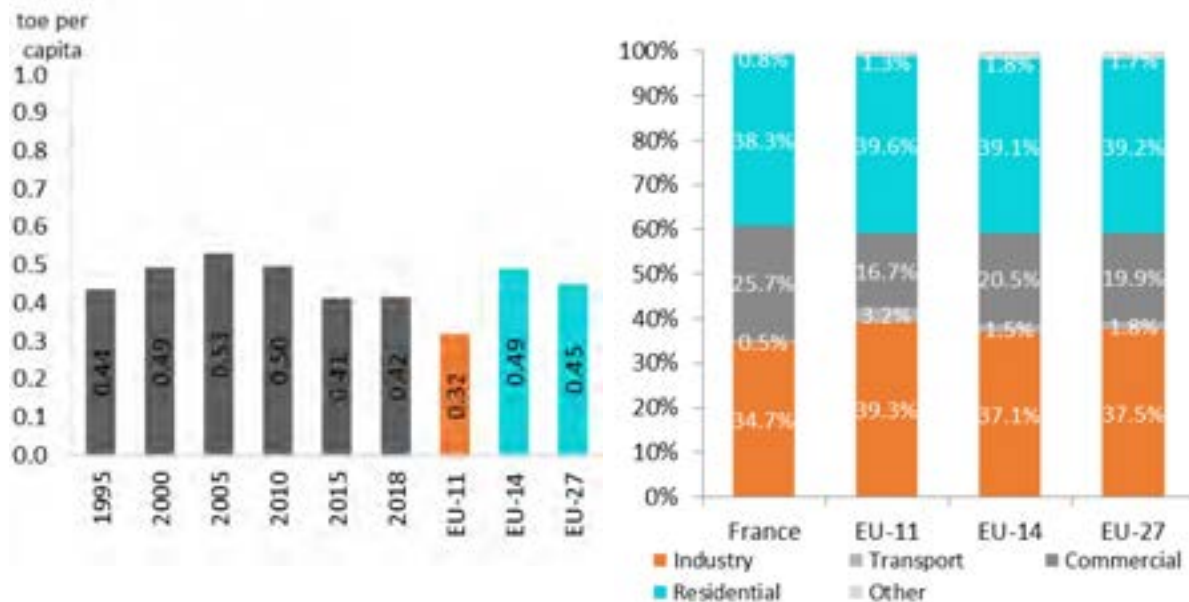
The structure of final gas consumption in France in 2018 was characterized by lower share of industry - 34.7% versus 37.1% in EU-14. The share of use of gas in transport and residential applications were lower than the averages for EU-14 countries, but relatively more gas was used in the country in commercial sector than the average - 25.7% versus 20.5%.

When compared to EU-11 countries, France was using relatively less gas industry than EU-11 countries - 34.7% versus 39.3%. The country was also using less gas in residential and transport sector - 38.3% versus 39.6% and 0.5% versus 3.2%. On other hand, the share of gas used in commercial sector was higher than in EU-11 countries, 25.7% versus 16.7%.

Item 148: Final consumption of gas per capita in France in 1995-2018 and gas final consumption by sectors in France and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of gas per capita in France (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Gas final consumption by sectors in France and EU-11, EU-14 and EU-27 countries in 2018



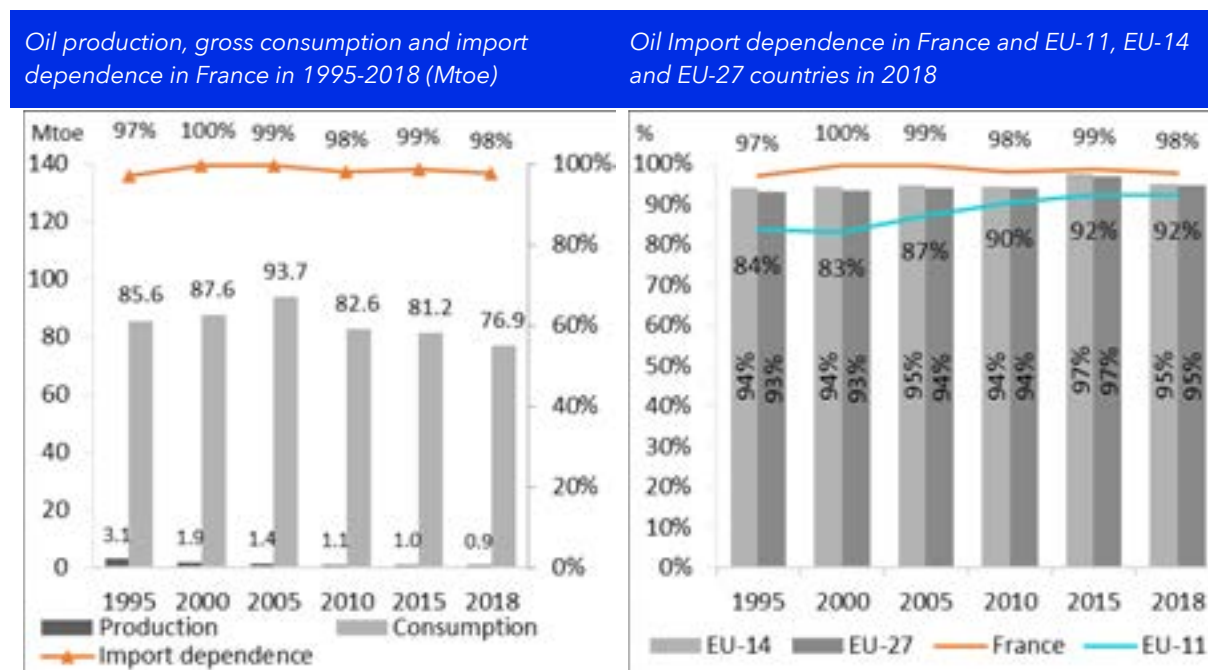
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Natural Gas G3000. Errors in summation to 100% are due to rounding

7.7 Overview of oil sector

The oil consumption of France dropped from 85.6 Mtoe in 1995 to 76.9 Mtoe in 2018. At the same time the national production dropped from 3.1 Mtoe to 0.9 Mtoe. Therefore, the level of import dependency was high - between 97% and 100%.

When compared to EU-14 and EU-27 average import dependency, the country had a higher import dependency of 98% versus 95% in EU-14 and EU-27 countries. At the same time, the import dependency of the country was higher than EU-11 average - 98% versus 92%.

Item 149: Oil sector in France



Source: Eurostat data for 2018, extracted in 2020. Detail references: Oil production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Import dependence above 100% has been rounded to 100%

The final consumption of oil per capita in France decreased from 1.11 toe per capita in 1995 to 0.81 toe per capita in 2018. The level of final consumption per capita remained higher than the one for EU-11 and EU-27 but lower than EU-14 average.

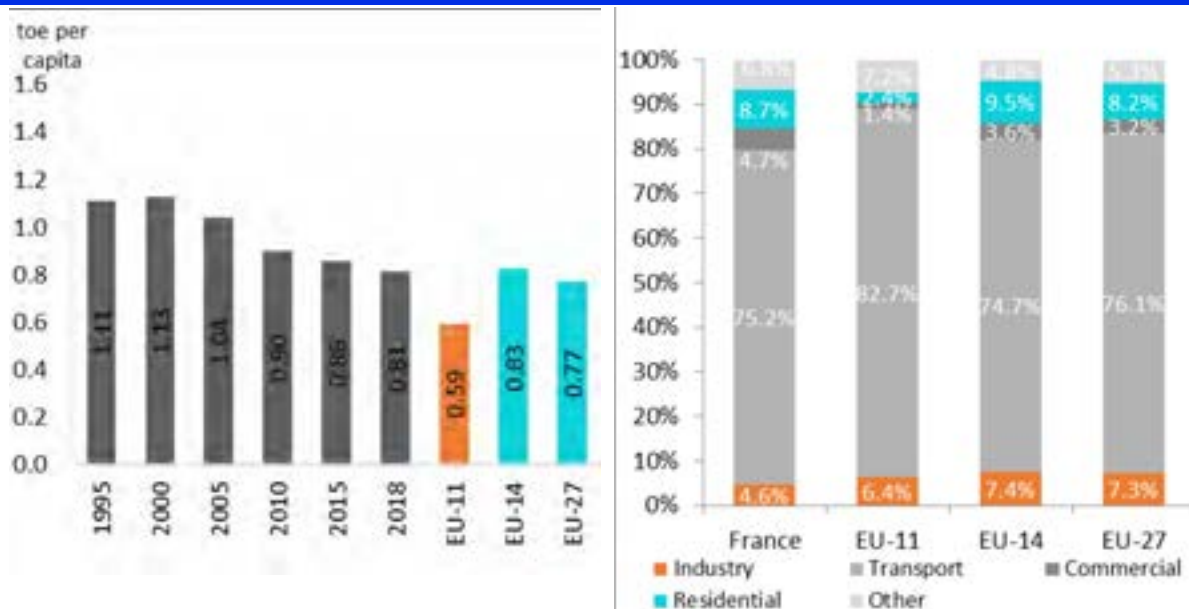
Oil consumption was dominated by transport sector - 75.2% versus 74.7% in EU-14 countries. Relatively less oil was used in industry - 4.6% versus 7.4% but more in commercial sector - 4.7% versus 3.6%. The residential use of oil was lower than EU-14 average - 8.7% versus 9.5%.

The relative consumption of oil in France compared to EU-11 was lower in 2018 - 82.3% versus 82.7%. The use in industry was also relatively lower - 3.5% versus 6.4%. At the same time commercial and residential sector were consuming relatively more oil in the country than EU-11 averages - 2.0% and 9.8% versus 1.4% and 2.4%.

Item 150: Final consumption of oil per capita in France in 1995-2018 and oil final consumption by sectors in France and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of oil per capita in France (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Oil final consumption by sectors in France and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Errors in summation to 100% are due to rounding

7.8 EU climate policy and its targets for France

France is subject to EU energy and climate regulations and therefore, specific targets were set and verified regarding greenhouse gas emission, share of energy from renewable energy sources and energy efficiency improvements (see Item 151).

Item 151: Energy and climate targets for France for 2020 and 2030

| | France 2020 targets | France 2030 targets |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | EU wide target of 20% reduction from 1990 levels (14% from 2005 level) | EU wide target of 40% reduction from 1990 levels |
| Greenhouse gas emissions in ETS | EU wide target of 21% reduction from 2005 | EU wide target of 43% reduction from 2005 |
| National emission reduction targets in non-ETS - Effort Sharing Decision (ESD) | -14% in relation to their 2005 levels | - |
| National emission reduction targets in non-ETS - Effort Sharing Regulations (ESR) | - | -37% in relation to their 2005 levels |
| Share of energy from renewable energy sources | EU wide target of 20% energy from renewables | EU wide target of minimum 32% share for renewable energy |
| EU wide target of share of energy from renewable energy sources | EU wide target of 20% share of gross final energy consumption | EU wide target of 32% share of gross final energy consumption |
| National target of share of energy from renewable energy sources | 23% of gross final consumption | Not yet available |
| Improvement in energy efficiency | EU wide target of 20% improvement in energy efficiency | EU wide target of at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |
| Primary energy consumption | EU wide target < 1,483 Mtoe National target < 219.9 Mtoe | EU wide target of 1,273 Mtoe (< 1,128 Mtoe EU-27) National targets not available yet |
| Final energy consumption | EU wide target < 1,086 Mtoe National target < 131.4 Mtoe | EU wide target < 956 Mtoe (< 846 Mtoe EU-27) National targets not available yet |

Source: EU website

In following chapter, the overview of France targets and performance are summarized.

7.8.1 Greenhouse gas emissions

EU set a target for CO₂ reduction by 20% compared to 1990 level at EU level. Regardless the fact that the target was not binding for specific country, the level of CO₂ emission in France was below EU wide target in 2018.

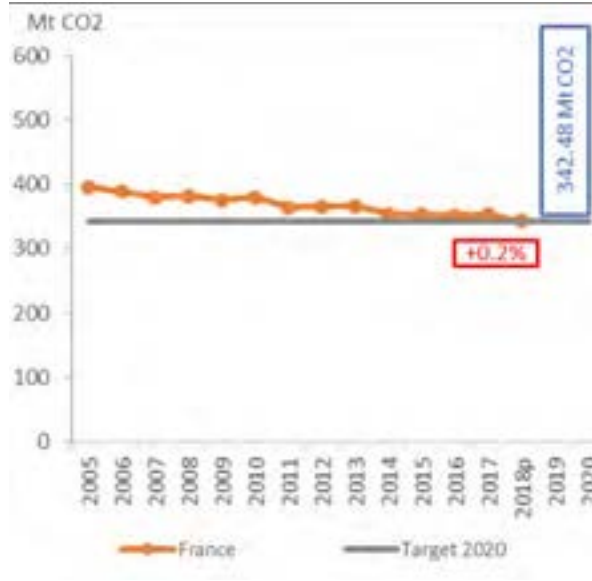
The non-ETS greenhouse gas emissions the binding national targets for France was 342.48 Mt of CO₂ equivalent emissions. Comparing to 2018 provisional results the level of emissions exceeded the target by 0.2%.

Item 152: Energy efficiency target data for France

Greenhouse gas emissions level in France and EU-28, base year 1990, and EU 2020 target



Greenhouse gas emissions in Effort Sharing Decision (ESD) sectors



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Greenhouse gas emissions, base year 1990 [T2020_30], Greenhouse gas emissions in ESD sectors [T2020_35]

7.8.2 Renewable energy sources

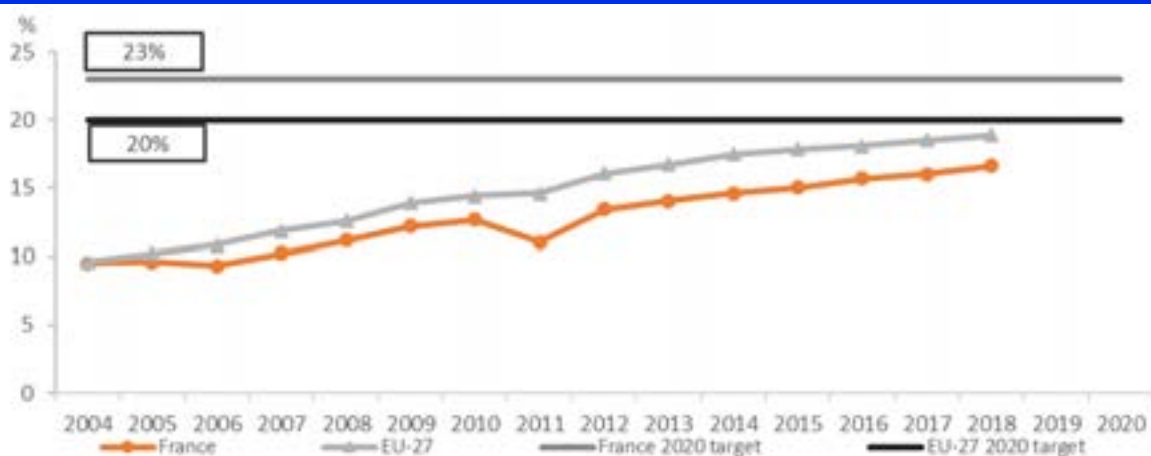
The following targets were set for France regarding the share of energy from renewable energy sources in gross final energy consumption:

- a 20% share of gross final energy consumption by 2020,
- a 23% national target for share of energy from renewable sources in gross final consumption of energy in 2020.

The share of energy from renewable energy sources in France was below EU wide and country specific targets in 2018.

Item 153: Share of energy from renewable energy sources in gross final energy consumption in France

Share of energy from renewable energy sources in gross final energy consumption in France in 2005-2018 and targets for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Share of energy from renewable sources [nrg_ind_ren]

7.8.3 Energy efficiency

The energy efficiency target set for France were respectively:

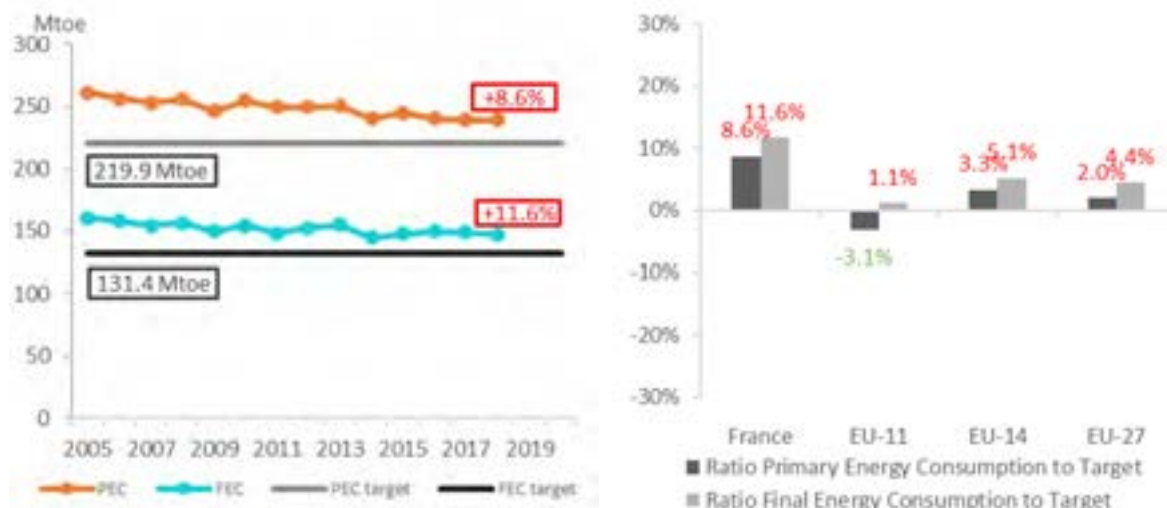
- Primary Energy Consumption in 2020: 219.9 Mtoe
- Final energy consumption in 2020: 131.4 Mtoe

Following the information provided in Item 154 the results for 2018 were above the targets in both criteria, respectively +8.6% of primary energy consumption and 11.6% of final energy consumption. This does not exclude France to achieve the targets in 2020.

Item 154: Energy efficiency target data for France

Primary energy consumption and final energy consumption in France in 2005-2018 and targets for 2020

Ratio of primary energy consumption to target for 2020 and final energy consumption to target for 2020 in France, EU-11, EU-14 and EU-27 in 2018



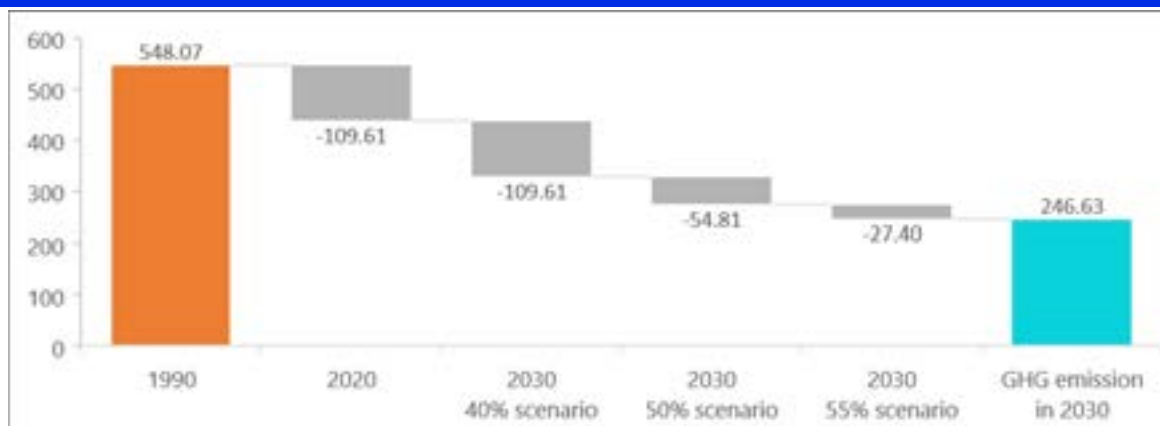
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Primary energy consumption - Primary energy consumption (Europe 2020-2030)(PEC2020-2030), final energy consumption - Final energy consumption (Europe 2020-2030) (FEC2020-2030). EU-11 and EU-14 data estimated based on Eurostat data

7.9 Review of potential impact of Green Deal propositions

At the current stage of discussions regarding the European Green Deal only partial information are available regarding the future targets. EU is proposing to increase the greenhouse gas emission reduction to 50% or 55% for 2030. This is a proposition included in the draft proposal of "Climate Law". Assuming the France greenhouse gas emissions in 1990, an estimation of EU 2030 target emissions can be drafted. The 2020 target of 20% reduction resulted in 109.61 Mt CO₂ emission drop. Further increase of the target to 40% in 2030 require additional 109.61 Mt CO₂ reduction. If the 50% target proposed under European Green Deal is applied then additional 54.81 Mt CO₂ emission decrease is needed, or 82.21 Mt CO₂ decrease, if 55% target is adopted.

Item 155: Estimation regarding greenhouse gas emissions in France under different scenarios (Mt CO₂)

Estimation regarding greenhouse gas emissions in France under different scenarios (Mt CO₂)



Source: Eurostat data for 2018, extracted in 2020. Estimations delivered by the Author

Nevertheless, it is worth to highlight that, if the current structure of greenhouse gas emissions target is maintain, then the 50% target for 2030 is an EU wide target. It is not a binding element for specific countries. Country specific targets could be expected as per ESD and ESR but there is no way to anticipate the potential targets.

At the same time, the review of key EU regulations around climate and energy as:

- Emissions Trading System Directive;
- Effort Sharing Regulation;
- Land use, land use change and forestry Regulation;
- Energy Efficiency Directive;
- Renewable Energy Directive;
- CO₂ emissions performance standards for cars and vans
- Energy Taxation Directive

can bring some additional targets in area of share of energy from renewable energy sources and energy efficiency. For the moment, any estimation of potential targets is not available nor possible to estimate.



8 Germany

8.1 General information

Germany is the fourth biggest country within EU-14 group in terms of total country area and represents 11.6% of the area. At the same time, it is the 4th country in EU-27 with 8.5% of the area. It represents 24.2% of EU-14 population and 18.6% of EU-27 population, but 27.7% of its total nominal GDP of EU-14 and 24.8% of EU-27. Despite the robust economic growth in 1995-2018 period, in 2018 German GDP per capita amounted to 123% of the whole EU average (133% in 1995).

Item 156: Germany - key data



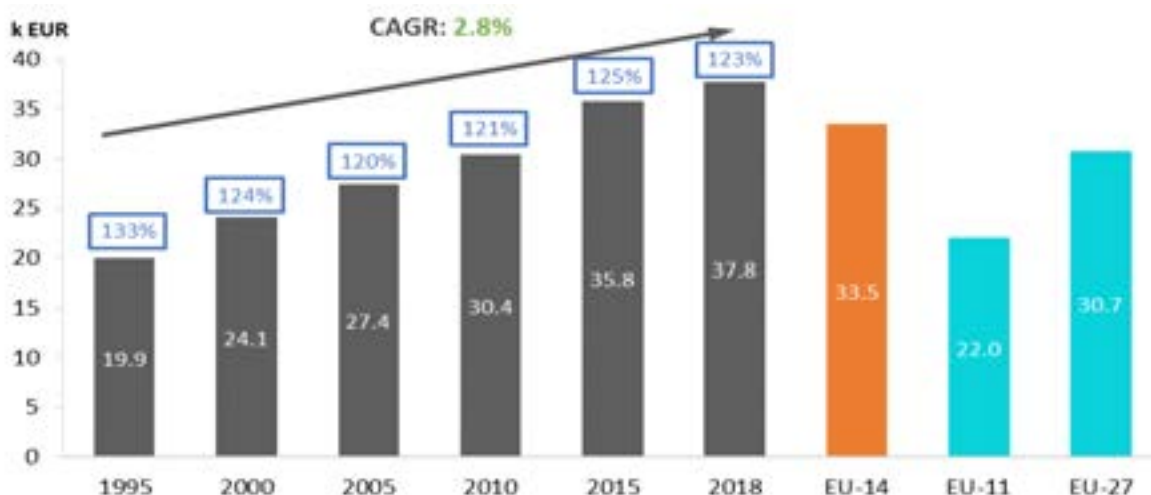
Key data

| | |
|------------------------------------------------------|--------|
| Population (M) | 82.8 |
| GDP per capita (EUR, nominal) | 40,340 |
| GDP per capita (EUR, PPS) | 37,760 |
| GDP as share of EU-14 | 27.7% |
| GDP as share of EU-27 | 24.8% |
| Energy intensity of the economy (kgoe per 1,000 EUR) | 103.3 |
| Greenhouse gas emissions (Mg per capita) | 11.0 |

Source: Eurostat data for 2018, extracted in 2020

With the compounded annual growth rate amounting to 2.8% German economy considerably grew in the period of 1995-2018 (see Item 157). Its GDP per capita was above EU-14 and EU-27 averages (equal to 113% and 123% of the respective averages). Its GDP per capita was also 172% of the average GDP per capita for EU-11 countries.

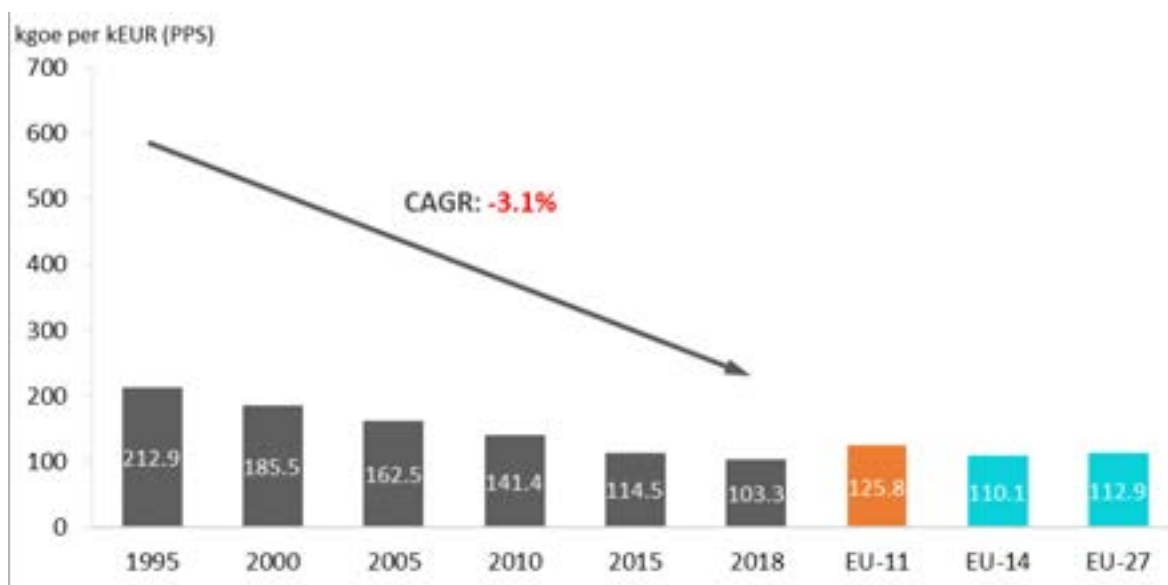
Item 157: GDP per capita in Germany for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in 2018 (kEUR, PPS) and share of Germany GDP per capita in relation to EU-27 average



Source: Eurostat data for 2018, extracted in 2020. Detail references: GDP per capita - Gross domestic product at market prices (B1GQ), Current prices, purchasing power standard per capita (CP_PPS_HAB)

The German economy energy intensity was about 103.3 kgoe per 1,000 EUR PPS in 2018, thanks to a decrease of the energy intensity indicator during the years 1995-2018. It dropped by 109.6 kgoe per 1,000 EUR PPS, i.e. it was reduced by about 51%. The energy intensity of Germany in 2018 represented 82% and 91% of EU-14 and EU-27 averages. At the same time, it represented 94% of EU-11 average.

Item 158: Energy intensity of the economy in Germany in 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)



Source: Eurostat data for 2018, extracted in 2020. Values for EU-11 and EU-14 were recalculated based on energy intensity and GDP data from Eurostat. Detail references: Energy intensity of GDP in purchasing power standards (PPS) - EI_GDP_PPS

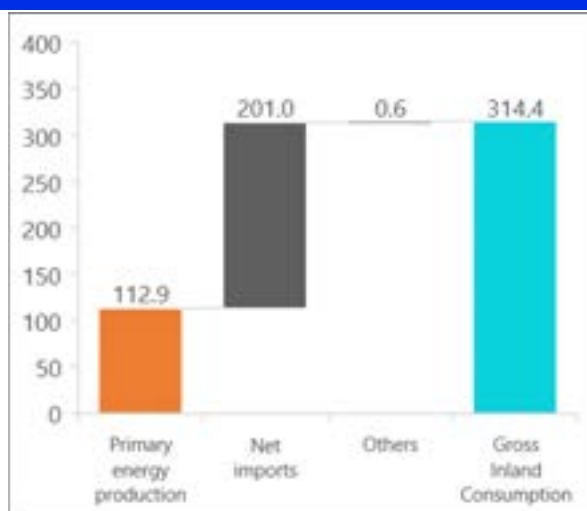
8.2 Energy balance of Germany

The energy balance of Germany in 2018 is presented in Item 159. The primary energy production was equal to 112.9 Mtoe in 2018. Net imports added 201.0 Mtoe to the balance. The total gross inland consumption accounted for 314.4 Mtoe. The level of import of energy to Germany was fluctuating from 195 to 220 Mtoe. In the last 23 years it increased from about 195 Mtoe to more than 200 Mtoe. At the same time the level of net import reported to the energy needs increased slowly and it was about 65%.

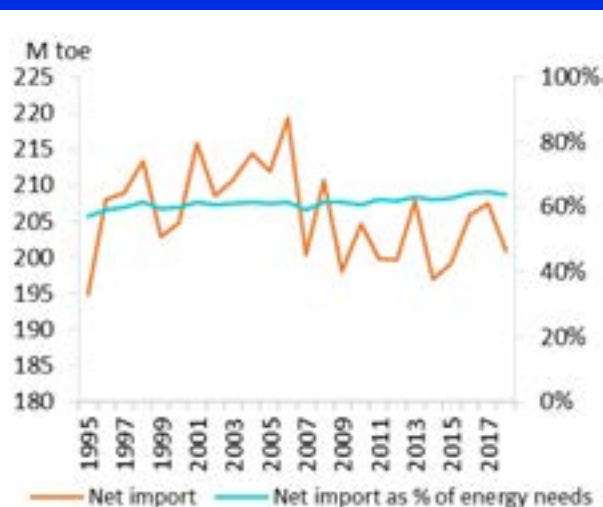
The primary energy production decreased over past 23 years. Gross energy consumption remained stable. National production was meeting only 36% of the country gross consumption and this factor decreased over last 23 years from 42%.

Item 159: Energy balance in Germany

Energy balance in Germany in 2018 (Mtoe)



Net import of energy in Germany in 1995-2018 (Mtoe and as percentage of GIC)



Gross inland consumption, primary energy production (Mtoe) and ratio of primary energy production to gross inland consumption in 1995-2018 in Germany (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Gross inland consumption - GIC. Net imports = Import (IMP) - Export (EXP), Other = Change in stock (STK-CHG) - International maritime bunkers (INTMARB)

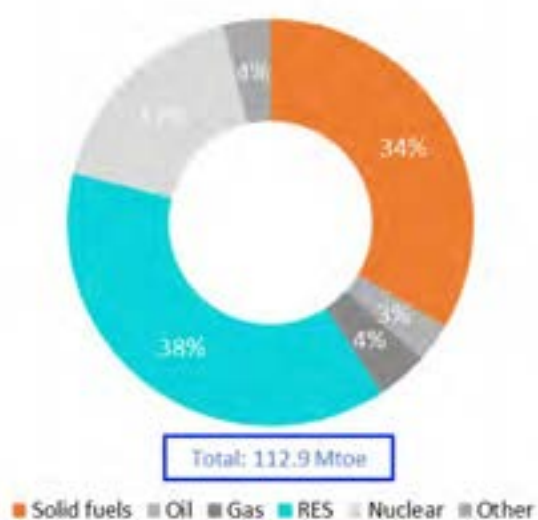
The primary energy production in Germany was dominated by solid fuels (34%), renewable energy sources (38%) and nuclear energy 17%). The mix was completed by 3% share of oil and 4% share of gas in the mix, as well as 4% of other sources.

When compared to the European averages, Germany was characterized by very high share of solid fuels in the energy mix - 34% versus 10% EU-14 average and 19% EU-27 average. The share of renewable energy sources in the German fuel mix was the same as in EU-14 (38%) but higher than EU-27 average (34%). At the same time, the share of oil and gas were lower in Germany than the averages for EU-14 and EU-27 (3% and 4% versus 4% and 9% and 5% and 9%). The share of nuclear energy was lower in Germany - 17% versus 38% in EU-11 and 31% in EU-27.

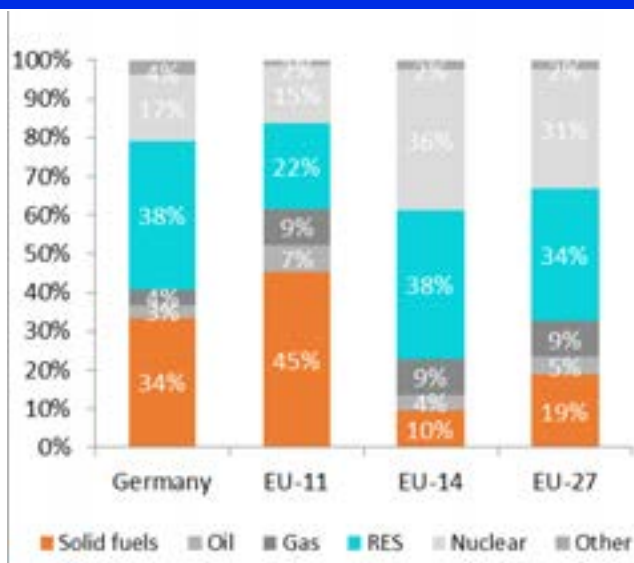
The comparison of Germany to EU-11 averages was mainly characterized by much higher share of RES (38% versus 22%). The shares of oil, gas and solid fuels were lower than EU-11 averages (3%,4%, 34% versus 7%, 9%, 45%). The share of nuclear was similar (17% versus 15%).

Item 160: Primary energy structure in Germany

Primary energy structure in Germany in 2018 (%)



Primary energy production structure in Germany in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H) , Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

Gross inland consumption of energy in Germany was dominated by oil (35%), gas (23%), solid fuels (22) and renewable energy sources (14%). The mix was completed by 6% of nuclear energy.

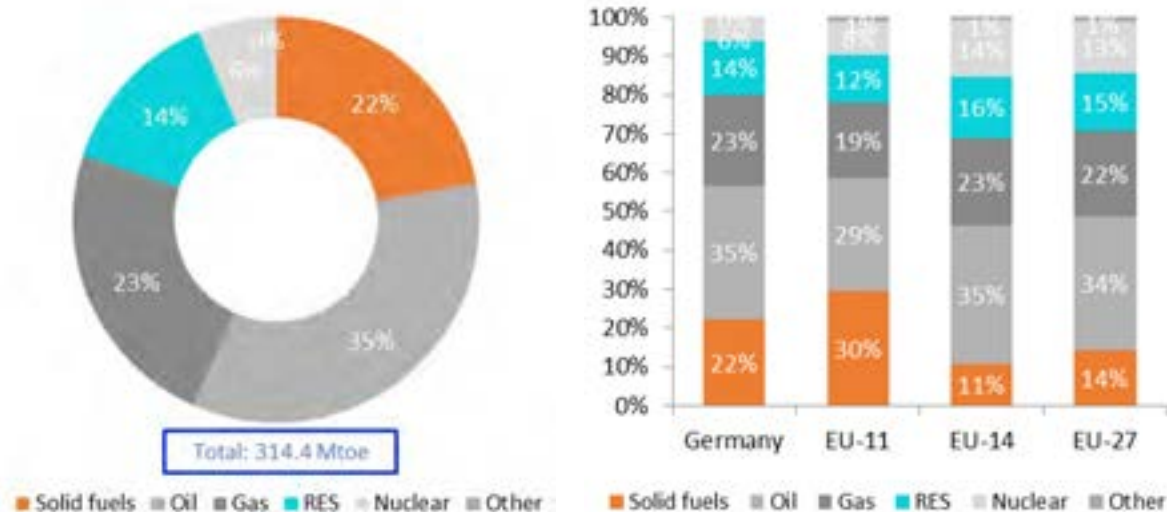
Comparing to European averages gross inland consumption of energy in Germany was marked by high share of solid fuels (22% versus 11% in EU-14 and 14% in EU-27). The share of oil was similar in Germany (35%) as than in EU-14 (35%) and EU-27 (34%) as well as the share of gas (22-23%). Germany was characterized by lower share of renewable energy sources than the averages - 14% versus 16% and 15%, and lower share of nuclear energy - 6% versus 14% and 13% in EU-14 and EU-27.

When compared to EU-11 the main difference was around much lower share of solid fuels consumption in Germany (22% versus 30% in EU-11) and higher share of renewable energy sources (14% versus 12%). The share of gas and oil use in Germany were also higher than in EU-11 countries (35% versus 29% and 23% versus 19% respectively). EU-11 average gross final consumption included nuclear energy at 8%. In Germany it was 6%.

Item 161: Gross inland consumption structure in Germany

Gross inland consumption structure in Germany in 2018 (%)

Gross inland consumption structure in Germany in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gross inland consumption - GIC, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

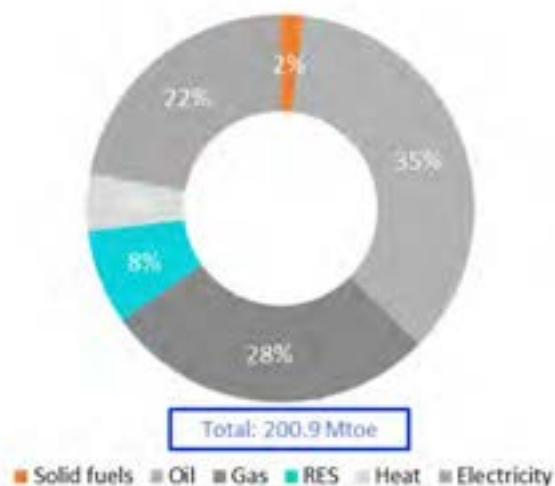
The final energy consumption in Germany was dominated by oil (35%), followed by gas (28%), electricity (22%) and renewable energy sources (8%). The mix was completed by heat (5%) and solid fuels (2%).

The sectoral final energy consumption in Germany was characterized by higher share of industrial but lower of transport sectors than in EU-14 and EU-27 (29% and 28% versus 26% and 31% in EU-14 and EU-27). The share of commercial and public services in final energy consumption was at similar level Germany (14%) than in EU-14 (15%) and EU-27 (14%).

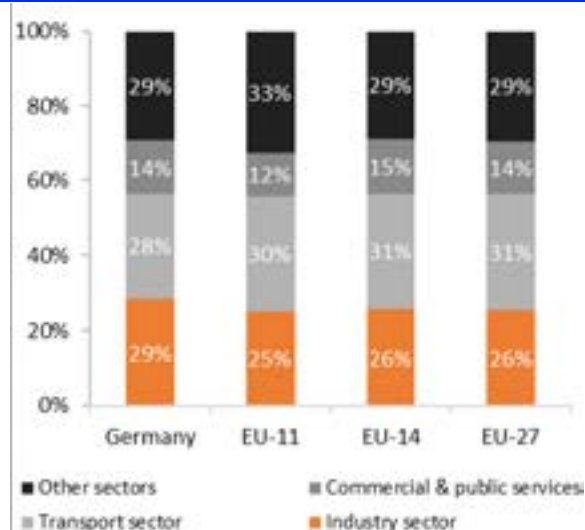
When compared to EU-11 Germany similar conclusions as related to EU-14 and EU-27 can be drawn.

Item 162: Final energy consumption structure in Germany

Final energy consumption structure in Germany in 2018 (%)



Final energy consumption structure in Germany in 2018 in comparison with EU-11, EU-14, and EU-27 averages



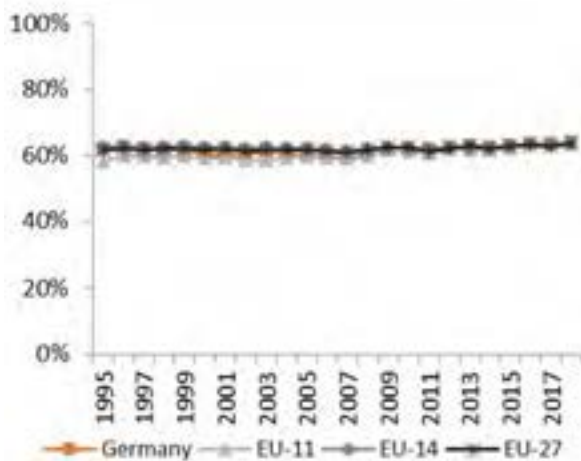
Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Heat (H8000), Electricity (E7000), Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial & public services - FC_OTH_CP_E, Other - FC_OTH_E-FC_OTH_CP_E. Errors in summation to 100% are due to rounding

German final energy consumption to gross inland consumption ratio which measure energy efficiency was close to the averages for EU-11, EU-14 and EU-27. The situation remained stable for last 23 years.

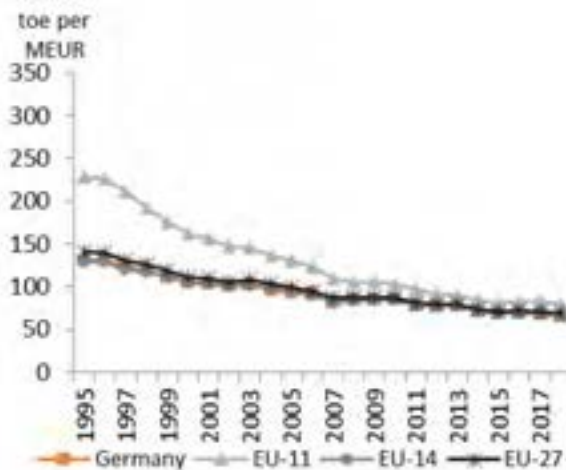
Simultaneously, a decrease of energy volume associated with generating gross domestic product was noticed in line with the averages for EU-14 and EU-27 averages.

Item 163: Final energy consumption in Germany in relation to selected indicators

Final energy consumption to gross inland consumption ratio in Germany in 1995-2018 (%)



Final energy consumption to gross domestic product ratio in Germany in 1995-2018 in comparison with EU-11, EU-14, and EU-27 averages (toe per M EUR)



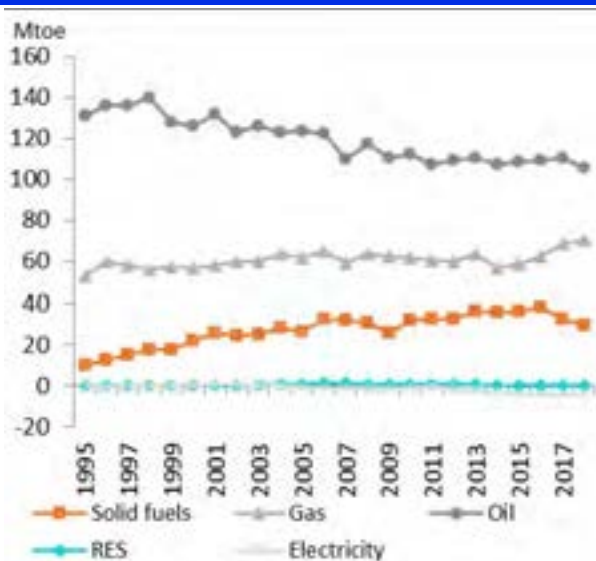
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final energy consumption - FEC, Gross inland consumption - GIC, Gross Domestic Product - Gross domestic product at market prices B1GQ, Current prices - CP-MEUR

Net import of energy to Germany by fuels was characterized by a decrease of oil imports and an increase of gas and solid fuels import.

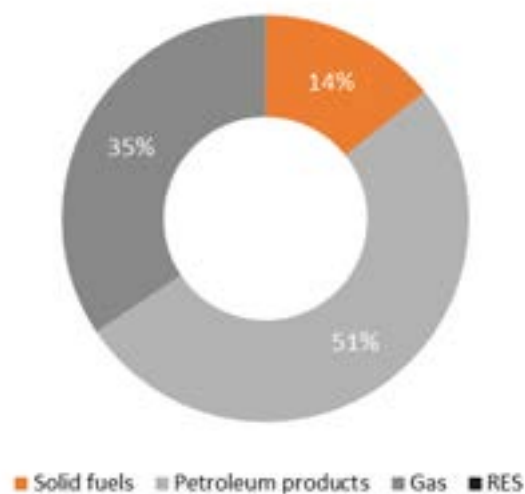
The import structure of energy to Belgium Germany was dominated by oil (51%) and gas (35%). The imports were completed by 14% of solid fuels.

Item 164: Net import of energy in Germany

Net import of energy by fuel in 1995-2018 (Mtoe)



Net import structure in 2018 (% , only fuels for which import is greater than export)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil

and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Electricity (E7000). Errors in summation to 100% are due to rounding

Solid fuels were imported to Germany mainly from Russia (41%), United States (21%), Australia (11%) and several other countries.

Main oil importers to Germany were Russia (30%), Netherlands (15%), Norway (8%) and Belgium (6%). The remaining 41% were imported from various locations.

Germany was importing gas mainly from Russia (51%) and Norway (3%). The remaining 46% were supplied from not specified locations.

Electricity was mainly imported from France (51%), Czech Republic (23%), Austria (22%) and Netherlands (less than 1%).

Item 165: Foreign fuel suppliers

Foreign suppliers of solid fuels in Germany in 2018 (%)



Total: 30.9 Mtoe

Foreign suppliers of crude oil in Germany in 2018(%)



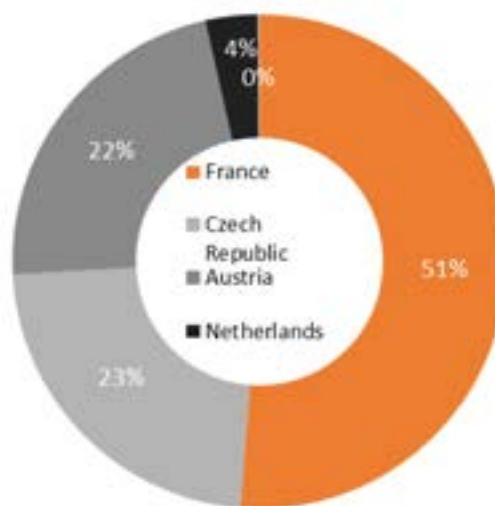
Total: 127.6 Mtoe

Foreign suppliers of gas in Germany in 2018 (%)



Total: 70.5 Mtoe

Foreign suppliers of electricity in Germany in 2018 (%)



Total: 2.7 Mtoe

Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fossil fuels - C000X0350-0370, Gas - Natural gas (G3000), Oil - Oil and petroleum products (excluding biofuel portion) (O4000XBIO), Electricity - E7000. Errors in summation to 100% are due to rounding

8.3 Greenhouse gas emissions

Between 1995-2017 greenhouse gases emissions in Germany were decreased - from over 1,251.0 Mt CO₂ in 1995 to 906.6 Mt CO₂ in 2017. Consequently average emissions per capita decreased to 11.0 Mg CO₂ per capita in 2017 (from 13.7 Mg CO₂ per capita in 1995), which was higher comparing to EU-14 and EU-27 averages (8.5 Mg CO₂ per capita and 8.6 Mg CO₂ per capita, respectively), and also higher than in EU-11 (9.0 Mg CO₂ per capita)

There were some noteworthy changes in the German structure of greenhouse gas emissions over the period considered. The significance of waste management and industrial processes emissions dropped swiftly by 74% and 35%, as well as emissions from energy industries 15%. Emissions from all other sectors also dropped over last 23 years.

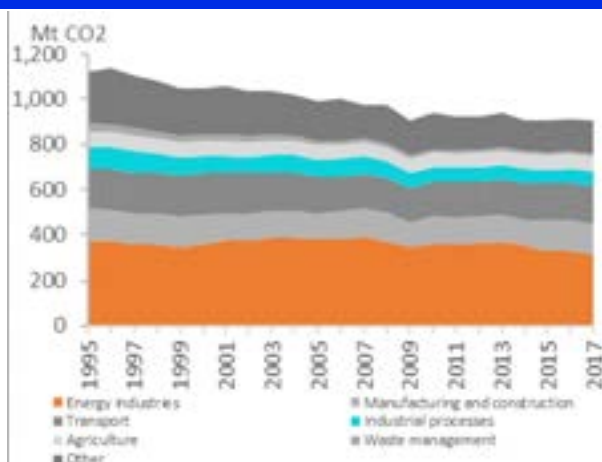
Comparing to EU-11, EU-14 and EU-27 countries, Germany was characterized by higher share of emissions from energy industries and manufacturing and construction sectors but lower share in case of other sectors.

Item 166: Greenhouse gas emissions in Germany

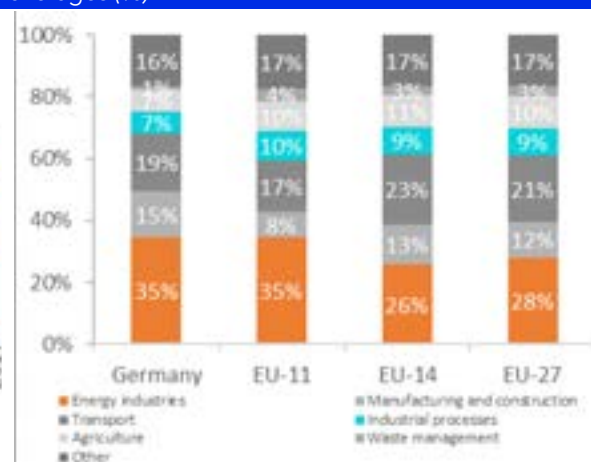
Greenhouse gas emissions per capita in Germany in 1995-2017 in comparison with EU-11, EU-14 and EU-27 averages in 2017 (Mg per capita)



Greenhouse gas emissions in Germany by sectors in 1995-2017 (Mt CO₂)



Greenhouse gas emissions in Germany by sectors in 2017 in comparison with EU-11, EU-14 and EU-27 averages (%)



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - * values for EU-11, EU-14 and EU-27 recalculated by the Author; Energy industry - Fuel combustion in energy industries (CRF1A1), Manufacturing and construction - Fuel combustion in manufacturing industries and construction (CRF1A2), Transport - Fuel combustion in transport (CRF1A3), Industrial processes - Industrial processes and product use (CRF2), Agriculture - Agriculture (CRF3), Waste management - Waste management (CRF5), Other = Other fuel combustion sectors (CRF1A4)+ Other fuel combustion sectors n.e.c. (CRF1A5) + Fuels - fugitive emissions (CRF1B)+Other sectors (CRF6); Total GHG emissions equal to All sectors (excluding LULUCF)

and memo items) (CRF1-6X4_MEMO) i.e. emission from all sectors excluding Land use, land use change, and forestry (LULUCF), Transport and storage of CO₂ (memo item), International aviation (memo item), International navigation (memo item), Multilateral operations (memo item), Biomass - CO₂ emissions (memo item). Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. Errors in summation to 100% are due to rounding

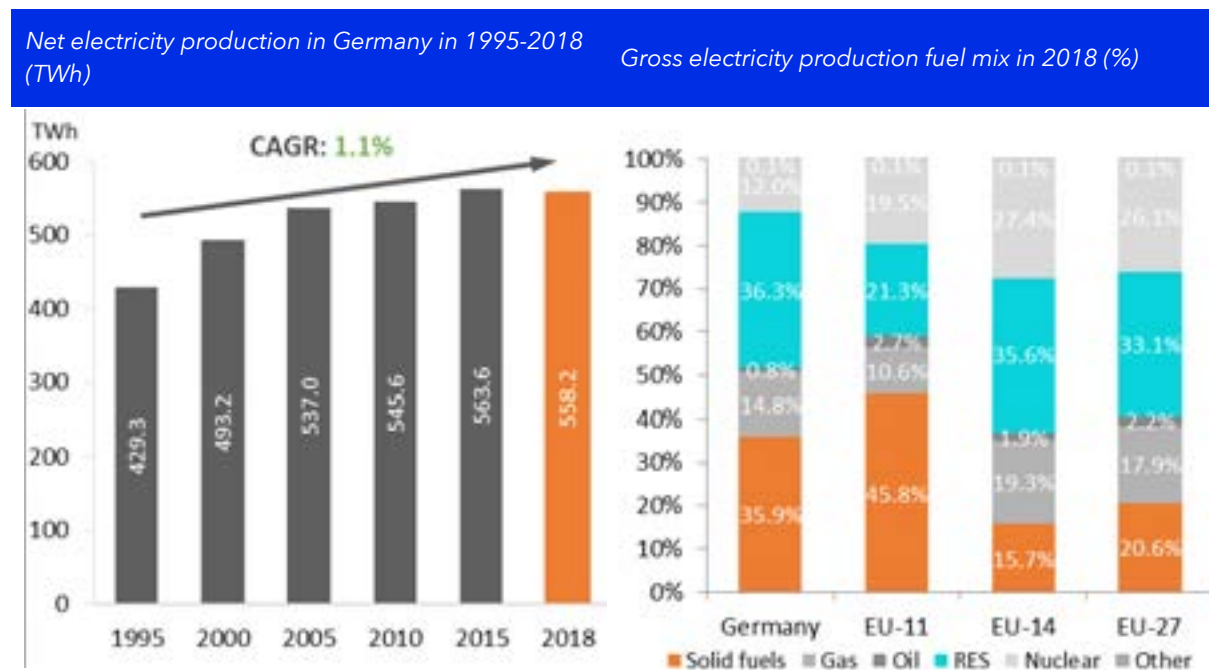
8.4 Overview of electricity sector

Item 167 presents electricity production and the current fuel mix of Germany. Over last 23 years net electricity production increased from 429.3 TWh in 1995 to 558.2 TWh in 2018 (CAGR 1.1%). As visible, net electricity production represents 26.0% of EU-14 total electricity production, which was lower compared to German GDP share of 27.7%.

The German fuel mix was dominated by renewable energy sources and solid fuels with shares of 36.3% and 35.9% respectively. The mix was completed by 14.8% of gas and 12% of nuclear energy, as well as small amounts of oil (0.8%). Compared to EU-14 and EU-27 countries, Germany had a much bigger share of solid fuels and renewable energy sources in its energy mix. On other hand, the country produced relatively less electricity from gas, oil, and nuclear energy, respectively 14.8%, 0.8% and 12%.

When compared to EU-11 average fuel mix one can notice much higher share of renewable energy sources and gas used in Germany than in EU-11 (36.3% and 14.8% versus 21.3% and 10.6%) and significantly lower use of solid fuels and oil (35.9% and 0.8% versus 45.8% and 2.7%). The share of nuclear energy was lower than in EU-11 (12.0% versus 19.5%).

Item 167: Net electricity production and gross electricity production fuel mix in Germany



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Electricity Production - NEP, Gross Electricity Production - GEP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear

= Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

In Item 168 the evolution of final per capita consumption of electricity and its breakdown by economic sector is presented. In recent years final consumption of electricity in Germany increased (CAGR in the period of 1995-2019 was around 0.5%) and its level was higher compared to EU-14 and EU-27 countries. German final energy consumption per capita represented 100.4% of EU-14 level and 110.0% of EU-27 level.

The structure of final electricity consumption in Germany was dominated by industry (44.9% versus 37.6% in EU-14 countries). Relatively the same energy was used in transport (2.4%) and less in commercial and residential sectors (26.7% and 25.0% versus 29.2% and 28.5%).

Germany was consuming relatively more electricity in industry sector than EU-11 countries (44.9% versus 40.9%) and transport (2.4 versus 2.3%). At the same time, it used relatively less electricity in residential and commercial sectors (25.0% and 26.7% versus 25.6% and 29.7%).

Item 168: Final consumption of electricity in Germany

Final consumption of electricity per capita in Germany (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Final consumption of electricity in Germany by sectors in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Electricity E7000. Errors in summation to 100% are due to rounding

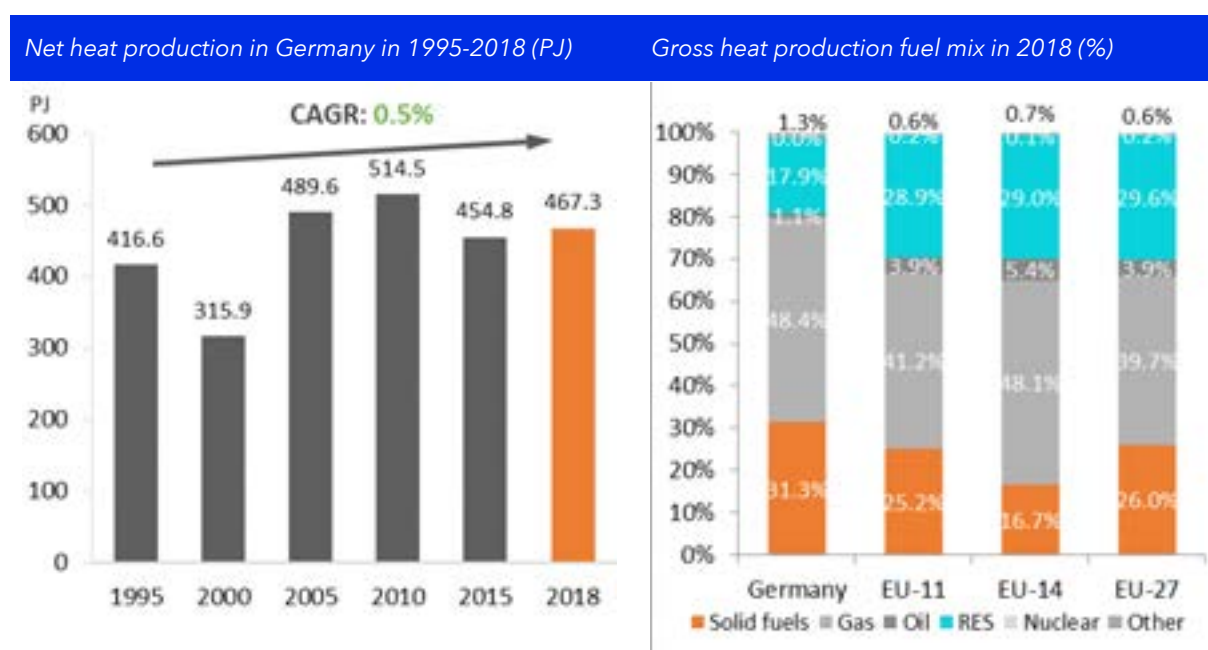
8.5 Overview of heat sector

Item 169 presents heat production and the current fuel mix of Germany. Over last 23 years net heat production increased from 416.6 PJ in 1995 to 467.3 PJ in 2018 (CAGR 0.5%).

The German fuel mix of heat production was dominated by solid fuels with share of 31.3% and gas with share of 48.4%. The mix was completed by 17.9% of renewable energy sources and 1.1% of oil. Compared to EU-14 and EU-27 countries, Germany had a much bigger share of solid fuels in its heat production mix. On other hand, the country produced relatively less heat from renewable energy sources and oil, respectively 17.9% and 1.1%. The share of gas was higher - 48.4% versus 48.1% in EU-14. Germany did not use nuclear energy for heat production where some heat was produced in nuclear facilities in EU-14 countries (0.1%).

When compared to EU-11 average fuel mix one can notice much higher share of gas used in Germany than in EU-11 (48.4% versus 41.2%) and higher use of solid fuels (31.3% versus 25.2%). The share of renewable energy sources was lower in Germany (17.9% versus 28.9%) as well as the share of oil (1.1% versus 3.9%). Germany was not using nuclear energy for heat generation in opposite to EU-11 where the share of nuclear was 0.2%.

Item 169: Net heat production and gross electricity production fuel mix in Germany



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Heat Production - NHP, Gross Heat Production - GHP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

Item 170 presents final heat consumption per capita and its breakdown by sectors.

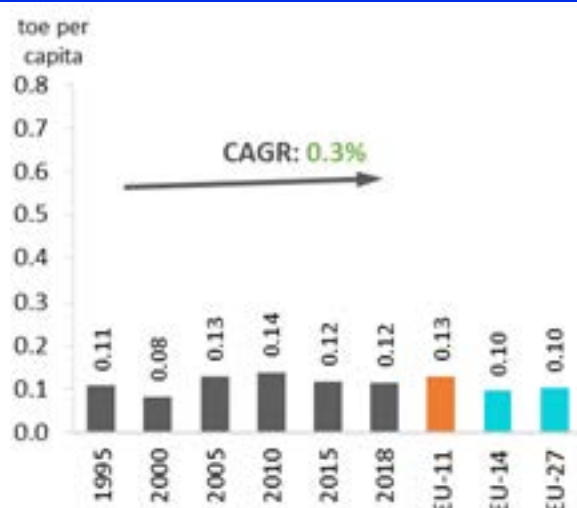
The per capita demand for heat in Germany increased from 0.11 toe per capita in 1995 to 0.12 toe per capita in 2018. As a result, within the 23 years analyzed, heat consumption per capita increased at CAGR of 0.3%. The heat consumption remained higher than the averages for EU-14 and EU-27, respectively 0.10 toe per capita and 0.10 toe per capita. At the same time, the final consumption per capita was lower than EU-11 countries (0.12 toe per capita versus 0.13 toe per capita)

The structure of final consumption of heat in Germany was characterized by lower share of commercial sector (13.8% compared to 21.3% in EU-14) and residential usage (38.3% compared to 40.1% in EU-14). The share of industry in heat consumption was higher than the averages (47.9% compared to 37.9% in EU-14).

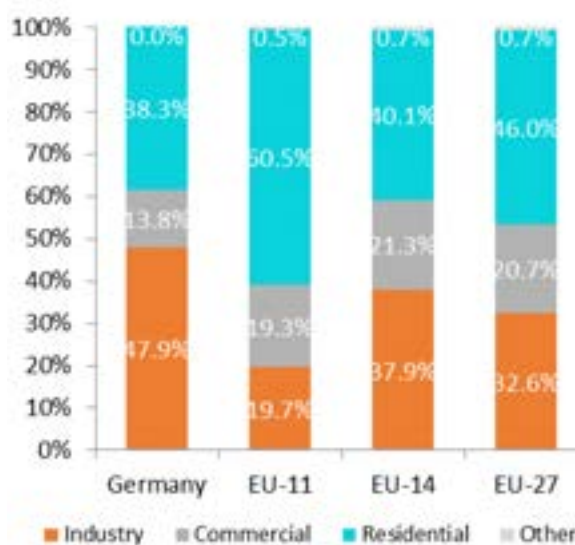
In relation to EU-11 countries, the structure of final heat consumption in Germany was characterized by lower share of residential sector (38.3% versus 60.5%) and lower share of commercial sector (13.8% versus 19.3%). The industrial use of heat consumed 47.9% of it in Germany whereas 19.7% in EU-11.

Item 170: Final consumption of heat in Germany

Final consumption of heat per capita in Germany (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)



Final consumption of heat in Germany by sectors in 2018 (%)



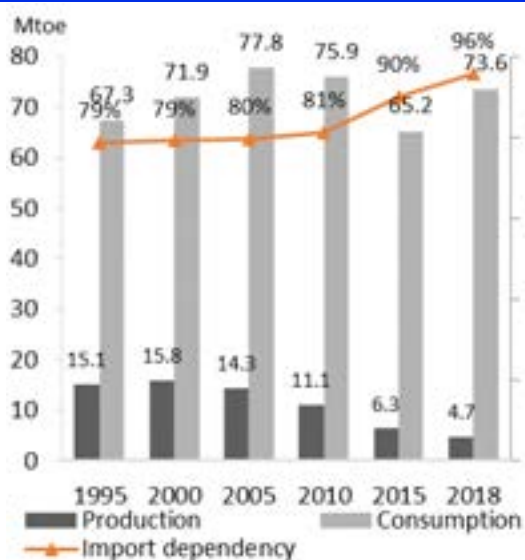
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Heat H8000. Errors in summation to 100% are due to rounding

8.6 Overview of gas sector

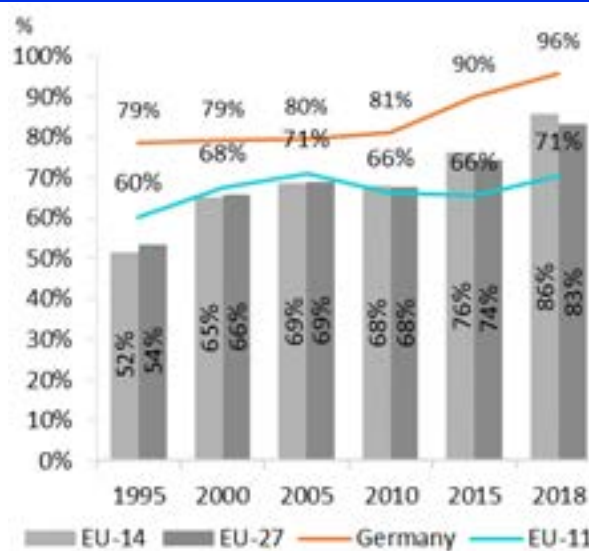
Germany consumed 73.6 Mtoe of gas in 2018. It increased from 67.3 Mtoe in 1995 to 77.8 Mtoe in 2005 and then decreased. National production accounted for 4.7 Mtoe and it decreased over past 23 years from 15.1 Mtoe to the current value. The remaining part of gas was imported. The country dependency on import was increasing from 79% to 96% over past 23 years. In 2018 the country was more dependent on import than EU-11, EU-14 and EU-27 average values.

Item 171: Gas sector in Germany

Gas production, gross consumption and import dependence in Germany in 1995-2018 (Mtoe)



Gas Import dependence in Germany and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gas production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Natural Gas G3000

The final consumption of gas per capita in Germany increased from 0.59 toe per capita to 0.64 toe per capita over past 23 years. This value was higher than the average values for EU-14, EU-11 and EU-27 countries.

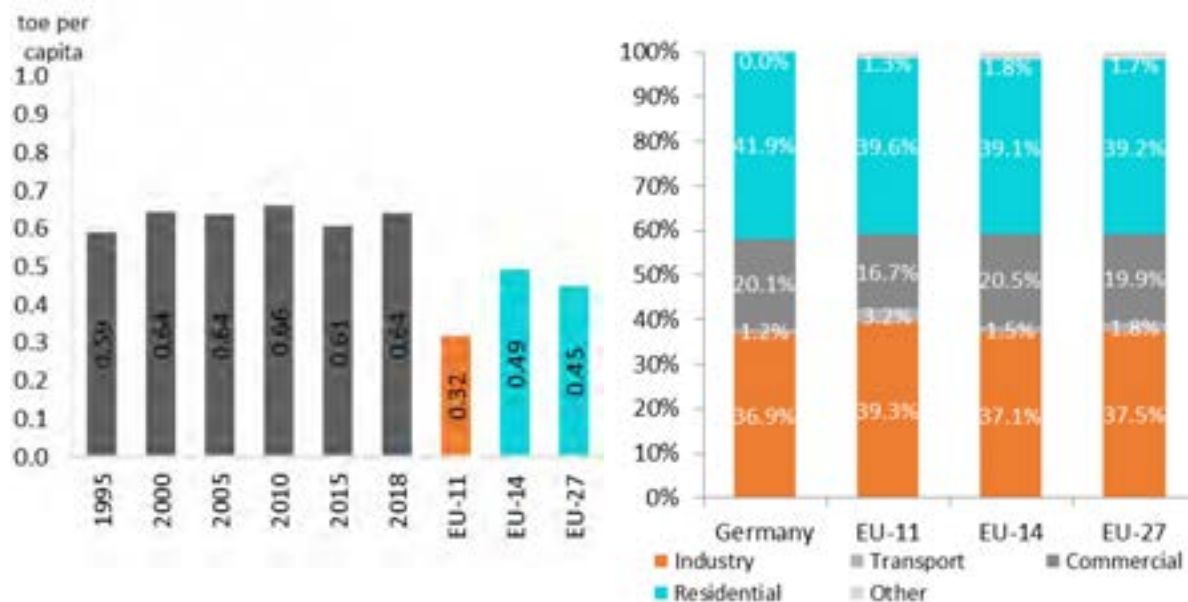
The structure of final gas consumption in Germany in 2018 was characterized by lower share of industry - 36.9% versus 37.1% in EU-14. The share of use of gas in transport and commercial sectors were also lower than the averages for EU-14 countries, but the share of residential use of gas was higher - 41.9% versus 39.1%.

When compared to EU-11 countries, Germany was using relatively less gas industry than EU-11 countries - 36.9% versus 39.3%. The country was also using less gas in transport - 1.2% versus 3.2%. On other hand, the share of gas used in commercial and residential sectors was higher than in EU-11 countries, 20.1% versus 16.7% and 41.9% versus 39.6% respectively.

Item 172: Final consumption of gas per capita in Germany in 1995-2018 and gas final consumption by sectors in Germany and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of gas per capita in Germany (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Gas final consumption by sectors in Germany and EU-11, EU-14 and EU-27 countries in 2018



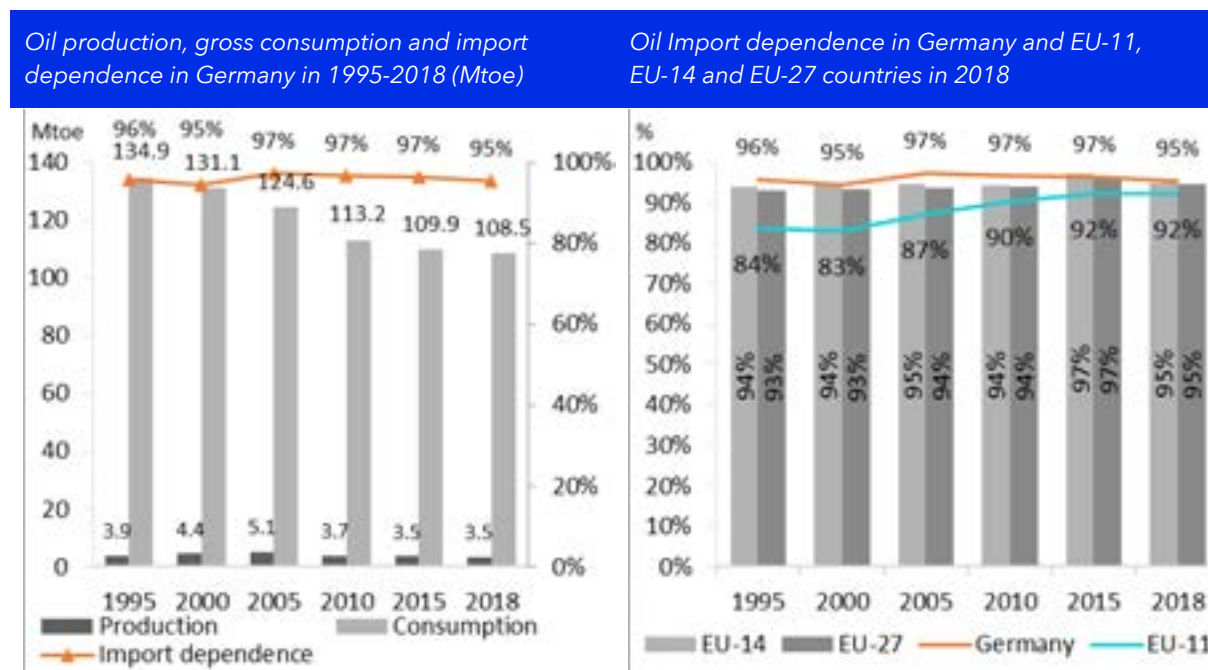
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Natural Gas G3000. Errors in summation to 100% are due to rounding

8.7 Overview of oil sector

The oil consumption of Germany dropped from 134.9 Mtoe in 1995 to 108.5 Mtoe in 2018. At the same time the national production dropped from 3.9 Mtoe to 3.5 Mtoe. Therefore, the level of import dependency was high - between 95% and 97%.

When compared to EU-14 and EU-27 average import dependency, the country had the same import dependency of 95% as in EU-14 and EU-27 countries. At the same time, the import dependency of the country was higher than EU-11 average - 94% versus 92%.

Item 173: Oil sector in Germany



Source: Eurostat data for 2018, extracted in 2020. Detail references: Oil production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Import dependence above 100% has been rounded to 100%

The final consumption of oil per capita in Germany decreased from 1.21 toe per capita in 1995 to 0.85 toe per capita in 2018. The level of final consumption per capita remained higher than the one for EU-11, EU-14 and EU-27.

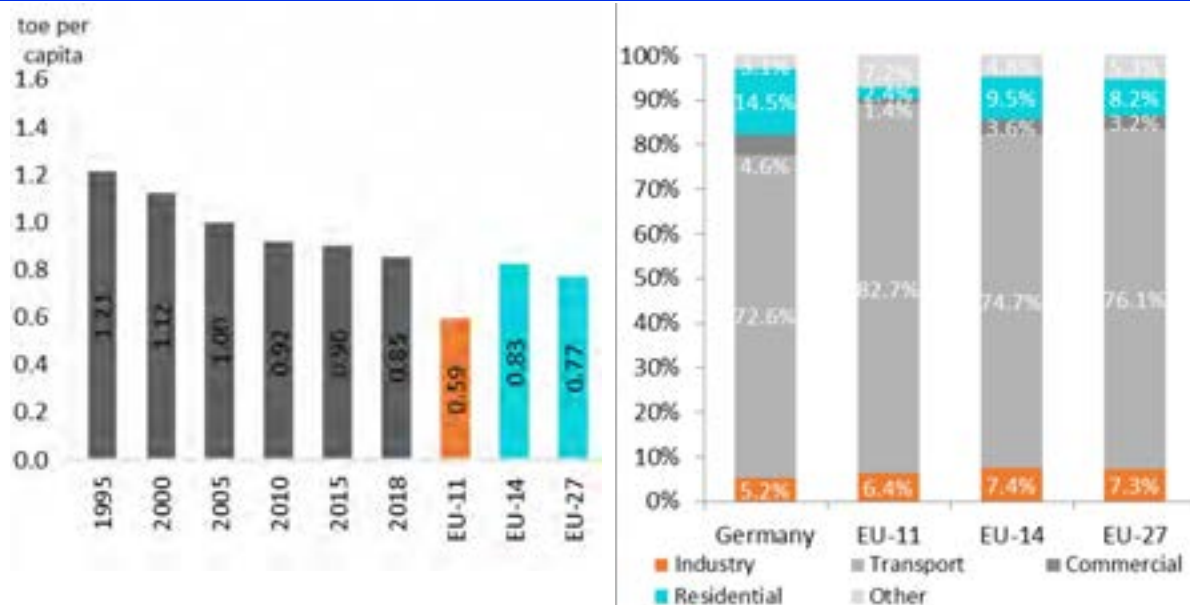
Oil consumption was dominated by transport sector, but its share was lower than EU-14 average - 72.6% versus 74.7% in EU-14 countries. Relatively less oil was used in industry - 5.2% versus 7.4%. The residential and commercial use of oil were higher than EU-14 average - 14.5% versus 9.5% and 4.6% versus 3.6%.

The relative consumption of oil in Germany compared to EU-11 was lower in 2018 - 72.6% versus 82.7%. The use in industry was also relatively lower - 5.2% versus 6.4%. At the same time commercial and residential sector were consuming relatively more oil in the country than EU-11 averages - 4.6% and 14.5% versus 1.4% and 2.4%.

Item 174: Final consumption of oil per capita in Germany in 1995-2018 and oil final consumption by sectors in Germany and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of oil per capita in Germany (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Oil final consumption by sectors in Germany and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Errors in summation to 100% are due to rounding

8.8 EU climate policy and its targets for Germany

Denmark is subject to EU energy and climate regulations and therefore, specific targets were set and verified regarding greenhouse gas emission, share of energy from renewable energy sources and energy efficiency improvements (see Item 175).

Item 175: Energy and climate targets for Germany for 2020 and 2030

| | Germany 2020 targets | Germany 2030 targets |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | EU wide target of 20% reduction from 1990 levels (14% from 2005 level) | EU wide target of 40% reduction from 1990 levels |
| Greenhouse gas emissions in ETS | EU wide target of 21% reduction from 2005 | EU wide target of 43% reduction from 2005 |
| National emission reduction targets in non-ETS - Effort Sharing Decision (ESD) | -14% in relation to their 2005 levels | - |
| National emission reduction targets in non-ETS - Effort Sharing Regulations (ESR) | - | -38% in relation to their 2005 levels |
| Share of energy from renewable energy sources | EU wide target of 20% energy from renewables | EU wide target of minimum 32% share for renewable energy |
| EU wide target of share of energy from renewable energy sources | EU wide target of 20% share of gross final energy consumption | EU wide target of 32% share of gross final energy consumption |
| National target of share of energy from renewable energy sources | 18% of gross final consumption | Not yet available |
| Improvement in energy efficiency | EU wide target of 20% improvement in energy efficiency | EU wide target of at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |
| Primary energy consumption | EU wide target < 1,483 Mtoe National target < 276.6 Mtoe | EU wide target of 1,273 Mtoe (< 1,128 Mtoe EU-27) National targets not available yet |
| Final energy consumption | EU wide target < 1,086 Mtoe National target < 194.3 Mtoe | EU wide target < 956 Mtoe (< 846 Mtoe EU-27) National targets not available yet |

Source: EU website

In following chapter, the overview of Germany targets and performance are summarized.

8.8.1 Greenhouse gas emissions

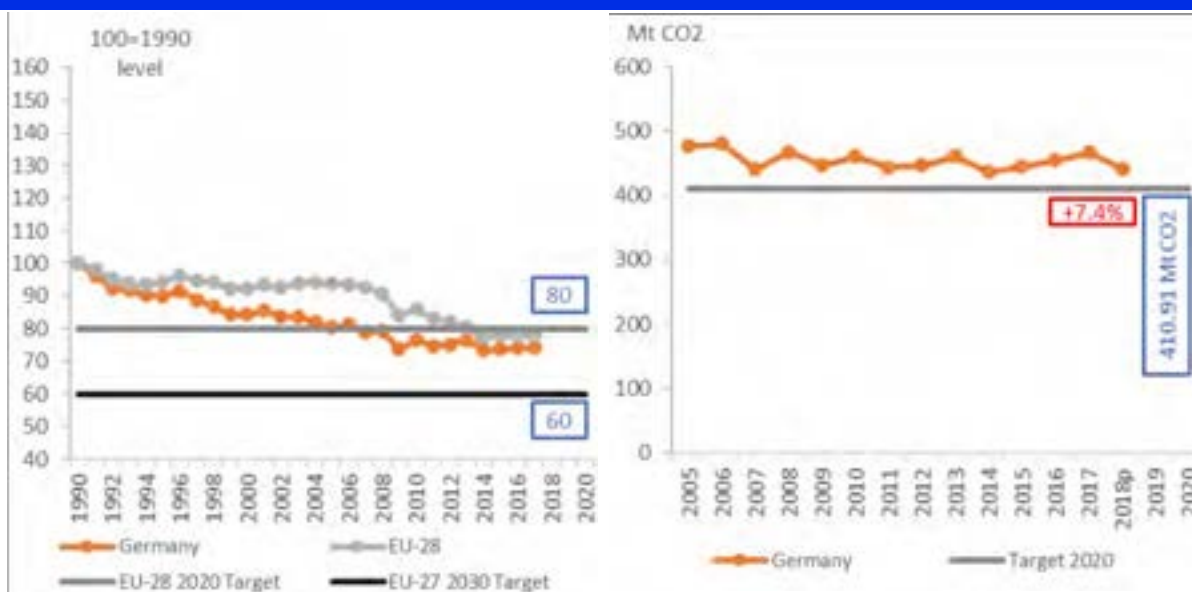
EU set a target for CO₂ reduction by 20% compared to 1990 level at EU level. Regardless the fact that the target was not binding for specific country, the level of CO₂ emission in Germany was below EU wide target in 2018.

The non-ETS greenhouse gas emissions the binding national targets for Germany was 410.91 Mt of CO₂ equivalent emissions. Comparing to 2018 provisional results the level of emissions exceeded the target by 7.4% in 2018.

Item 176: Energy efficiency target data for Germany

Greenhouse gas emissions level in Germany and EU-28, base year 1990, and EU 2020 target

Greenhouse gas emissions in Effort Sharing Decision (ESD) sectors



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Greenhouse gas emissions, base year 1990 [T2020_30], Greenhouse gas emissions in ESD sectors [T2020_35]

8.8.2 Renewable energy sources

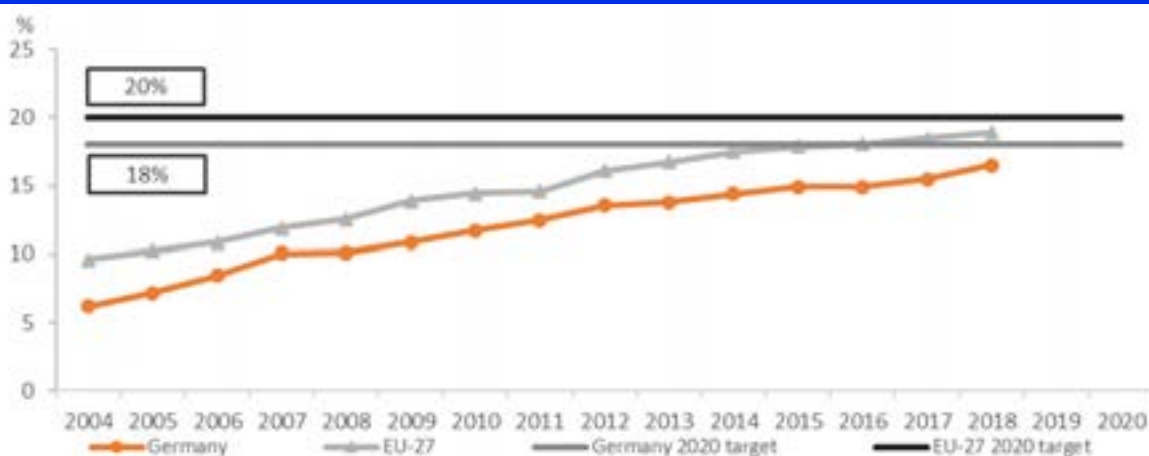
The following targets were set for Germany regarding the share of energy from renewable energy sources in gross final energy consumption:

- a 20% share of gross final energy consumption by 2020,
- a 18% national target for share of energy from renewable sources in gross final consumption of energy in 2020.

The share of energy from renewable energy sources in Germany was below EU wide and country specific targets in 2018.

Item 177: Share of energy from renewable energy sources in gross final energy consumption in Germany

Share of energy from renewable energy sources in gross final energy consumption in Germany in 2005-2018 and targets for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Share of energy from renewable sources [nrg_ind_ren]

8.8.3 Energy efficiency

The energy efficiency target set for Germany were respectively:

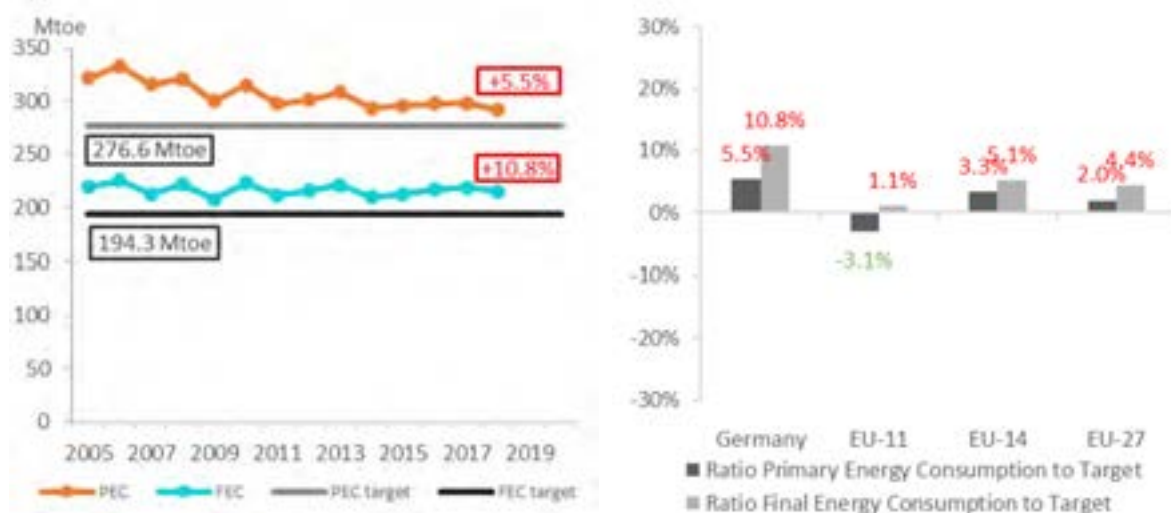
- Primary Energy Consumption in 2020: 276.6 Mtoe
- Final energy consumption in 2020: 194.3 Mtoe

Following the information provided in Item 178 the results for 2018 were above the targets in both criteria, respectively +5.5% of primary energy consumption and 10.8% of final energy consumption. This does not exclude Germany to achieve the targets in 2020.

Item 178: Energy efficiency target data for Germany

Primary energy consumption and final energy consumption in Germany in 2005-2018 and targets for 2020

Ratio of primary energy consumption to target for 2020 and final energy consumption to target for 2020 in Germany, EU-11, EU-14 and EU-27 in 2018



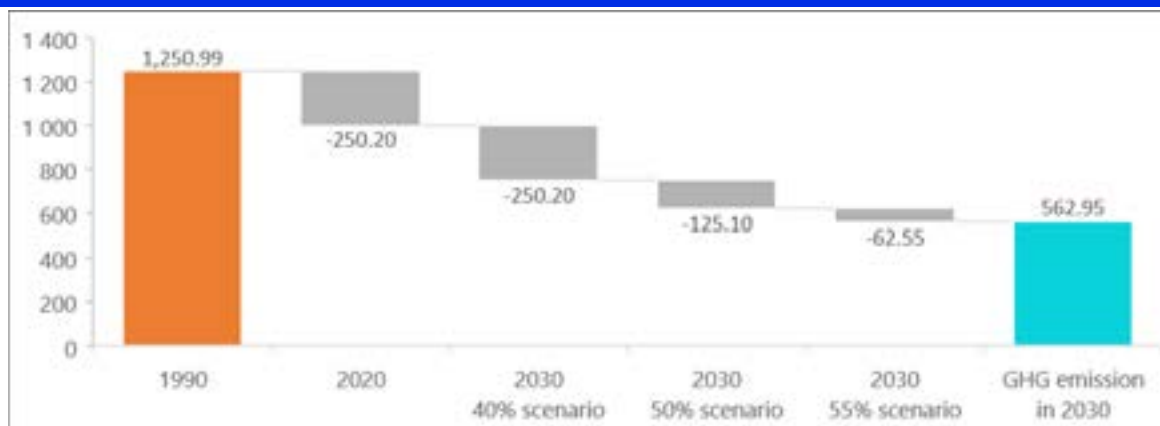
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Primary energy consumption - Primary energy consumption (Europe 2020-2030)(PEC2020-2030), final energy consumption - Final energy consumption (Europe 2020-2030) (FEC2020-2030). EU-11 and EU-14 data estimated based on Eurostat data

8.9 Review of potential impact of Green Deal propositions

At the current stage of discussions regarding the European Green Deal only partial information are available regarding the future targets. EU is proposing to increase the greenhouse gas emission reduction to 50% or 55% for 2030. This is a proposition included in the draft proposal of "Climate Law". Assuming the Germany greenhouse gas emissions in 1990, an estimation of EU 2030 target emissions can be drafted. The 2020 target of 20% reduction resulted in 250.20 Mt CO₂ emission drop. Further increase of the target to 40% in 2030 require additional 250.20 Mt CO₂ reduction. If the 50% target proposed under European Green Deal is applied then additional 125.10 Mt CO₂ emission decrease is needed, or 187.65 Mt CO₂ decrease, if 55% target is adopted.

Item 179: Estimation regarding greenhouse gas emissions in Germany under different scenarios (Mt CO₂)

Estimation regarding greenhouse gas emissions in Germany under different scenarios (Mt CO₂)



Source: Eurostat data for 2018, extracted in 2020. Estimations delivered by the Author

Nevertheless, it is worth to highlight that, if the current structure of greenhouse gas emissions target is maintain, then the 50% target for 2030 is an EU wide target. It is not a binding element for specific countries. Country specific targets could be expected as per ESD and ESR but there is no way to anticipate the potential targets.

At the same time, the review of key EU regulations around climate and energy as:

- Emissions Trading System Directive;
- Effort Sharing Regulation;
- Land use, land use change and forestry Regulation;
- Energy Efficiency Directive;
- Renewable Energy Directive;
- CO₂ emissions performance standards for cars and vans
- Energy Taxation Directive

can bring some additional targets in area of share of energy from renewable energy sources and energy efficiency. For the moment, any estimation of potential targets is not available nor possible to estimate.



9 Greece

9.1 General information

Greece is the seventh biggest country within EU-14 group in terms of total country area and represents 4.3% of the area. At the same time, it is the 9th country in EU-27 with 3.1% of the area. It represents 3.1% of EU-14 population and 2.4% of EU-27 population, but 1.5% of its total nominal GDP of EU-14 and 1.4% of EU-27. Despite the economic growth in 1995-2018 period, in 2018 Greek GDP per capita amounted to 68% of the whole EU average (87% in 1995).

Item 180: Greece - key data



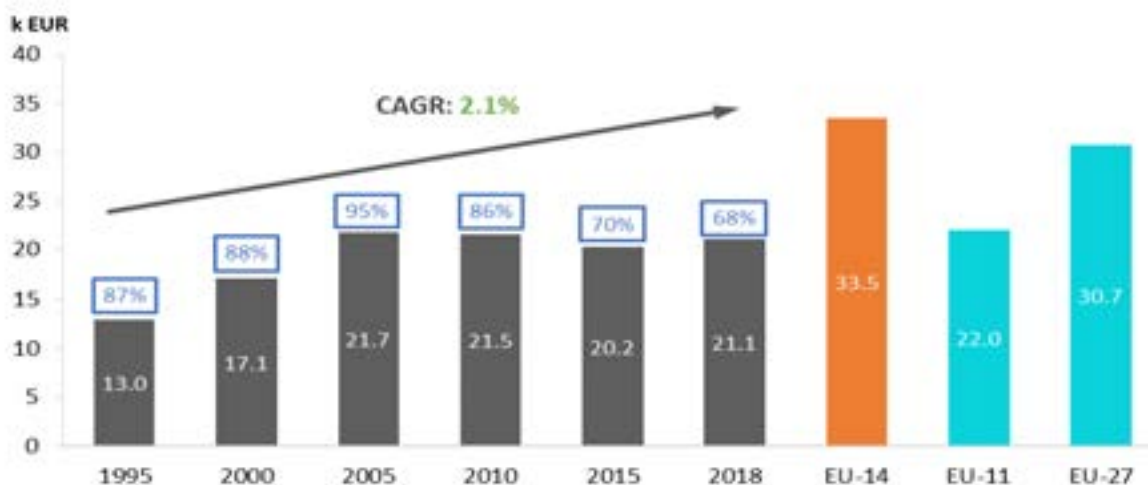
Key data

| | |
|------------------------------------------------------|--------|
| Population (M) | 10.7 |
| GDP per capita (EUR, nominal) | 17,210 |
| GDP per capita (EUR, PPS) | 21,050 |
| GDP as share of EU-14 | 1.5% |
| GDP as share of EU-27 | 1.4% |
| Energy intensity of the economy (kgoe per 1,000 EUR) | 117.8 |
| Greenhouse gas emissions (Mg per capita) | 8.9 |

Source: Eurostat data for 2018, extracted in 2020

With the compounded annual growth rate amounting to 2.1% Greek economy considerably grew in the period of 1995-2018 (see Item 181). Its GDP per capita was above EU-14 and EU-27 averages (equal to 63% and 68% of the respective averages). Its GDP per capita was also 93% of the average GDP per capita for EU-11 countries.

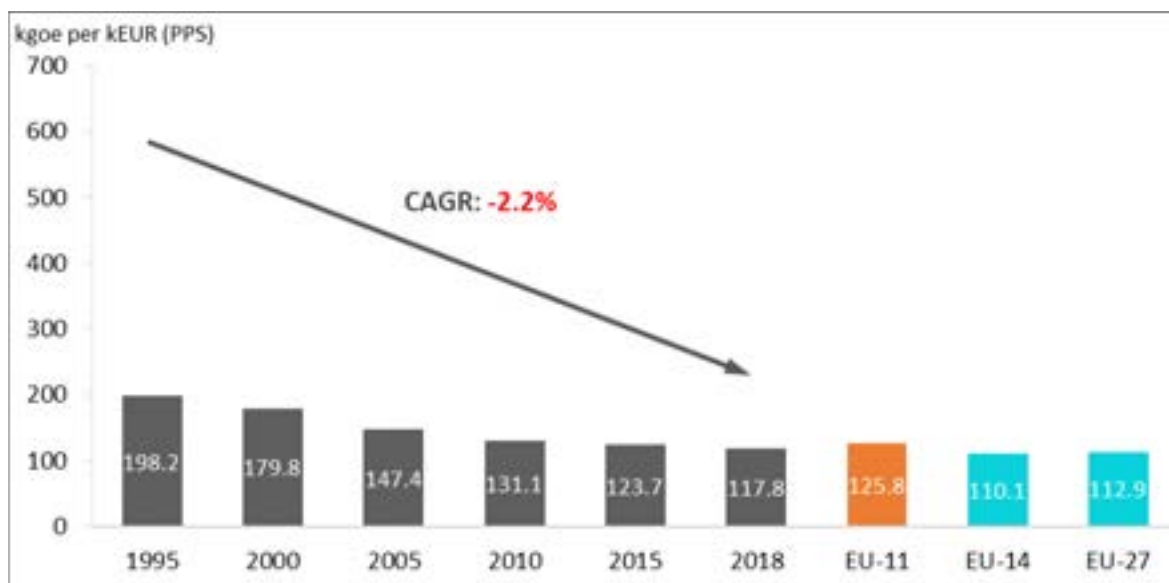
Item 181: GDP per capita in Greece for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in 2018 (kEUR, PPS) and share of Greece GDP per capita in relation to EU-27 average



Source: Eurostat data for 2018, extracted in 2020. Detail references: GDP per capita - Gross domestic product at market prices (B1GQ), Current prices, purchasing power standard per capita (CP_PPS_HAB)

The Greek economy energy intensity was about 117.8 kgoe per 1,000 EUR PPS in 2018, thanks to a decrease of the energy intensity indicator during the years 1995-2018. It dropped by 80.4 kgoe per 1,000 EUR PPS, i.e. it was reduced by about 41%. The energy intensity of Greece in 2018 represented 94% and 104% of EU-14 and EU-27 averages. At the same time, it represented 107% of EU-11 average.

Item 182: Energy intensity of the economy in Greece in 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)



Source: Eurostat data for 2018, extracted in 2020. Values for EU-11 and EU-14 were recalculated based on energy intensity and GDP data from Eurostat. Detail references: Energy intensity of GDP in purchasing power standards (PPS) - EI_GDP_PPS

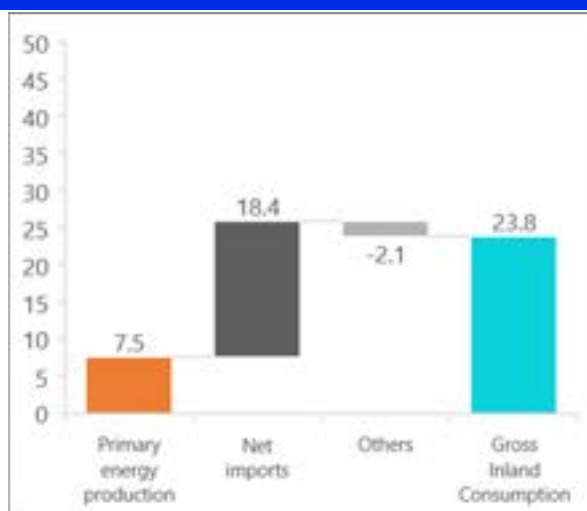
9.2 Energy balance of Greece

The energy balance of Greece in 2018 was presented in Item 183. The primary energy production was equal to 7.5 Mtoe in 2018. Net imports added 18.4 Mtoe to the balance. The total gross inland consumption accounted for 23.8 Mtoe. The level of import of energy to Greece grew up to 2007 and then dropped to the 1995 level. At the same time the level of net import reported to the energy needs decreased slowly up to 2013 and then increased close to 1995 level

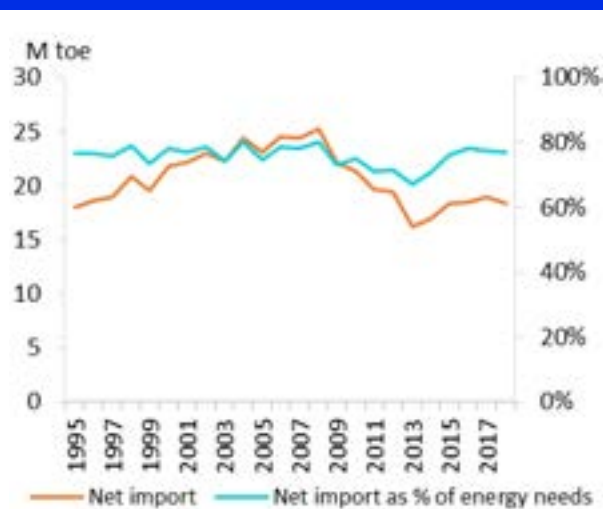
The primary energy production decreased over past 23 years whereas gross energy consumption increased. National production was meeting only 32% of the country gross consumption and this factor decreased over last 23 years from 40%.

Item 183: Energy balance in Greece

Energy balance in Greece in 2018 (Mtoe)



Net import of energy in Greece in 1995-2018 (Mtoe and as percentage of GIC)



Gross inland consumption, primary energy production (Mtoe) and ratio of primary energy production to gross inland consumption in 1995-2018 in Greece (%)



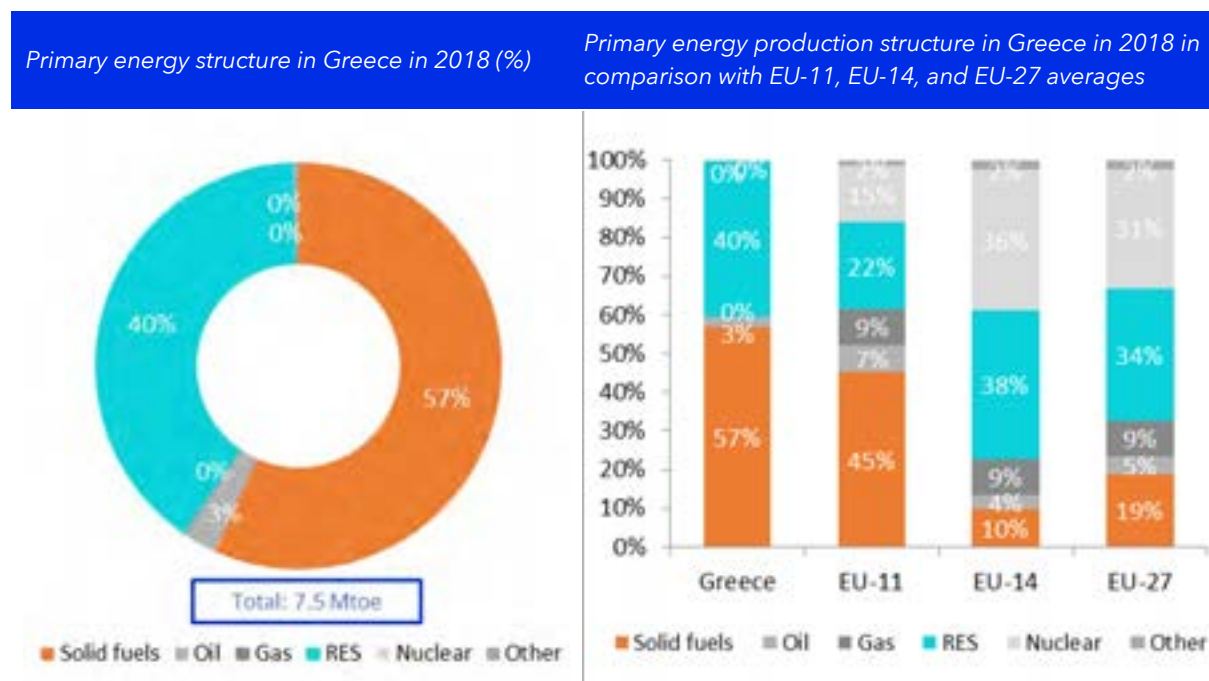
Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Gross inland consumption - GIC. Net imports = Import (IMP) - Export (EXP), Other = Change in stock (STK-CHG) - International maritime bunkers (INTMARB)

The primary energy production in Greece was dominated by solid fuels (57% and renewable energy sources (40%). The mix was completed by 3% share of oil. Usage of nuclear energy was null, and gas was negligible.

When compared to the European averages, Greece was characterized by very high share of solid fuels in the energy mix - 57% versus 10% EU-14 average and 19% EU-27 average. At the same time, the share of renewable energy sources in Greek fuel mix was a higher than in EU-14 and EU-27 (40% versus 38% in EU-14 and 34% EU-27). At the same time, the share of oil was lower in Greece than the averages for EU-14 and EU-27 (3% versus 4% and 5%). In opposite to EU averages Greece was not using nuclear energy for primary energy production and the use of gas was negligible.

The comparison of Greece to EU-11 averages was mainly characterized by much higher share of solid fuels (57% versus 45%) and of renewable energy sources (40% versus 22% in EU-11). The share of oil was lower in Greece - 3% versus 7% in EU-11. At the same time, the share of gas and nuclear were higher in EU-11 (9% and 15% in EU-11 versus 0% in Greece).

Item 184: Primary energy structure in Greece



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

Gross inland consumption of energy in Greece was dominated by oil (48%), solid fuels (19%), gas (17%) and renewable energy sources (13%). The mix was completed by 3% of other energy sources. There was no nuclear energy in gross inland consumption mix.

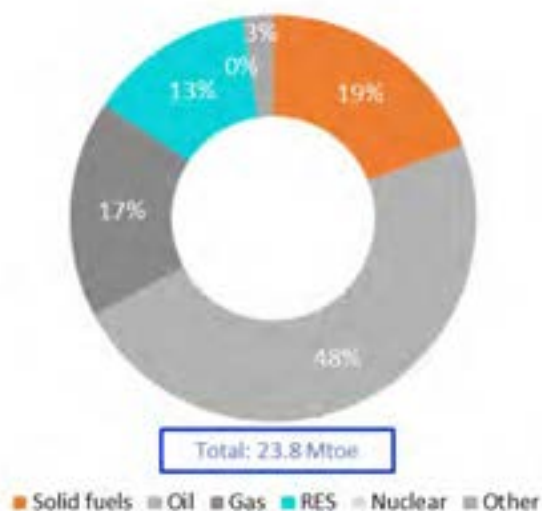
Comparing to European averages gross inland consumption of energy in Greece was marked by high share of solid fuels (19% versus 11% in EU-14 and 14% in EU-27). The share of oil was higher in Greece (48%) than in EU-14 (35%) and EU-27 (34%) whereas the share of gas was lower (17% versus 23% and 22% in EU-14 and EU-27). Greece was characterized by lower share of renewable energy sources in the mix - 13% versus 16% and 15% in EU-14 and EU-27 respectively, and lack of nuclear energy in the mix (versus 14% in EU-14 and 13% in EU-27).

When compared to EU-11 the main difference was around much lower share of solid fuels consumption in Greece (19% versus 30% in EU-11) and higher share of renewable energy sources (13% versus 12%). The share of oil use in Greece was also higher than in EU-11 countries (48% versus 29%) whereas the share of gas was lower (17% versus 19%). EU-11

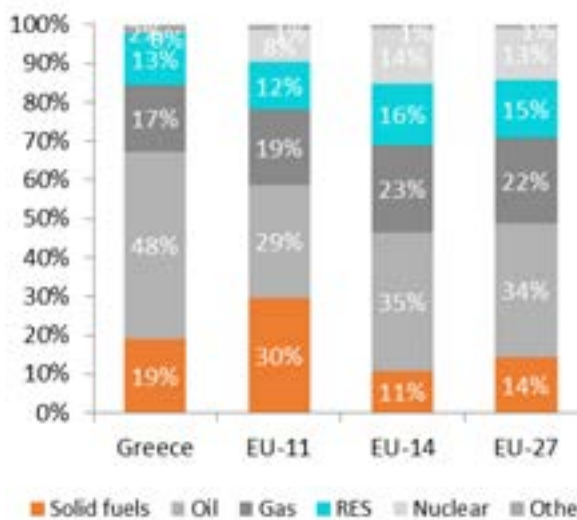
average gross final consumption included nuclear energy at 8%. Greece was not using nuclear energy.

Item 185: Gross inland consumption structure in Greece

Gross inland consumption structure in Greece in 2018 (%)



Gross inland consumption structure in Greece in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gross inland consumption - GIC, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

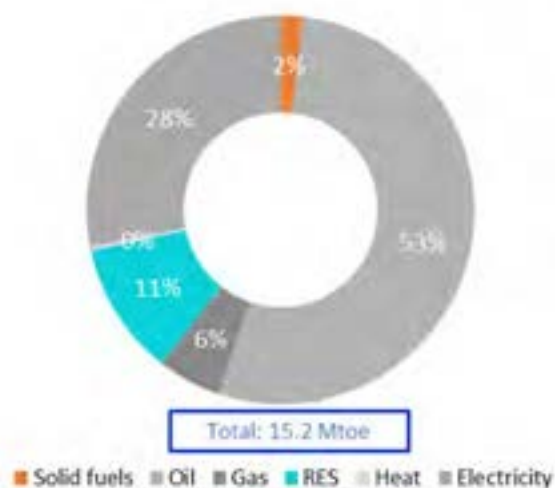
The final energy consumption in Greece was dominated by oil (53%), followed by electricity (28%) and renewable energy sources (11%). The mix was completed by gas (6%) and solid fuels (2%).

The sectoral final energy consumption in Greece was characterized by lower share of industrial but higher of transport sectors than in EU-14 and EU-27 (18% and 39% versus 26% and 31% in EU-14 and EU-27). The share of commercial and public services in final energy consumption was at similar level in Greece (10%) as in EU-14 (15%) and EU-27 (14%).

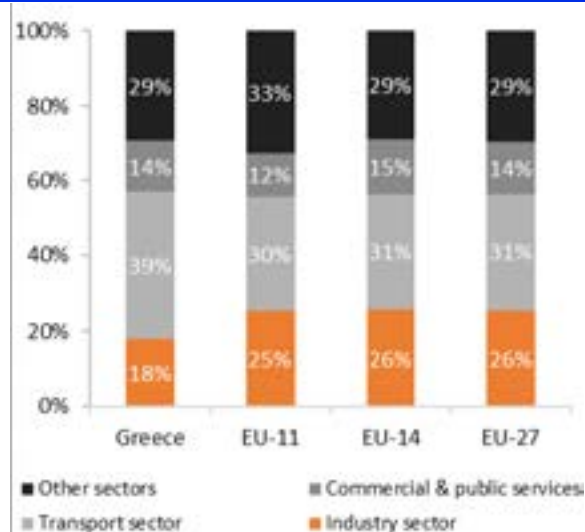
When compared to EU-11 Greece similar conclusions as related to EU-14 and EU-27 can be drawn.

Item 186: Final energy consumption structure in Greece

Final energy consumption structure in Greece in 2018 (%)



Final energy consumption structure in Greece in 2018 in comparison with EU-11, EU-14, and EU-27 averages



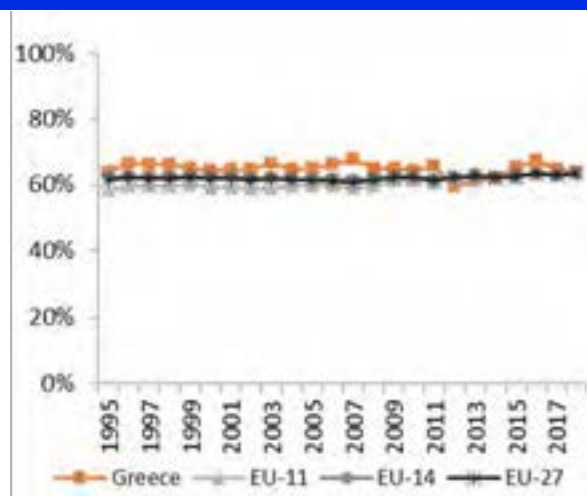
Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Heat (H8000), Electricity (E7000), Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial & public services - FC_OTH_CP_E, Other - FC_OTH_E-FC_OTH_CP_E. Errors in summation to 100% are due to rounding

Greek final energy consumption to gross inland consumption ratio which measure energy efficiency was equal to the averages for EU-11, EU-14 and EU-27. It used to be higher in the past.

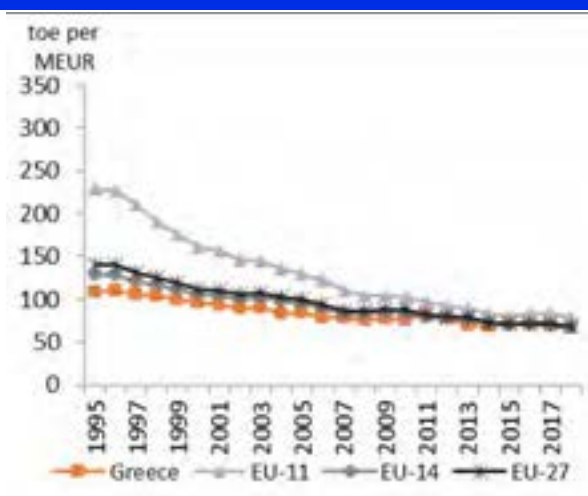
Simultaneously, a decrease of energy volume associated with generating gross domestic product was noticed in line with the averages for EU-14 and EU-27 averages.

Item 187: Final energy consumption in Greece in relation to selected indicators

Final energy consumption to gross inland consumption ratio in Greece in 1995-2018 (%)



Final energy consumption to gross domestic product ratio in Greece in 1995-2018 in comparison with EU-11, EU-14, and EU-27 averages (toe per M EUR)



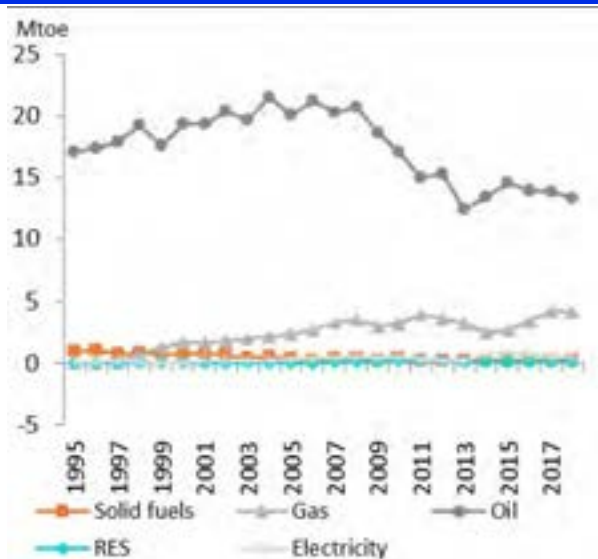
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final energy consumption - FEC, Gross inland consumption - GIC, Gross Domestic Product - Gross domestic product at market prices B1GQ, Current prices - CP-MEUR

Net import of energy to Greece by fuels was characterized by a decrease of oil imports and an increase of gas import. Import of solid fuels decreased over past 23 years.

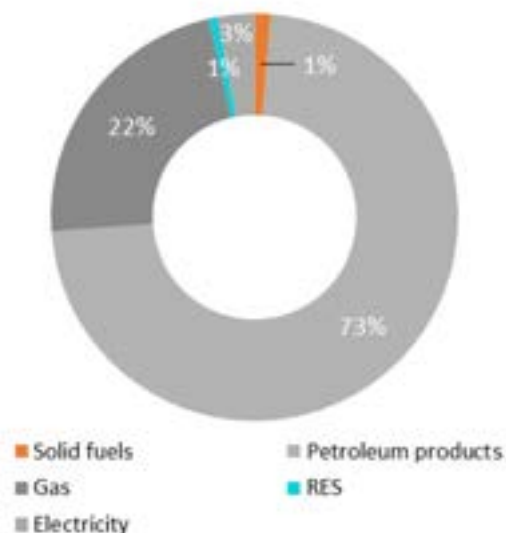
The import structure of energy to Greece was dominated by oil (73%) and gas (22%). The imports were completed by 1% of solid fuels, 3% of electricity and 1% of renewable energy sources.

Item 188: Net import of energy in Greece

Net import of energy by fuel in 1995-2018 (Mtoe)



Net import structure in 2018 (% , only fuels for which import is greater than export)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Electricity (E7000). Errors in summation to 100% are due to rounding

Solid fuels were imported to Greece mainly from Russia (89%) and United States (11%).

Main oil importers to Greece were Iraq (32%), Russia (23%), Kazakhstan (9%) and Iran (7%). The remaining 29% were imported from various locations.

Greece was importing gas mainly from Russia (53%), Algeria (30%), Turkey (11%), United States (3%) and Qatar (3%).

Electricity was mainly imported from Turkey (34%), Bulgaria (25%), North Macedonia (22%), Albania (12%) and Italy (7%).

Item 189: Foreign fuel suppliers

Foreign suppliers of solid fuels in Greece in 2018 (%) Foreign suppliers of crude oil in Greece in 2018(%)



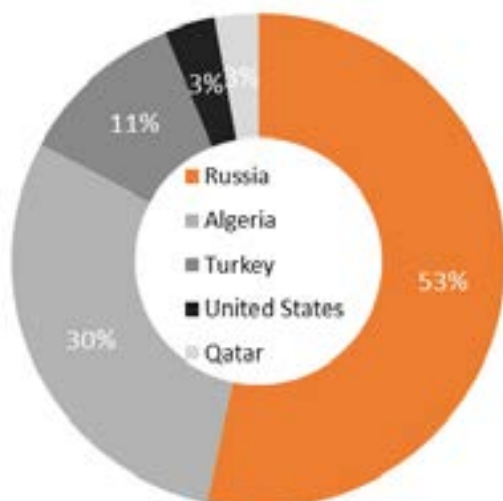
Total: 0.2 Mtoe



Total: 33.7 Mtoe

Foreign suppliers of gas in Greece in 2018 (%)

Foreign suppliers of electricity in Greece in 2018 (%)



Total: 4.1 Mtoe



Total: 0.7 Mtoe

Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fossil fuels - C000X0350-0370, Gas - Natural gas (G3000), Oil - Oil and petroleum products (excluding biofuel portion) (O4000XBIO), Electricity - E7000. Errors in summation to 100% are due to rounding

9.3 Greenhouse gas emissions

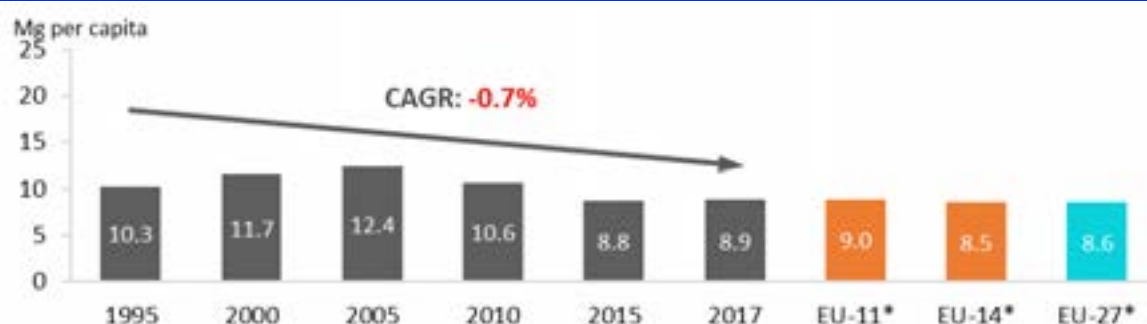
Between 1995-2017 greenhouse gases emissions in Greece were decreased - from over 103.1 Mt CO₂ in 1995 to 95.4 Mt CO₂ in 2017. Consequently average emissions per capita decreased to 8.9 Mg CO₂ per capita in 2017 (from 10.3 Mg CO₂ per capita in 1995), which was higher comparing to EU-14 and EU-27 averages (8.5 Mg CO₂ per capita and 8.6 Mg CO₂ per capita, respectively), but lower than in EU-11 (9.0 Mg CO₂ per capita)

There were some noteworthy changes in the Greek structure of greenhouse gas emissions over the period considered. The significance of manufacturing and construction sectors emissions dropped swiftly by 39%, as well as emissions from energy industries 12%. On other hand, transport emissions gained in importance increasing by 4%.

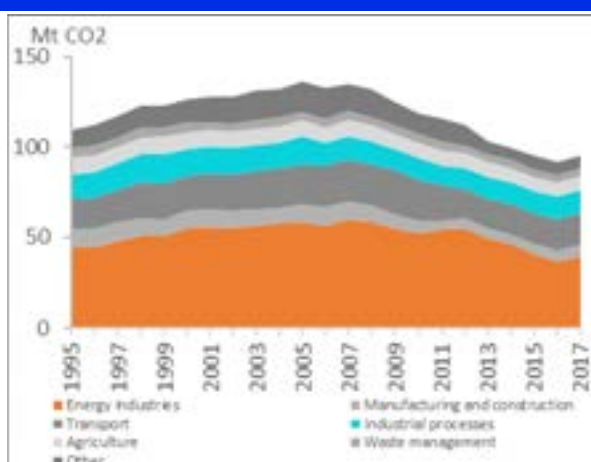
Comparing to EU-11, EU-14 and EU-27 countries, Greece was characterized by higher share of emissions from energy industries, industrial processes, agriculture, and waste management sector. Manufacturing and construction share of emissions was lower than the averages.

Item 190: Greenhouse gas emissions in Greece

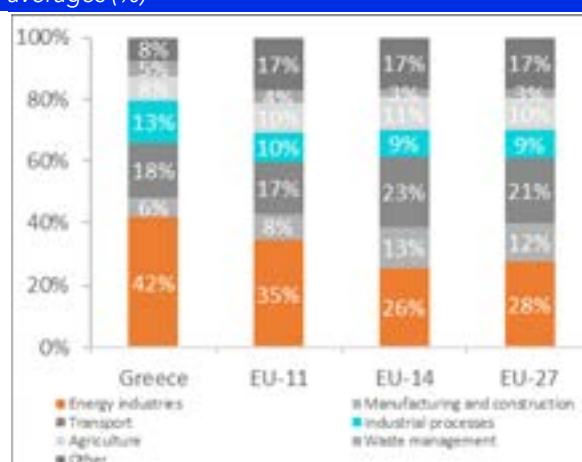
Greenhouse gas emissions per capita in Greece in 1995-2017 in comparison with EU-11, EU-14 and EU-27 averages in 2017 (Mg per capita)



Greenhouse gas emissions in Greece by sectors in 1995-2017 (Mt CO₂)



Greenhouse gas emissions in Greece by sectors in 2017 in comparison with EU-11, EU-14 and EU-27 averages (%)



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - * values for EU-11, EU-14 and EU-27 recalculated by the Author; Energy industry - Fuel combustion in energy industries (CRF1A1), Manufacturing and construction - Fuel combustion in manufacturing industries and construction (CRF1A2), Transport - Fuel combustion in transport (CRF1A3), Industrial processes - Industrial processes and product use (CRF2), Agriculture - Agriculture (CRF3), Waste management - Waste management (CRF5), Other = Other fuel combustion sectors (CRF1A4)+ Other fuel combustion sectors n.e.c. (CRF1A5) + Fuels

- fugitive emissions (CRF1B)+Other sectors (CRF6); Total GHG emissions equal to All sectors (excluding LULUCF and memo items) (CRF1-6X4_MEMO) i.e. emission from all sectors excluding Land use, land use change, and forestry (LULUCF), Transport and storage of CO₂ (memo item), International aviation (memo item), International navigation (memo item), Multilateral operations (memo item), Biomass - CO₂ emissions (memo item). Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. Errors in summation to 100% are due to rounding

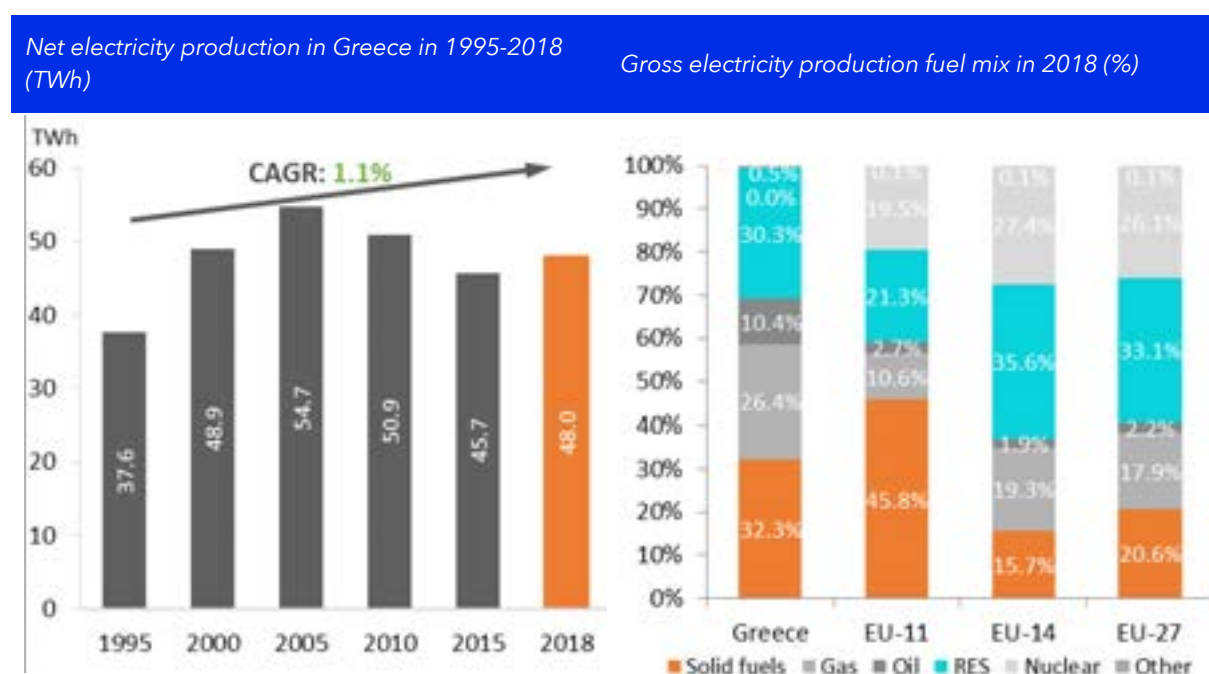
9.4 Overview of electricity sector

Item 71 presents electricity production and the current fuel mix of Greece. Over last 23 years net electricity production decreased from 37.6 TWh in 1995 to 48.0 TWh in 2018 (CAGR 1.1%). As visible, net electricity production represents 2.2% of EU-14 total electricity production, which was higher compared to Greek GDP share of 1.5%.

The Greek fuel mix was dominated by nuclear solid fuels and renewable energy sources with shares of 32.3 and 30.3% respectively. The mix was completed by 26.4% of gas and 10.4% of oil. Compared to EU-14 and EU-27 countries, Greece had a much bigger share of solid fuels, gas, and oil in its energy mix. On other hand, the country produced relatively less electricity from renewable energy sources 30.3 versus 35.6%.

When compared to EU-11 average fuel mix one can notice much higher share of gas, oil and renewable energy sources used in Greece than in EU-11 (26.4%, 10.4% and 30.3% versus 10.6%, 2.7% and 21.3%) and significantly lower use of solid fuels (32.3% versus 45.8%). Greece was not using nuclear energy which was responsible for 19.5% of EU-11 electricity production.

Item 191: Net electricity production and gross electricity production fuel mix in Greece



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Electricity Production - NEP, Gross Electricity Production - GEP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear

= Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

In Item 192 the evolution of final per capita consumption of electricity and its breakdown by economic sector is presented. In recent years final consumption of electricity in Greece had increased (CAGR in the period of 1995-2019 was around 1.5%) and its level was lower compared to EU-14 and EU-27 countries. Greek final energy consumption per capita represented 75.6% of EU-14 level and 81.8% of EU-27 level.

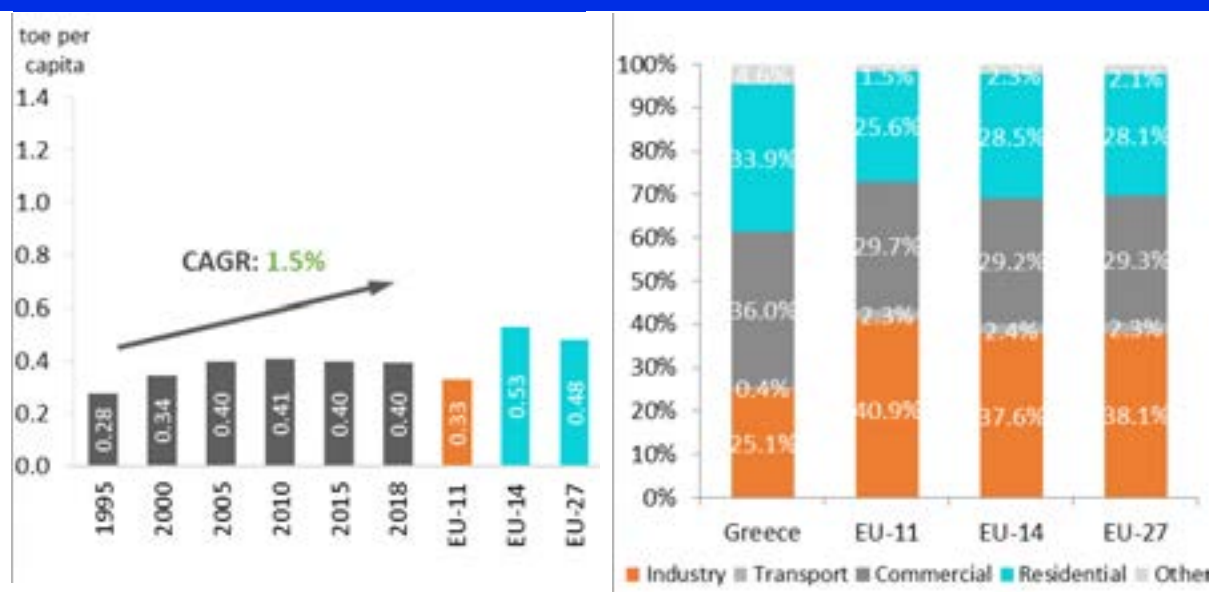
The structure of final electricity consumption in Greece was dominated by residential and commercial sectors (33.9% and 36.0% versus 28.5% and 29.2% in EU-14 countries). Relatively less energy was used in transport (0.4% versus 2.4%) and less in industry (25.1% versus 37.6%).

Greece was consuming relatively more electricity in residential sector than EU-11 countries (33.9% versus 25.6%) and commercial one (36.0% versus 29.7%). At the same time, it used relatively less electricity in industry and transport (25.1% and 0.4% versus 40.9% and 2.3%).

Item 192: Final consumption of electricity in Greece

Final consumption of electricity per capita in Greece (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Final consumption of electricity in Greece by sectors in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Electricity E7000. Errors in summation to 100% are due to rounding

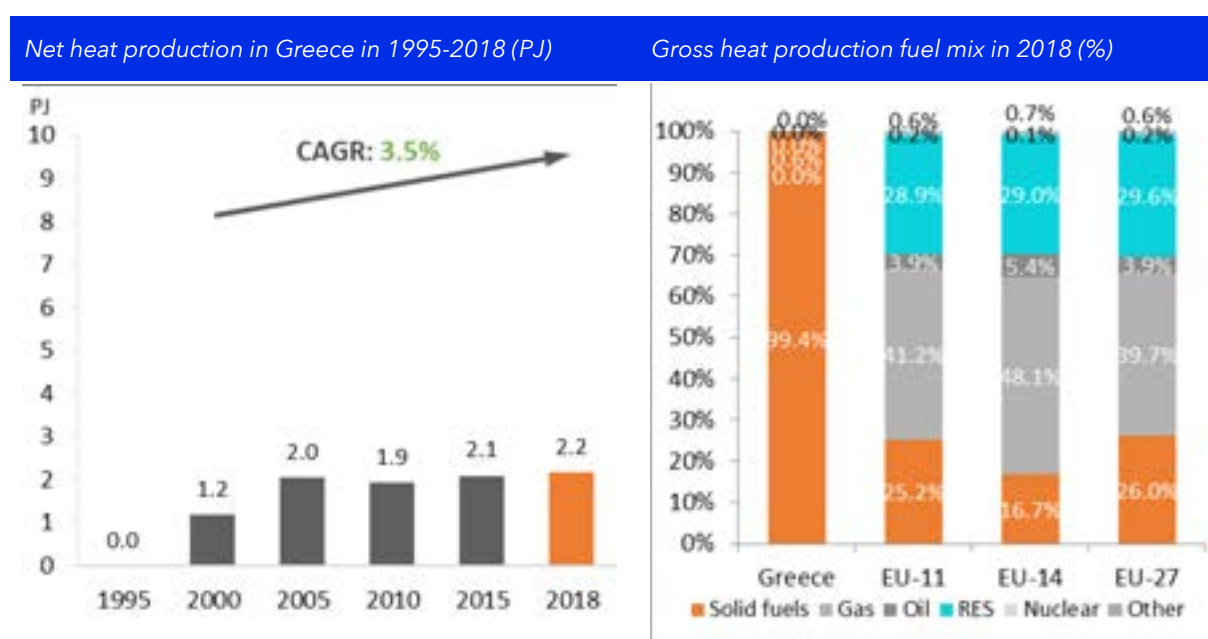
9.5 Overview of heat sector

Item 49 presents heat production and the current fuel mix of Greece. Over last 23 years net heat production increased from <0.1 PJ in 1995 to 2.2 PJ in 2018 (CAGR 3.5%).

The Greek fuel mix of heat production was dominated by coal with share of 99.4%. The mix was completed by 0.6% of oil. Compared to EU-14 and EU-27 countries, Greece had a much bigger share of solid fuels in its heat production mix. On other hand, the country practically was not using other source of energy to produce heat.

When compared to EU-11 average fuel mix one can notice much higher share of solid fuels used in Greece than in EU-11 (99.4% versus 28.9%). The share of oil in the Greek heat fuel mix was 0.6% and it was smaller than EU-11 3.9%. Other fuels were not used in the country.

Item 193: Net heat production and gross electricity production fuel mix in Greece



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Heat Production - NHP, Gross Heat Production - GHP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

Item 194 presents final heat consumption per capita and its breakdown by sectors.

The per capita demand for heat in Greece increased from 0.026 toe per capita in 2000 to 0.0048 toe per capita in 2018. As a result, within the 23 years analyzed, heat consumption per capita increased at CAGR of 3.5%. The heat consumption remained lower than the averages for EU-11, EU-14 and EU-27, respectively 0.13 toe per capita, 0.10 toe per capita and 0.10 toe per capita.

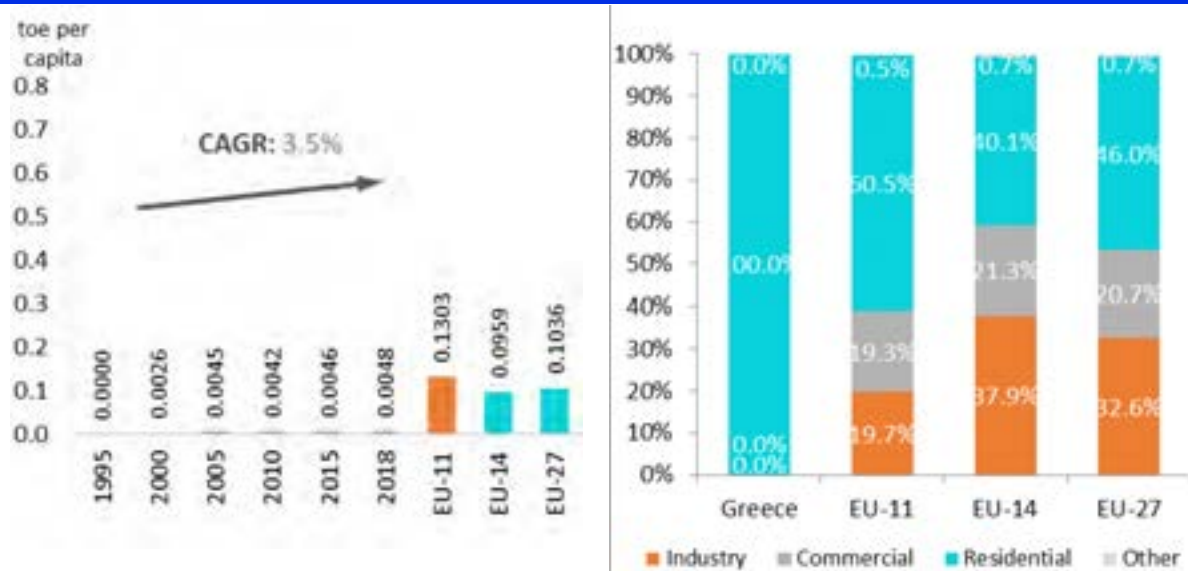
The structure of final consumption of heat in Greece was characterized by limited use of heat only for residential purposes.

In relation to EU-11 countries, the structure of final heat consumption in Greece was characterized by the use of heat limited to residential sector.

Item 194: Final consumption of heat in Greece

Final consumption of heat per capita in Greece (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Final consumption of heat in Greece by sectors in 2018 (%)



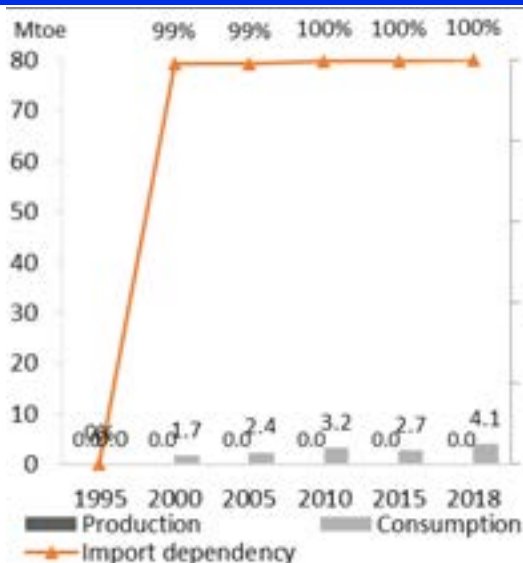
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Heat H8000. Errors in summation to 100% are due to rounding

9.6 Overview of gas sector

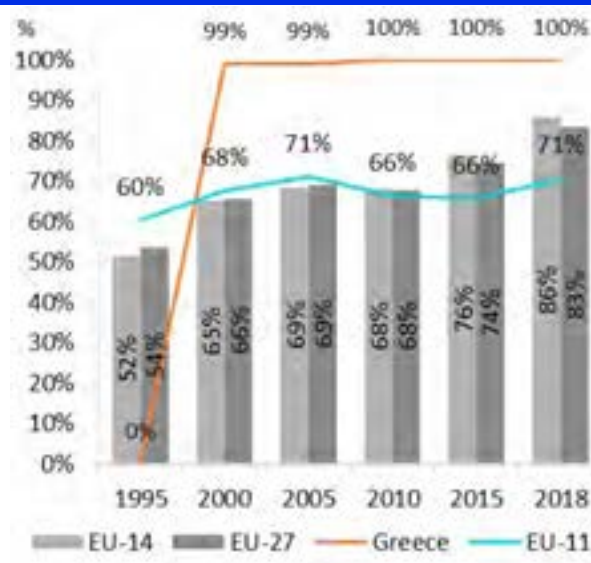
Greece consumed 4.1 Mtoe of gas in 2018. It increased from <0.1 Mtoe in 1995 to the current value. National production accounted for <0.1 Mtoe and it was remaining low compared to use. The remaining part of gas was imported. The country dependency on import was fluctuating from 99% to 100% over past 23 years (there was no import of gas in 1995). In 2018 the country was more dependent on import than EU-11, EU-14 and EU-27 average values.

Item 195: Gas sector in Greece

Gas production, gross consumption and import dependence in Greece in 1995-2018 (Mtoe)



Gas Import dependence in Greece and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gas production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Natural Gas G3000

The final consumption of gas per capita in Greece increased from <0.01 toe per capita to 0.08 toe per capita over past 23 years. This value was lower than the average values for EU-14, EU-11 and EU-27 countries.

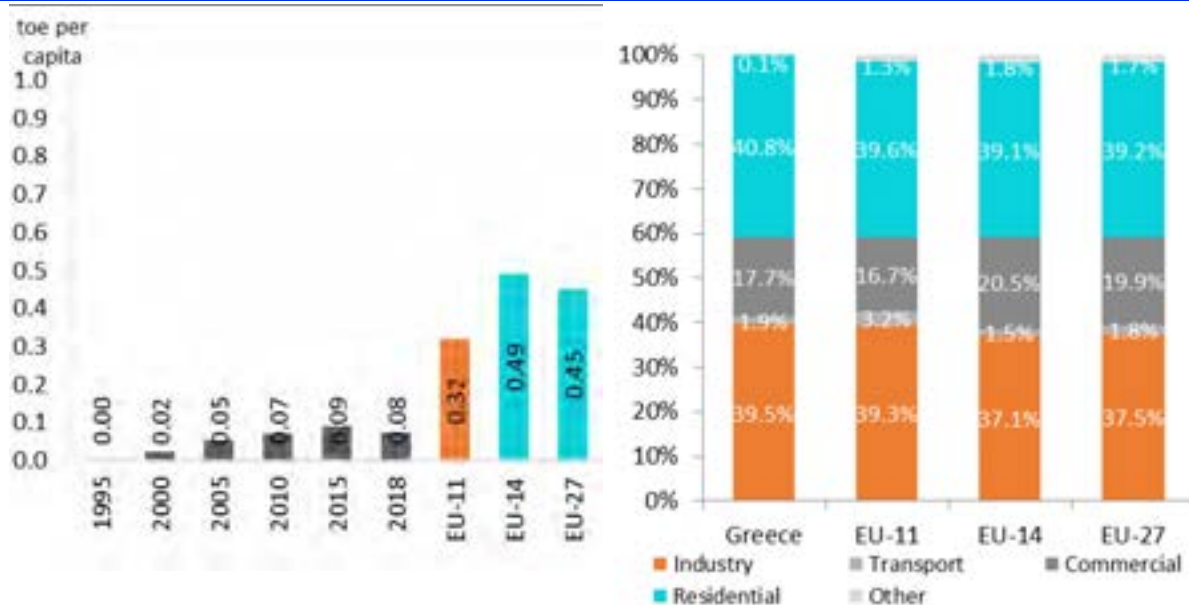
The structure of final gas consumption in Greece in 2018 was characterized by high share of industry - 39.5% versus 37.1% in EU-14. The share of use of gas in transport and residential applications were also higher than the averages for EU-14 countries, but relatively less gas was used in commercial sector.

When compared to EU-11 countries, Greece was using relatively more gas industry than EU-11 countries - 39.5% versus 39.3%. The country was using less gas in transport - 1.9% versus 3.2%. On other hand, the share of gas used in commercial and residential sectors was higher than in EU-11 countries, 17.7% versus 16.7% and 40.8% versus 39.6% respectively.

Item 196: Final consumption of gas per capita in Greece in 1995-2018 and gas final consumption by sectors in Greece and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of gas per capita in Greece (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Gas final consumption by sectors in Greece and EU-11, EU-14 and EU-27 countries in 2018



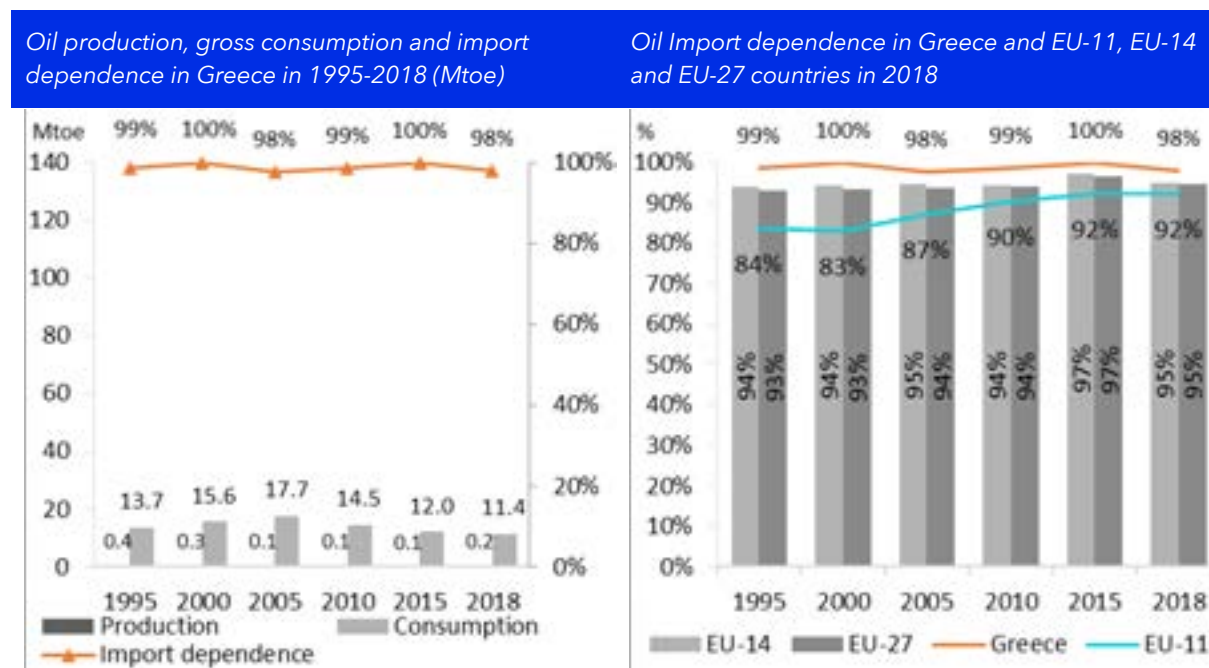
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Natural Gas G3000. Errors in summation to 100% are due to rounding

9.7 Overview of oil sector

The oil consumption of Greece dropped from 13.7 Mtoe in 1995 to 11.4 Mtoe in 2018. At the same time the national production dropped from 0.4 Mtoe to 0.2 Mtoe. Therefore, the level of import dependency was high - between 98% and 100%.

When compared to EU-14 and EU-27 average import dependency, the country had a higher import dependency of 98% versus 95% in EU-14 and EU-27 countries. At the same time, the import dependency of the country was higher than EU-11 average - 98% versus 92%.

Item 197: Oil sector in Greece



Source: Eurostat data for 2018, extracted in 2020. Detail references: Oil production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Import dependence above 100% has been rounded to 100%

The final consumption of oil per capita in Greece increased from 0.95 toe per capita in 1995 to 1.24 toe per capita in 2005 and then dropped to 0.75 toe per capita in 2018. The level of final consumption per capita remained higher than the one for EU-11 but lower than the averages for EU-14 and EU-27.

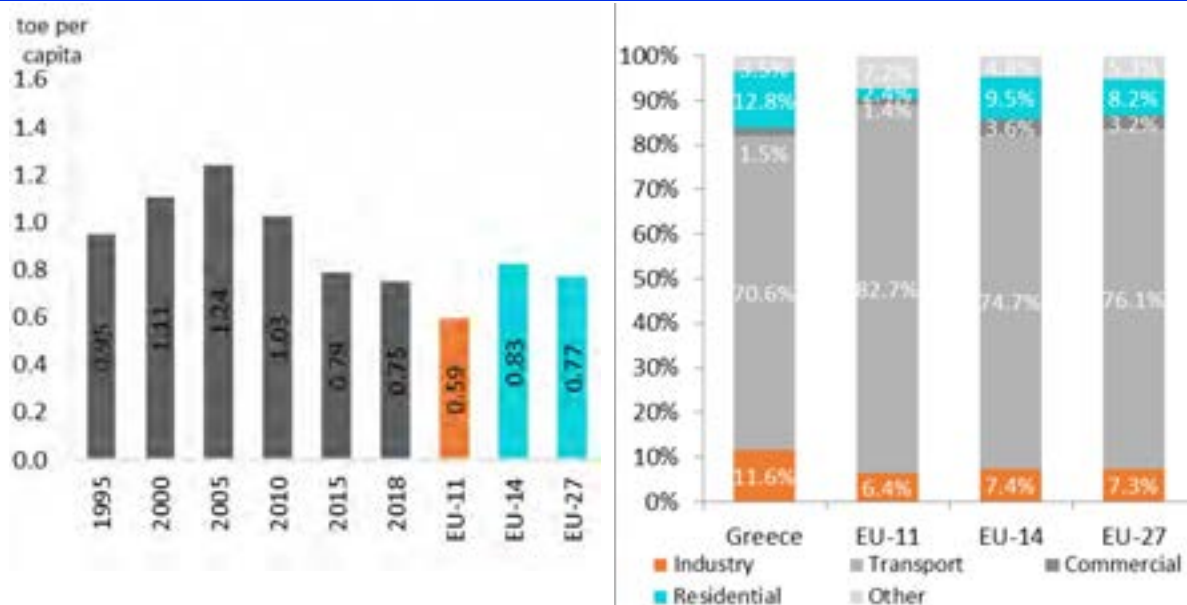
Oil consumption was dominated by transport sector, but its share was lower than EU-14 average - 70.6% versus 74.7% in EU-14 countries. Relatively more oil was used in industry - 11.6% versus 7.4% and in residential sector - 12.8% versus 9.5%. The commercial sector use of oil was lower than EU-14 average - 1.5% versus 3.6%.

The relative consumption of oil in Greece compared to EU-11 was lower in 2018 - 70.6% versus 82.7%. The use in industry was relatively higher - 11.6% versus 6.4%. At the same time commercial and residential sector were consuming relatively more oil in the country than EU-11 averages - 1.5% and 12.8% versus 1.4% and 2.4%.

Item 198: Final consumption of oil per capita in Greece in 1995-2018 and oil final consumption by sectors in Greece and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of oil per capita in Greece (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Oil final consumption by sectors in Greece and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Errors in summation to 100% are due to rounding

9.8 EU climate policy and its targets for Greece

Greece is subject to EU energy and climate regulations and therefore, specific targets were set and verified regarding greenhouse gas emission, share of energy from renewable energy sources and energy efficiency improvements (see Item 199).

Item 199: Energy and climate targets for Greece for 2020 and 2030

| | Greece 2020 targets | Greece 2030 targets |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | EU wide target of 20% reduction from 1990 levels (14% from 2005 level) | EU wide target of 40% reduction from 1990 levels |
| Greenhouse gas emissions in ETS | EU wide target of 21% reduction from 2005 | EU wide target of 43% reduction from 2005 |
| National emission reduction targets in non-ETS - Effort Sharing Decision (ESD) | -4% in relation to their 2005 levels | - |
| National emission reduction targets in non-ETS - Effort Sharing Regulations (ESR) | - | -16% in relation to their 2005 levels |
| Share of energy from renewable energy sources | EU wide target of 20% energy from renewables | EU wide target of minimum 32% share for renewable energy |
| EU wide target of share of energy from renewable energy sources | EU wide target of 20% share of gross final energy consumption | EU wide target of 32% share of gross final energy consumption |
| National target of share of energy from renewable energy sources | 18% of gross final consumption | Not yet available |
| Improvement in energy efficiency | EU wide target of 20% improvement in energy efficiency | EU wide target of at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |
| Primary energy consumption | EU wide target < 1,483 Mtoe National target < 24.7 Mtoe | EU wide target of 1,273 Mtoe (< 1,128 Mtoe EU-27) National targets not available yet |
| Final energy consumption | EU wide target < 1,086 Mtoe National target < 18.4 Mtoe | EU wide target < 956 Mtoe (< 846 Mtoe EU-27) National targets not available yet |

Source: EU website

In following chapter, the overview of Greece targets and performance are summarized.

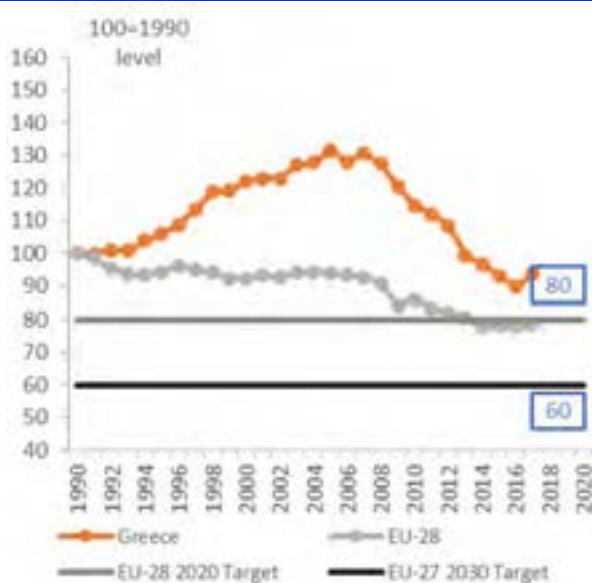
9.8.1 Greenhouse gas emissions

EU set a target for CO₂ reduction by 20% compared to 1990 level at EU level. Regardless the fact that the target was not binding for specific country, the level of CO₂ emission in Greece was below EU wide target.

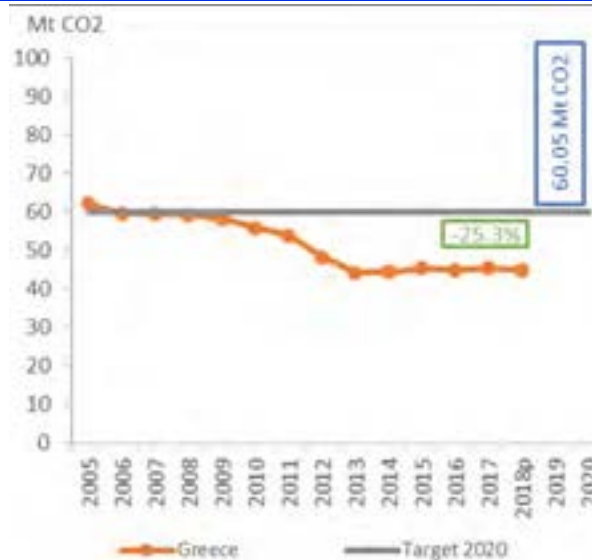
The non-ETS greenhouse gas emissions the binding national targets for Greece was 60.05 Mt of CO₂ equivalent emissions. Comparing to 2018 provisional results the level of emissions overachieved the target by 25.3%.

Item 200: Energy efficiency target data for Greece

Greenhouse gas emissions level in Greece and EU-28, base year 1990, and EU 2020 target



Greenhouse gas emissions in Effort Sharing Decision (ESD) sectors



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Greenhouse gas emissions, base year 1990 [T2020_30], Greenhouse gas emissions in ESD sectors [T2020_35]

9.8.2 Renewable energy sources

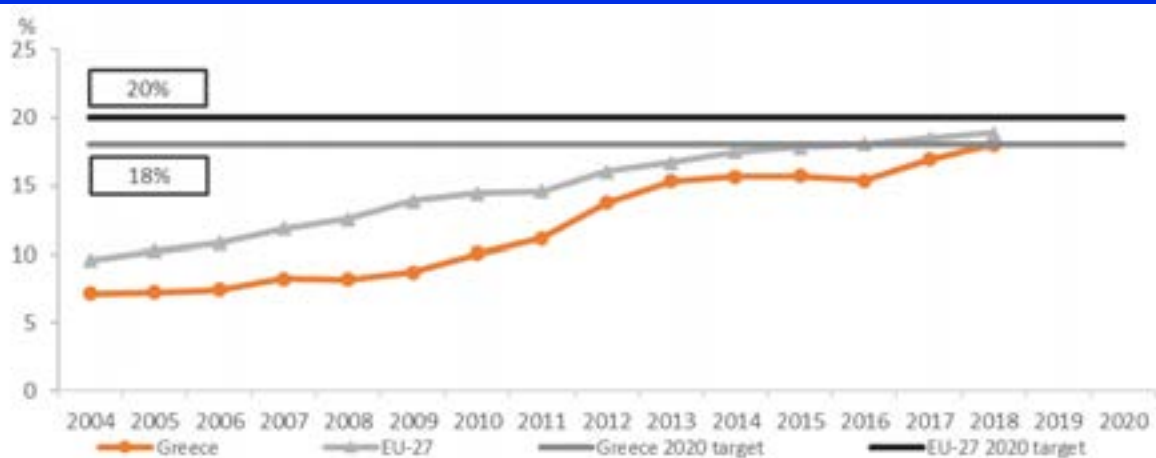
The following targets were set for Greece regarding the share of energy from renewable energy sources in gross final energy consumption:

- a 20% share of gross final energy consumption by 2020,
- a 18% national target for share of energy from renewable sources in gross final consumption of energy in 2020.

The share of energy from renewable energy sources in Greece was below EU wide and country specific targets in 2018.

Item 201: Share of energy from renewable energy sources in gross final energy consumption in Greece

Share of energy from renewable energy sources in gross final energy consumption in Greece in 2005-2018 and targets for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Share of energy from renewable sources [nrg_ind_ren]

9.8.3 Energy efficiency

The energy efficiency target set for Greece were respectively:

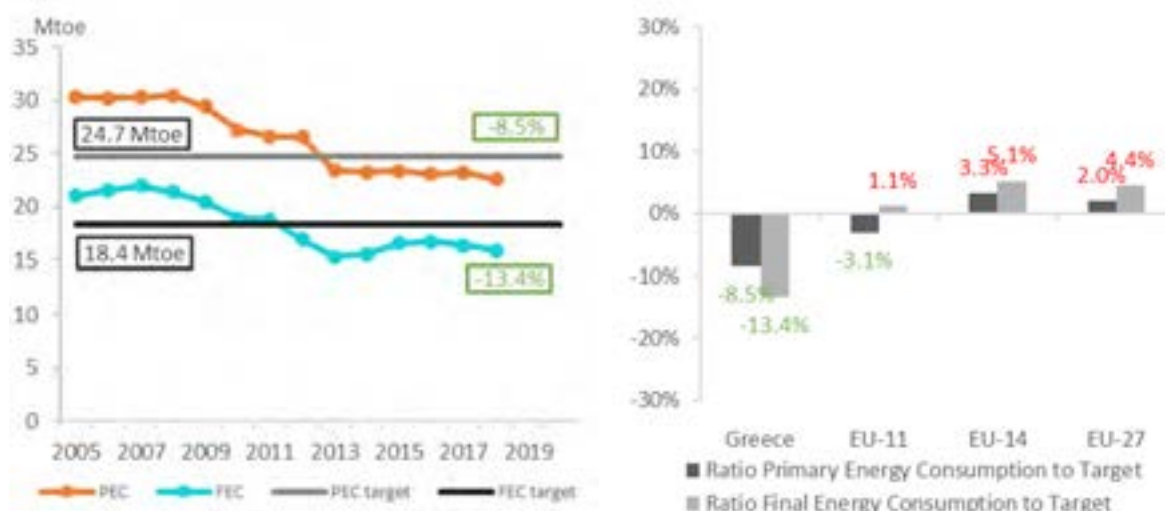
- Primary Energy Consumption in 2020: 24.7 Mtoe
- Final energy consumption in 2020: 18.4 Mtoe

Following the information provided in Item 202 the results for 2018 were below the targets in both criteria, respectively -8.5% of primary energy consumption and -13.4% of final energy consumption. This gives great chance to Greece to achieve the targets in 2020.

Item 202: Energy efficiency target data for Greece

Primary energy consumption and final energy consumption in Greece in 2005-2018 and targets for 2020

Ratio of primary energy consumption to target for 2020 and final energy consumption to target for 2020 in Greece, EU-11, EU-14 and EU-27 in 2018



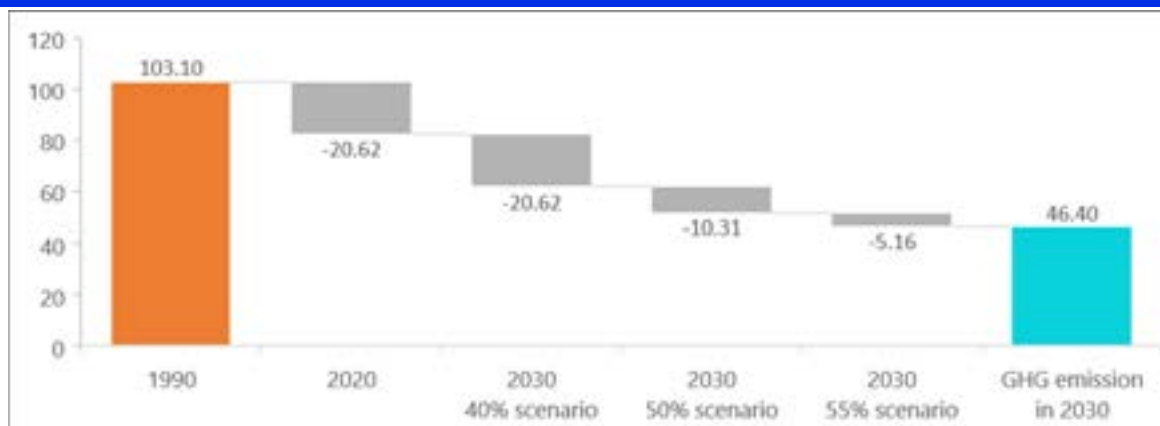
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Primary energy consumption - Primary energy consumption (Europe 2020-2030) (PEC2020-2030), final energy consumption - Final energy consumption (Europe 2020-2030) (FEC2020-2030). EU-11 and EU-14 data estimated based on Eurostat data

9.9 Review of potential impact of Green Deal propositions

At the current stage of discussions regarding the European Green Deal only partial information are available regarding the future targets. EU is proposing to increase the greenhouse gas emission reduction to 50% or 55% for 2030. This is a proposition included in the draft proposal of "Climate Law". Assuming the Greece greenhouse gas emissions in 1990, an estimation of EU 2030 target emissions can be drafted. The 2020 target of 20% reduction resulted in 20.62 Mt CO₂ emission drop. Further increase of the target to 40% in 2030 require additional 20.62 Mt CO₂ reduction. If the 50% target proposed under European Green Deal is applied then additional 10.31 Mt CO₂ emission decrease is needed, or 15.47 Mt CO₂ decrease, if 55% target is adopted.

Item 203: Estimation regarding greenhouse gas emissions in Greece under different scenarios (Mt CO₂)

Estimation regarding greenhouse gas emissions in Greece under different scenarios (Mt CO₂)



Source: Eurostat data for 2018, extracted in 2020. Estimations delivered by the Author

Nevertheless, it is worth to highlight that, if the current structure of greenhouse gas emissions target is maintain, then the 50% target for 2030 is an EU wide target. It is not a binding element for specific countries. Country specific targets could be expected as per ESD and ESR but there is no way to anticipate the potential targets.

At the same time, the review of key EU regulations around climate and energy as:

- Emissions Trading System Directive;
- Effort Sharing Regulation;
- Land use, land use change and forestry Regulation;
- Energy Efficiency Directive;
- Renewable Energy Directive;
- CO₂ emissions performance standards for cars and vans
- Energy Taxation Directive

can bring some additional targets in area of share of energy from renewable energy sources and energy efficiency. For the moment, any estimation of potential targets is not available nor possible to estimate.



10 Ireland

10.1 General information

Ireland is the tenth biggest country within EU-14 group in terms of total country area and represents 2.3% of the area. At the same time, it is the 15th country in EU-27 with 1.7% of the area. It represents 1.4% of EU-14 population and 1.1% of EU-27 population, but 2.7% of its total nominal GDP of EU-14 and 2.4% of EU-27. Due the robust economic growth in 1995-2018 period, in 2018 Irish GDP per capita amounted to 191% of the whole EU average (107% in 1995).

Item 204: Ireland - key data



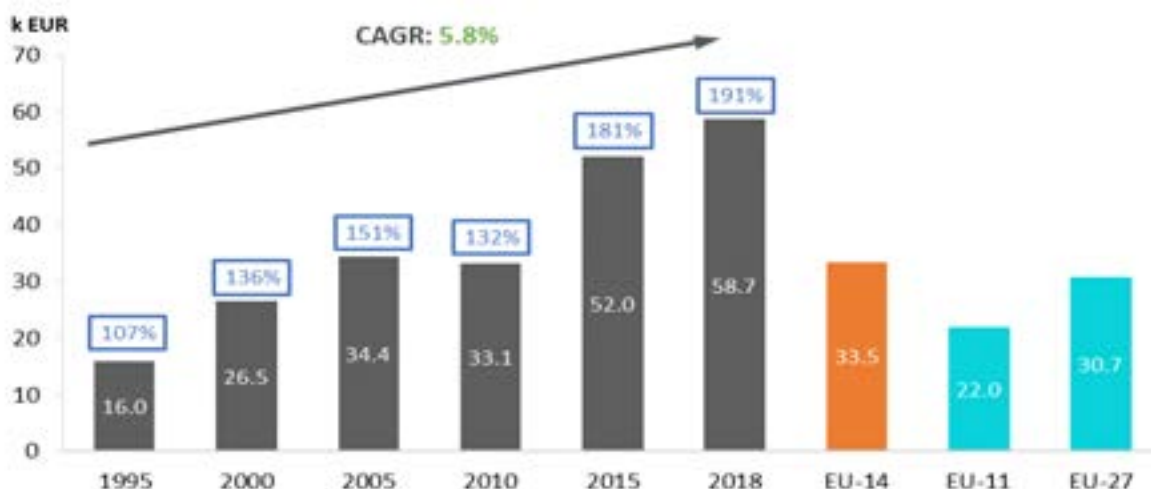
Key data

| | |
|------------------------------------------------------|--------|
| Population (M) | 4.8 |
| GDP per capita (EUR, nominal) | 66,670 |
| GDP per capita (EUR, PPS) | 58,650 |
| GDP as share of EU-14 | 2.7% |
| GDP as share of EU-27 | 2.4% |
| Energy intensity of the economy (kgoe per 1,000 EUR) | 53.4 |
| Greenhouse gas emissions (Mg per capita) | 12.6 |

Source: Eurostat data for 2018, extracted in 2020

With the compounded annual growth rate amounting to 5.8% Irish economy considerably grew in the period of 1995-2018 (see Item 205). Its GDP per capita was above EU-14 and EU-27 averages (equal to 175% and 191% of the respective averages). Its GDP per capita was also 266% of the average GDP per capita for EU-11 countries.

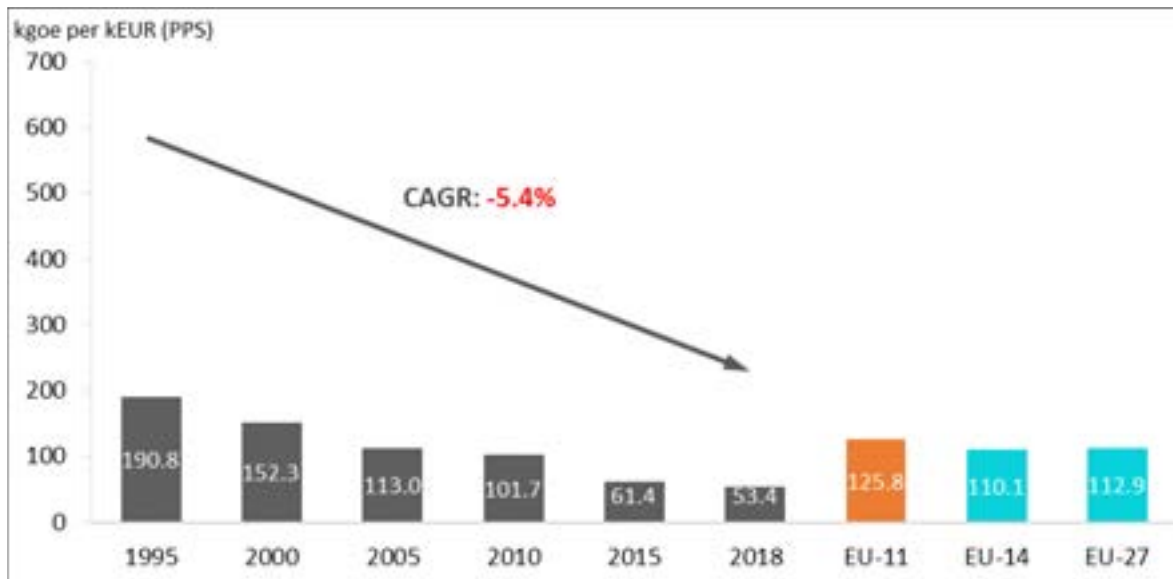
Item 205: GDP per capita in Ireland for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in 2018 (kEUR, PPS) and share of Ireland GDP per capita in relation to EU-27 average



Source: Eurostat data for 2018, extracted in 2020. Detail references: GDP per capita - Gross domestic product at market prices (B1GQ), Current prices, purchasing power standard per capita (CP_PPS_HAB)

The Irish economy energy intensity was about 53.4 kgoe per 1,000 EUR PPS in 2018, thanks to a decrease of the energy intensity indicator during the years 1995-2018. It dropped by 137.4 kgoe per 1,000 EUR PPS, i.e. it was reduced by about 72%. The energy intensity of Ireland in 2018 represented 42% and 47% of EU-14 and EU-27 averages. At the same time, it represented 48% of EU-11 average.

Item 206: Energy intensity of the economy in Ireland in 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)



Source: Eurostat data for 2018, extracted in 2020. Values for EU-11 and EU-14 were recalculated based on energy intensity and GDP data from Eurostat. Detail references: Energy intensity of GDP in purchasing power standards (PPS) - EI_GDP_PPS

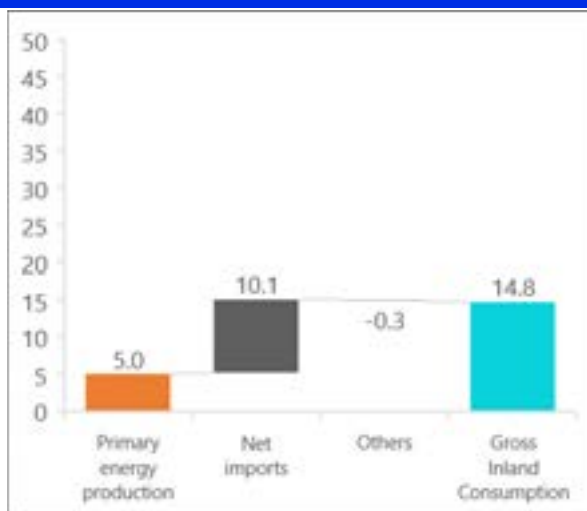
10.2 Energy balance of Ireland

The energy balance of Ireland in 2018 is presented in Item 207. The primary energy production was equal to 5.0 Mtoe in 2018. Net imports added 10.1 Mtoe to the balance. The total gross inland consumption accounted for 14.8 Mtoe. The level of import of energy to Ireland grew slowly up to 2001 and then remained stable until end of years 2000. Then it dropped. At the same time the level of net import reported to the energy needs followed similar patten to finally reach about 70% in 2018.

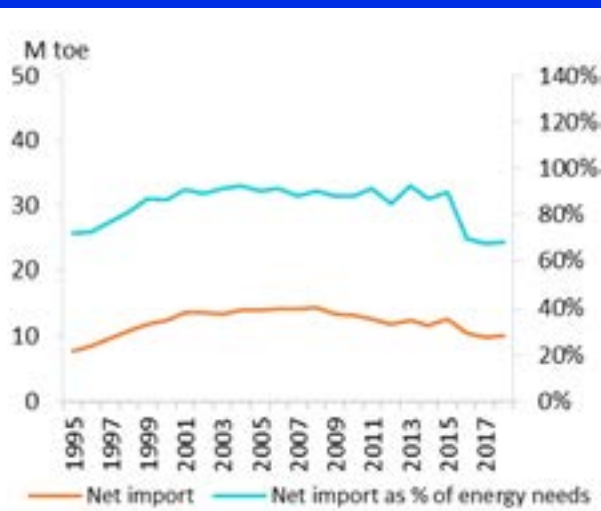
The primary energy production increased over past 23 years, as well as gross energy consumption. National production was meeting only 34% of the country gross consumption and this factor decreased over last 23 years from 38%.

Item 207: Energy balance in Ireland

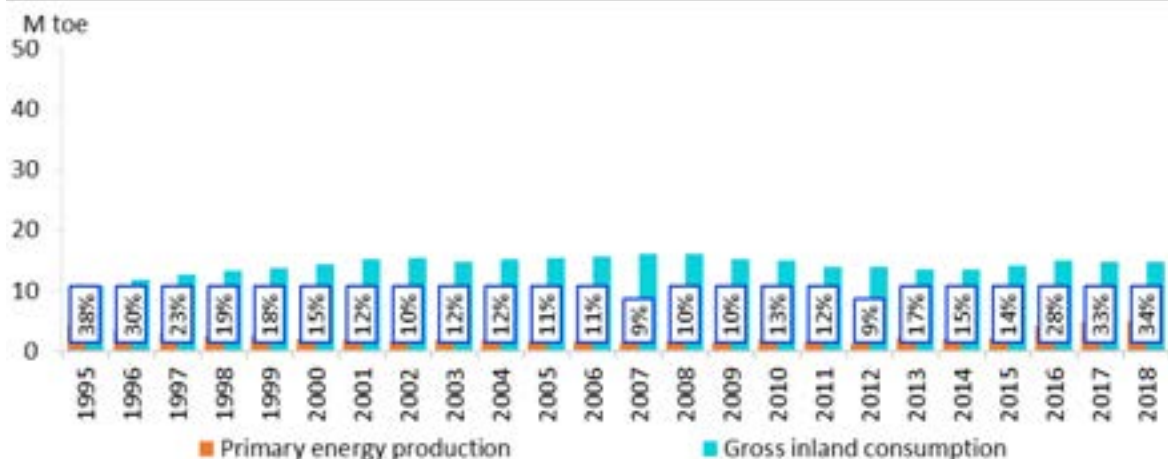
Energy balance in Ireland in 2018 (Mtoe)



Net import of energy in Ireland in 1995-2018 (Mtoe and as percentage of GIC)



Gross inland consumption, primary energy production (Mtoe) and ratio of primary energy production to gross inland consumption in 1995-2018 in Ireland (%)



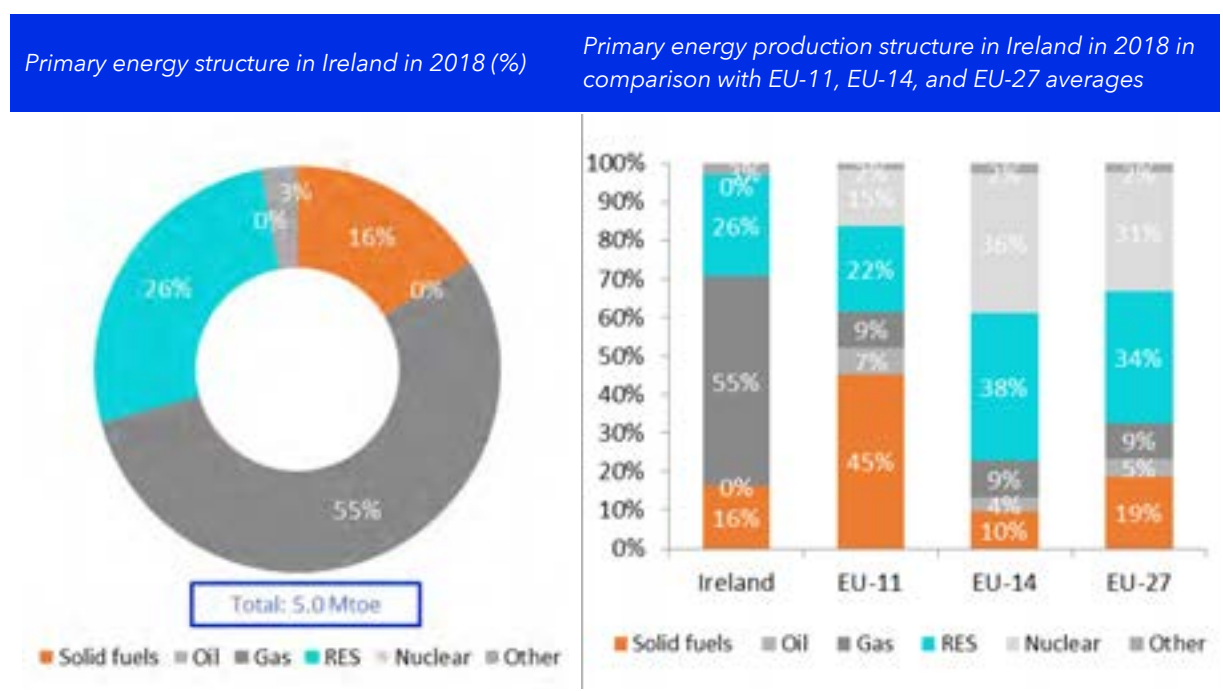
Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Gross inland consumption - GIC. Net imports = Import (IMP) - Export (EXP), Other = Change in stock (STK-CHG) - International maritime bunkers (INTMARB)

The primary energy production in Ireland was dominated by gas (55%) and renewable energy sources (26%). The mix was completed by 16% share of solid fuels and 3% share of other sources in the mix. Usage of oil and nuclear energy was null.

When compared to the European averages, Ireland was characterized by very high share of gas in the energy mix - 55% versus 9% EU-14 average and 9% EU-27 average. The share of renewable energy sources in the Irish fuel mix was a little lower than in EU-14 and EU-27 (26% versus 38% in EU-14 and 34% in EU-27). At the same time, the share of solid fuels was higher in Ireland than the averages for EU-14 and EU-27 (16% versus 10% and 19%). In opposite to EU averages Ireland was not using oil and nuclear energy for primary energy production.

The comparison of Ireland to EU-11 averages was mainly characterized by much higher share of gas (55% versus 9%) and higher share of renewable energy sources (26% versus 22%). At the same time the share of solid fuels was lower - 16% versus 45%. Ireland as not using oil and nuclear energy in opposite to EU-11 averages (7% and 15% shares).

Item 208: Primary energy structure in Ireland



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H) , Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

Gross inland consumption of energy in Ireland was dominated by oil (50%), gas 30%) and renewable energy sources (10%). The mix was completed by 9% of solid fuels and 1% of other energy sources.

Comparing to European averages gross inland consumption of energy in Ireland was marked by low share of solid fuels (9% versus 11% in EU-14 and 14% in EU-27). The share of oil was higher in Ireland (50%) than in EU-14 (35%) and EU-27 (34%) as well as the share of gas 30% versus 23% and 22% in EU-14 and EU-27). Ireland was characterized by lower share of renewable energy sources in the mix - 10% versus 16% and 15% in EU-14 and EU-27 respectively, and lack of nuclear energy in the mix (versus 14% in EU-14 and 13% in EU-27).

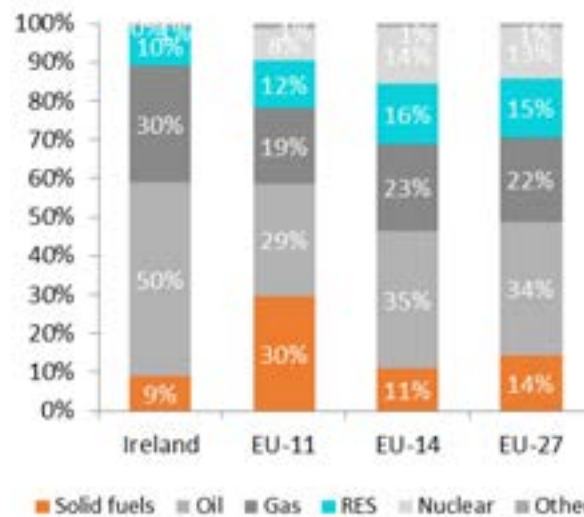
When compared to EU-11 the main difference was around much lower share of solid fuels consumption in Ireland (9% versus 30% in EU-11) and lower share of renewable energy sources (10% versus 12%). The share of oil and gas use in Ireland were higher than in EU-11 countries (50% versus 29% and 30% versus 19% respectively). EU-11 average gross final consumption included nuclear energy at 8%. Ireland was not using nuclear energy.

Item 209: Gross inland consumption structure in Ireland

Gross inland consumption structure in Ireland in 2018 (%)



Gross inland consumption structure in Ireland in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gross inland consumption - GIC, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

The final energy consumption in Ireland was dominated by oil (54%), followed by electricity (21%), gas (17%) and renewable energy sources (4%). The mix was completed by solid fuels (4%).

The sectoral final energy consumption in Ireland was characterized by lower share of industrial but higher of transport sectors than in EU-14 and EU-27 (23% and 37% versus 26% and 31% in EU-14 and EU-27). The share of commercial and public services was lower in final energy consumption in Ireland (13%) than in EU-14 (15%) and EU-27 (14%).

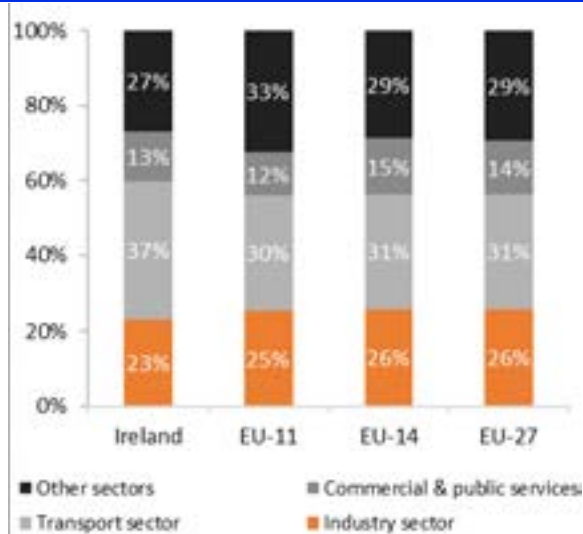
When compared to EU-11 Ireland similar conclusions as related to EU-14 and EU-27 can be drawn.

Item 210: Final energy consumption structure in Ireland

Final energy consumption structure in Ireland in 2018 (%)



Final energy consumption structure in Ireland in 2018 in comparison with EU-11, EU-14, and EU-27 averages



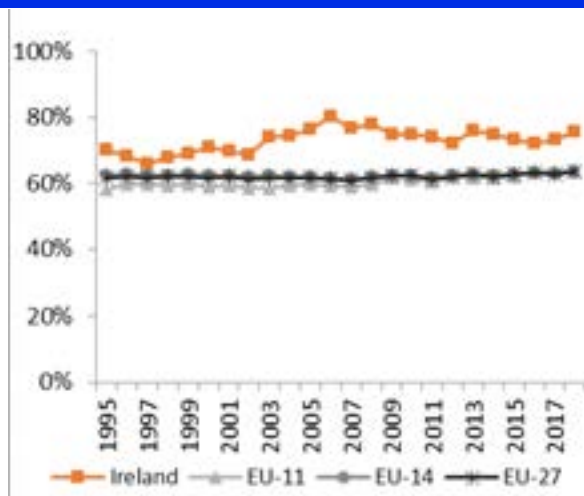
Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Heat (H8000), Electricity (E7000), Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial & public services - FC_OTH_CP_E, Other - FC_OTH_E-FC_OTH_CP_E. Errors in summation to 100% are due to rounding

Irish final energy consumption to gross inland consumption ratio which measure energy efficiency was higher than the averages for EU-11, EU-14 and EU-27. The situation remained stable for last 23 years.

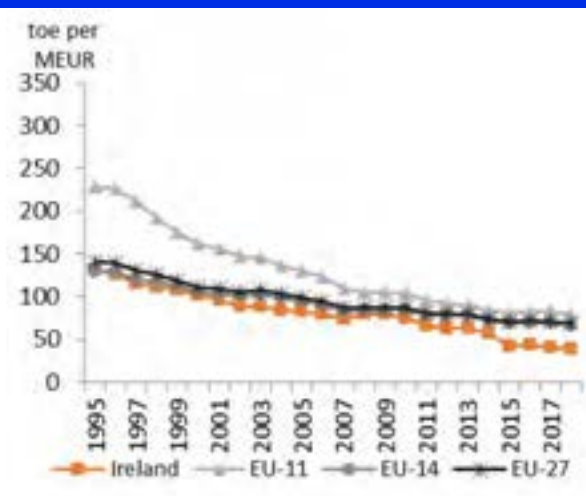
Simultaneously, a decrease of energy volume associated with generating gross domestic product was noticed at the current value was lower than the averages for EU-14 and EU-27 averages.

Item 211: Final energy consumption in Ireland in relation to selected indicators

Final energy consumption to gross inland consumption ratio in Ireland in 1995-2018 (%)



Final energy consumption to gross domestic product ratio in Ireland in 1995-2018 in comparison with EU-11, EU-14, and EU-27 averages (toe per M EUR)



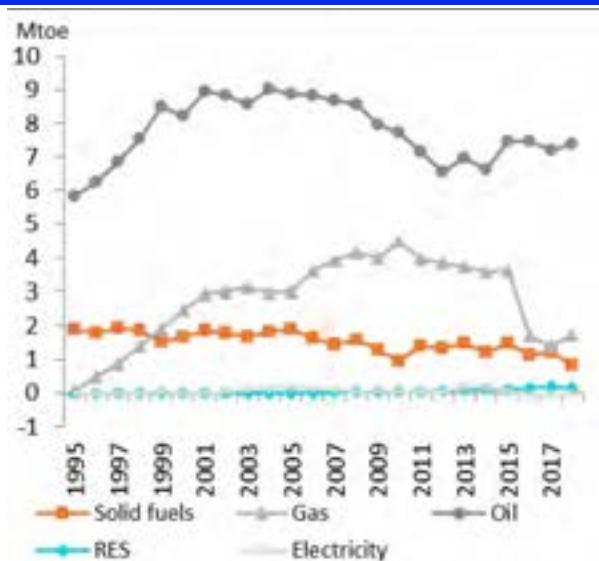
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final energy consumption - FEC, Gross inland consumption - GIC, Gross Domestic Product - Gross domestic product at market prices B1GQ, Current prices - CP-MEUR

Net import of energy to Ireland by fuels was characterized by an increase of oil imports and a decrease of gas ones. The level of solid fuels import was decreasing.

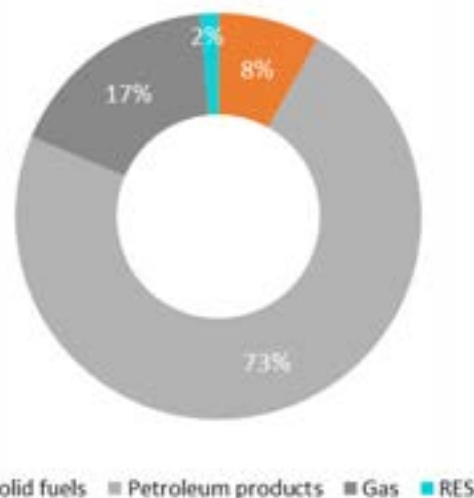
The import structure of energy to Ireland was dominated by oil (73%) and gas (17%). The imports were completed by 8% of solid fuels and 2% of renewable energy sources.

Item 212: Net import of energy in Ireland

Net import of energy by fuel in 1995-2018 (Mtoe)



Net import structure in 2018 (% , only fuels for which import is greater than export)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil

and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Electricity (E7000). Errors in summation to 100% are due to rounding

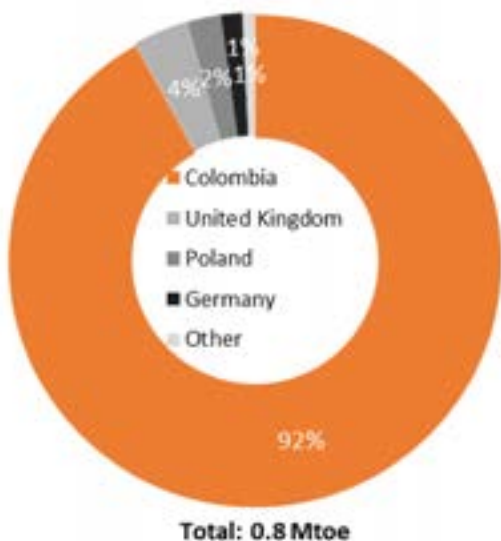
Solid fuels were imported to Ireland mainly from Colombia (92%) and several other countries.

Main oil importers to Ireland were United Kingdom (43%), Norway (17%), United States (10%) and Russia (8%). The remaining 22% were imported from various locations.

Ireland was importing gas and electric power from United Kingdom.

Item 213: Foreign fuel suppliers

Foreign suppliers of solid fuels in Ireland in 2018 (%)



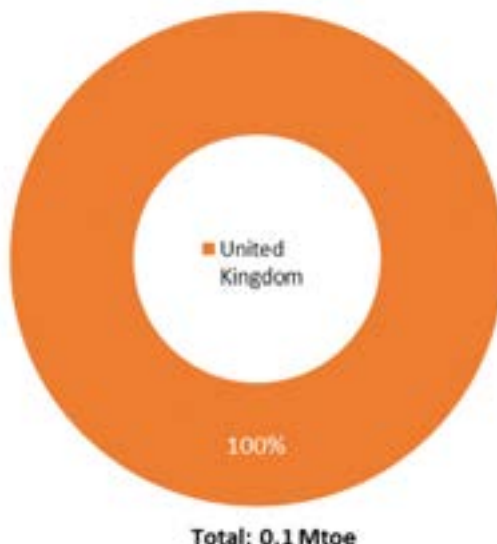
Foreign suppliers of crude oil in Ireland in 2018(%)



Foreign suppliers of gas in Ireland in 2018 (%)



Foreign suppliers of electricity in Ireland in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fossil fuels - C000X0350-0370, Gas - Natural gas (G3000), Oil - Oil and petroleum products (excluding biofuel portion) (O4000XBIO), Electricity - E7000. Errors in summation to 100% are due to rounding

10.3 Greenhouse gas emissions

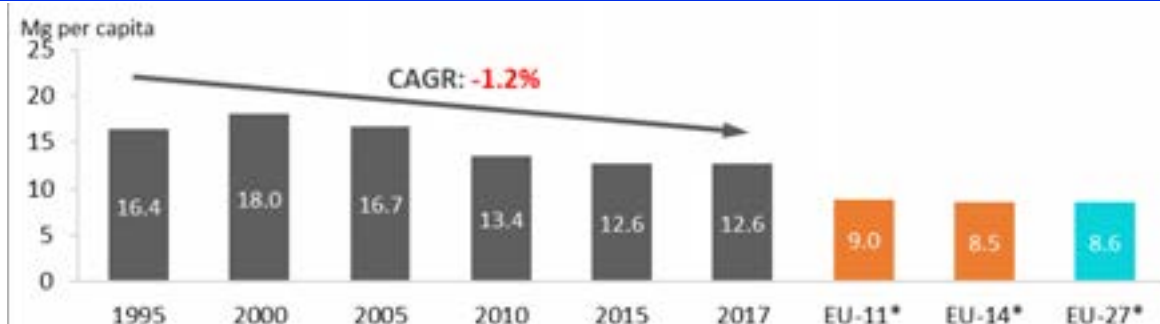
Between 1995-2017 greenhouse gases emissions in Ireland were increased - from over 55.4 Mt CO₂ in 1995 to 60.8 Mt CO₂ in 2017, but average emissions per capita decreased to 12.6 Mg CO₂ per capita in 2017 (from 16.4 Mg CO₂ per capita in 1995), which was higher comparing to EU-14 and EU-27 averages (8.5 Mg CO₂ per capita and 8.6 Mg CO₂ per capita, respectively), and also higher than in EU-11 (9.0 Mg CO₂ per capita)

There were some noteworthy changes in the Irish structure of greenhouse gas emissions over the period considered. The significance of waste management emissions dropped swiftly by 49%, as well as emissions from energy industries 13%. On other hand, transport emissions and industrial processes gained in importance increasing by 91% and 6% respectively.

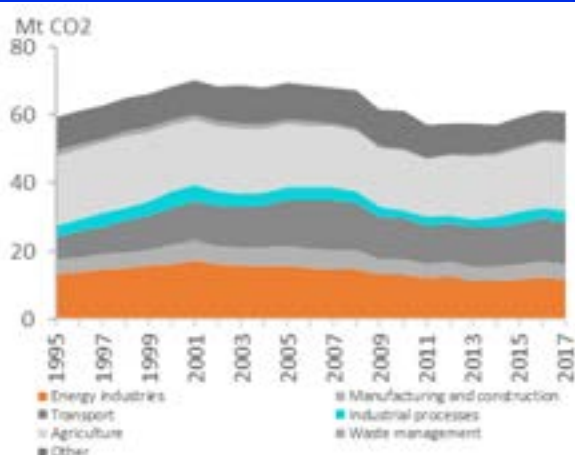
Comparing to EU-11, EU-14 and EU-27 countries, Ireland was characterized by higher share of emissions from agriculture. Shares of emissions from other sectors were generally lower than the European averages.

Item 214: Greenhouse gas emissions in Ireland

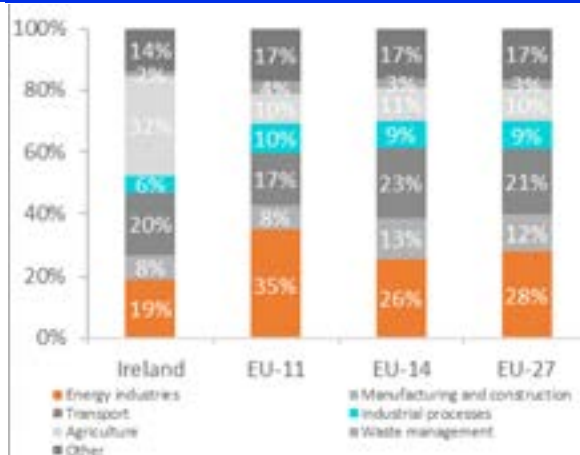
Greenhouse gas emissions per capita in Ireland in 1995-2017 in comparison with EU-11, EU-14 and EU-27 averages in 2017 (Mg per capita)



Greenhouse gas emissions in Ireland by sectors in 1995-2017 (Mt CO₂)



Greenhouse gas emissions in Ireland by sectors in 2017 in comparison with EU-11, EU-14 and EU-27 averages (%)



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - * values for EU-11, EU-14 and EU-27 recalculated by the Author; Energy industry - Fuel combustion in energy industries (CRF1A1), Manufacturing and construction - Fuel combustion in manufacturing industries and construction (CRF1A2), Transport - Fuel combustion in transport (CRF1A3), Industrial processes - Industrial processes and product use (CRF2), Agriculture - Agriculture (CRF3), Waste management - Waste management (CRF5), Other = Other fuel combustion sectors (CRF1A4)+ Other fuel combustion sectors n.e.c. (CRF1A5) + Fuels

- fugitive emissions (CRF1B)+Other sectors (CRF6); Total GHG emissions equal to All sectors (excluding LULUCF and memo items) (CRF1-6X4_MEMO) i.e. emission from all sectors excluding Land use, land use change, and forestry (LULUCF), Transport and storage of CO₂ (memo item), International aviation (memo item), International navigation (memo item), Multilateral operations (memo item), Biomass - CO₂ emissions (memo item). Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. Errors in summation to 100% are due to rounding

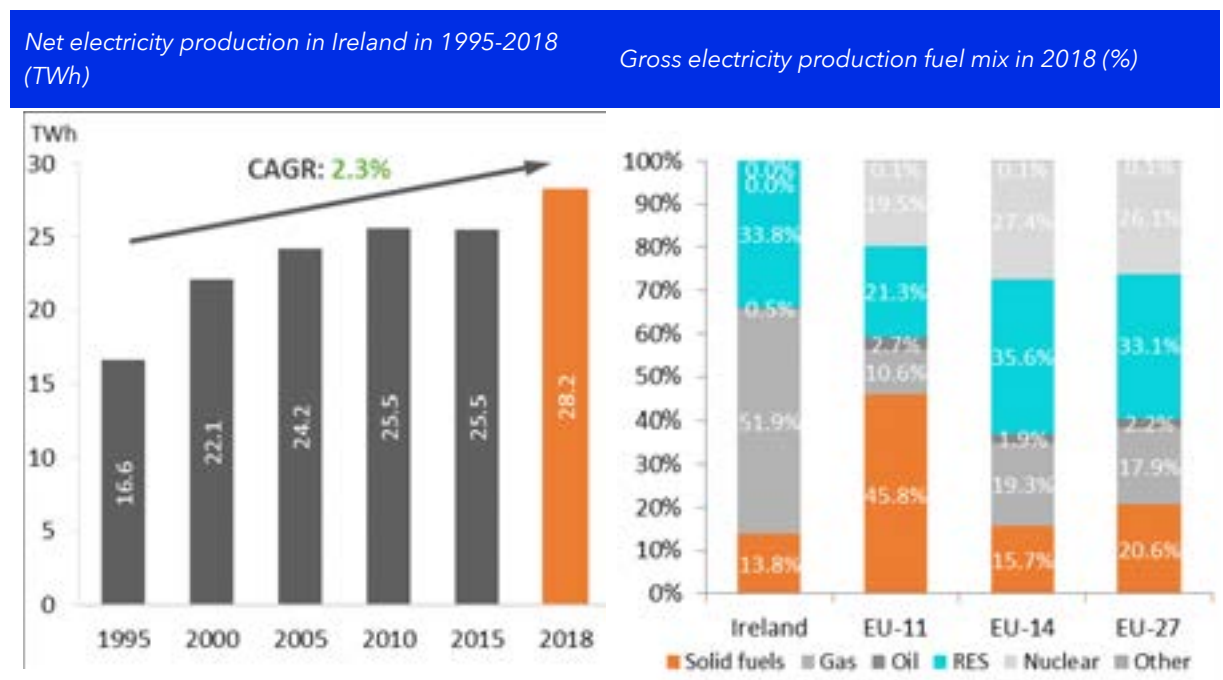
10.4 Overview of electricity sector

Item 215 presents electricity production and the current fuel mix of Ireland. Over last 23 years net electricity production increased from 16.6 TWh in 1995 to 28.2 TWh in 2018 (CAGR 2.3%). As visible, net electricity production represents 1.3% of EU-14 total electricity production, which was lower compared to Irish GDP share of 2.7%.

The Irish fuel mix was dominated by gas and renewable energy sources with shares of 51.9% and 33.8% respectively. The mix was completed by 13.8% of solid fuels and small shares of oil (0.5%). Compared to EU-14 and EU-27 countries, Ireland had a much bigger share of gas in its energy mix. On other hand, the country produced relatively less electricity from solid fuels, oil, and renewable energy sources, respectively 13.8%, 0.5% and 33.8% versus 15.7%, 1.9% and 35.6%. Ireland was not using nuclear power which was producing 27.4% of EU-14 electricity.

When compared to EU-11 average fuel mix one can notice much higher share of gas and renewable energy sources used in Ireland than in EU-11 (51.9% and 33.8% versus 10.6% and 21.3%) and significantly lower use of solid fuels (13.8% versus 45.8%). The share of oil was lower (0.5% versus 2.7%). No nuclear energy was used to produce electricity in Ireland whereas it produced 19.5% of electricity in EU-11 countries.

Item 215: Net electricity production and gross electricity production fuel mix in Ireland



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Electricity Production - NEP, Gross Electricity Production - GEP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000),

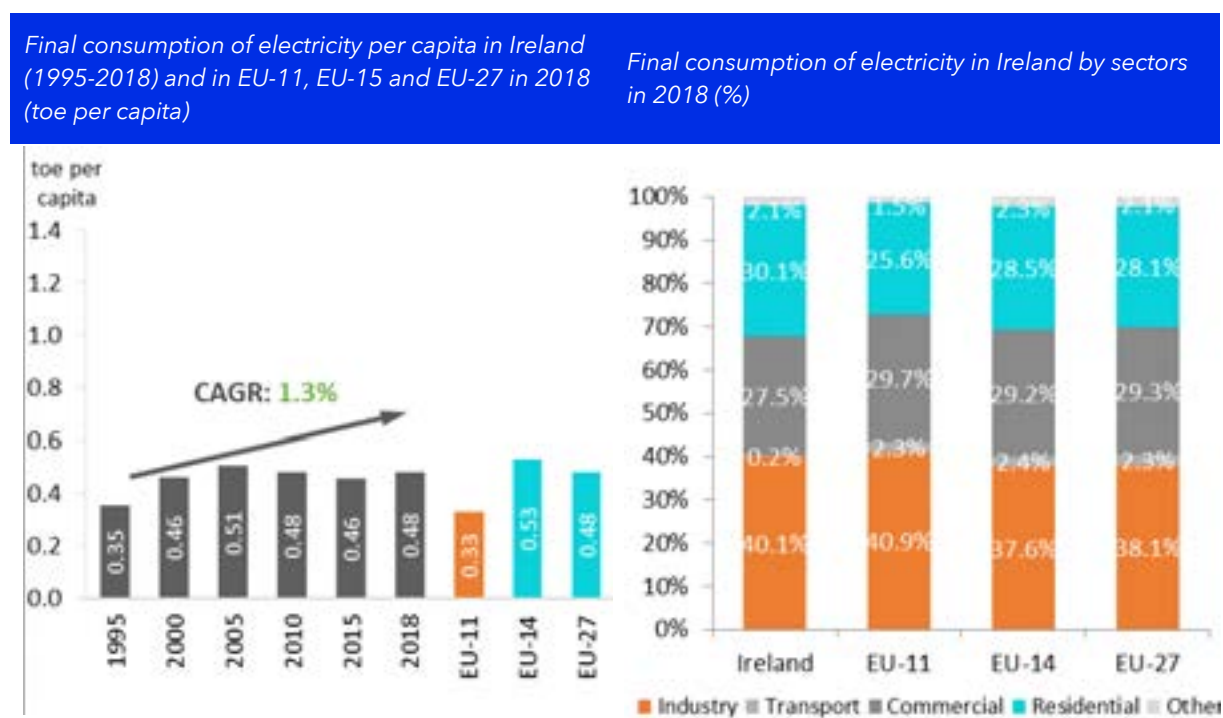
Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

In Item 216 the evolution of final per capita consumption of electricity and its breakdown by economic sector is presented. In recent years final consumption of electricity in Ireland increased (CAGR in the period of 1995-2019 was around 1.3%) and its level was lower compared to EU-14 and EU-27 countries. Irish final energy consumption per capita represented 91.1% of EU-14 level and 99.8% of EU-27 level.

The structure of final electricity consumption in Ireland was dominated by industry (40.1% versus 37.6% in EU-14 countries). Relatively more energy was used in residential sector (30.1% versus 28.5%) and less in transport and commercial sectors (0.2% and 27.5% versus 2.4% and 29.2%).

Ireland was consuming relatively less electricity in industry sector than EU-11 countries (40.1% versus 40.9%), commercial one (27.5% versus 29.7%) and transport (0.2% versus 2.3%). At the same time, it used relatively more electricity in residential sector (30.1% versus 25.6%).

Item 216: Final consumption of electricity in Ireland



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Electricity E7000. Errors in summation to 100% are due to rounding

10.5 Overview of heat sector

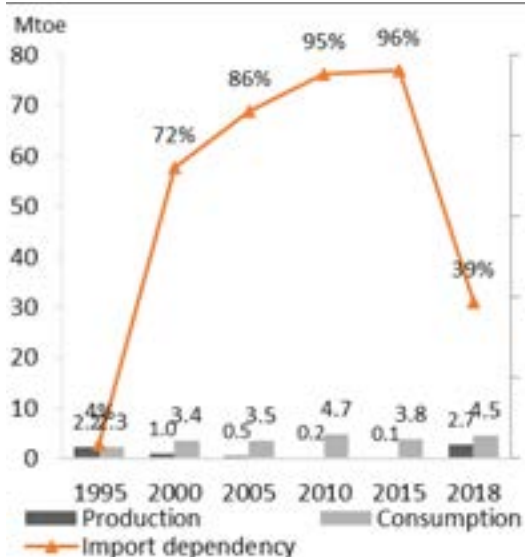
The official Eurostat statistic does not provide any information about Irish heat production, nor consumption. Therefore, there is no heat sector in Ireland.

10.6 Overview of gas sector

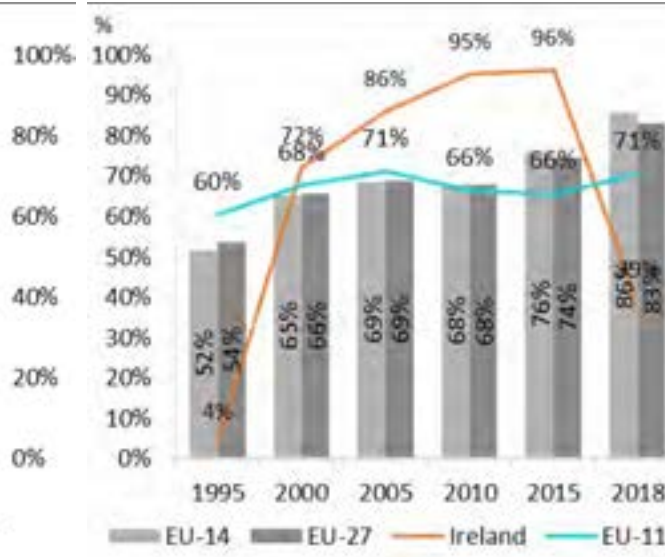
Ireland consumed 4.5 Mtoe of gas in 2018. It increased from 2.3 Mtoe 1995 to 4.7 Mtoe in 2010 and then decreased. National production accounted for 2.7 Mtoe and after a decrease from 2.2 Mtoe in 1995 to 0.1 Mtoe in 2015, it increased to 2.7 Mtoe in 2018. The remaining part of gas was imported. The country dependency on import was increasing from 1995 to 2015 from 4% to 96%. In 2018 the country import dependence was 39% and the country was less dependent on import than EU-11, EU-14 and EU-27 average values.

Item 217: Gas sector in Ireland

Gas production, gross consumption and import dependence in Ireland in 1995-2018 (Mtoe)



Gas Import dependence in Ireland and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gas production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Natural Gas G3000

The final consumption of gas per capita in Ireland increased from 0.22 toe per capita to 0.40 toe per capita over past 23 years. This value was lower than the average values for EU-14 and EU-27 countries but higher than the one for EU-11.

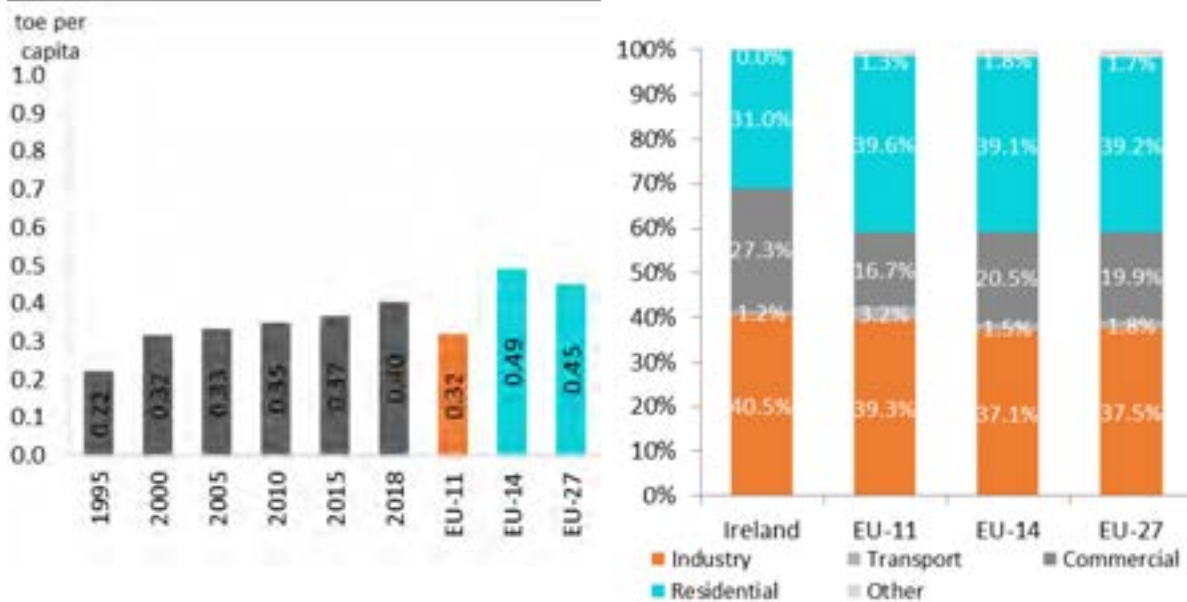
The structure of final gas consumption in Ireland in 2018 was characterized by high share of industry - 40.5% versus 37.1% in EU-14. The share of use of gas in transport and residential applications were lower than the averages for EU-14 countries but commercial sector consumed relatively more gas - 27.3% versus 20.5%.

When compared to EU-11 countries, Ireland was using relatively more gas industry than EU-11 countries - 40.5% versus 39.3%. The country was also using more gas in commercial sector - 27.3% versus 16.7%. On other hand, the share of gas used in residential and transport sectors was lower than in EU-11 countries, 31.0% versus 39.6% and 1.2% versus 3.2% respectively.

Item 218: Final consumption of gas per capita in Ireland in 1995-2018 and gas final consumption by sectors in Ireland and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of gas per capita in Ireland (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Gas final consumption by sectors in Ireland and EU-11, EU-14 and EU-27 countries in 2018



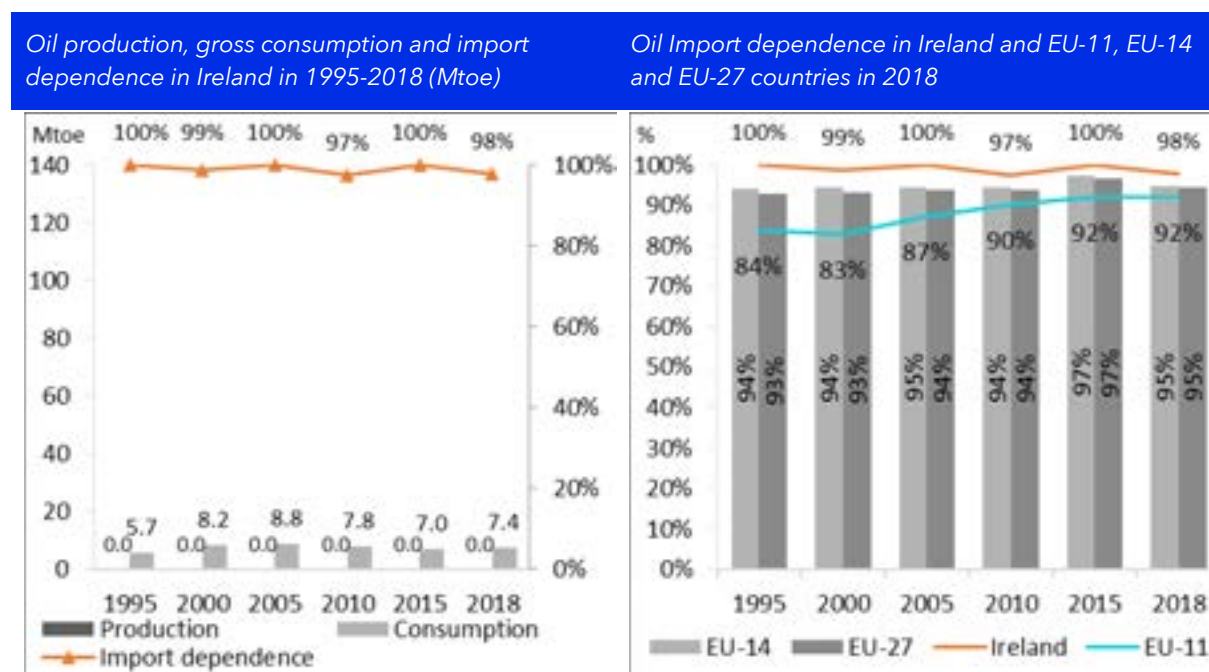
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Natural Gas G3000. Errors in summation to 100% are due to rounding

10.7 Overview of oil sector

The oil consumption of Ireland grew from 5.7 Mtoe in 1995 to 7.4 Mtoe in 2018. At the same time the national production remained null. Therefore, the level of import dependency was high - between 97% and 100%.

When compared to EU-14 and EU-27 average import dependency, the country had a higher import dependency of 98% versus 95% in EU-14 and EU-27 countries. At the same time, the import dependency of the country was higher than EU-11 average - 98% versus 92%.

Item 219: Oil sector in Ireland



Source: Eurostat data for 2018, extracted in 2020. Detail references: Oil production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Import dependence above 100% has been rounded to 100%

The final consumption of oil per capita in Ireland increased from 1.26 toe per capita in 1995 to 1.81 toe per capita in 2005 and then dropped to 1.24 toe per capita in 2018. The level of final consumption per capita remained higher than the one for EU-11, EU-14 and EU-27.

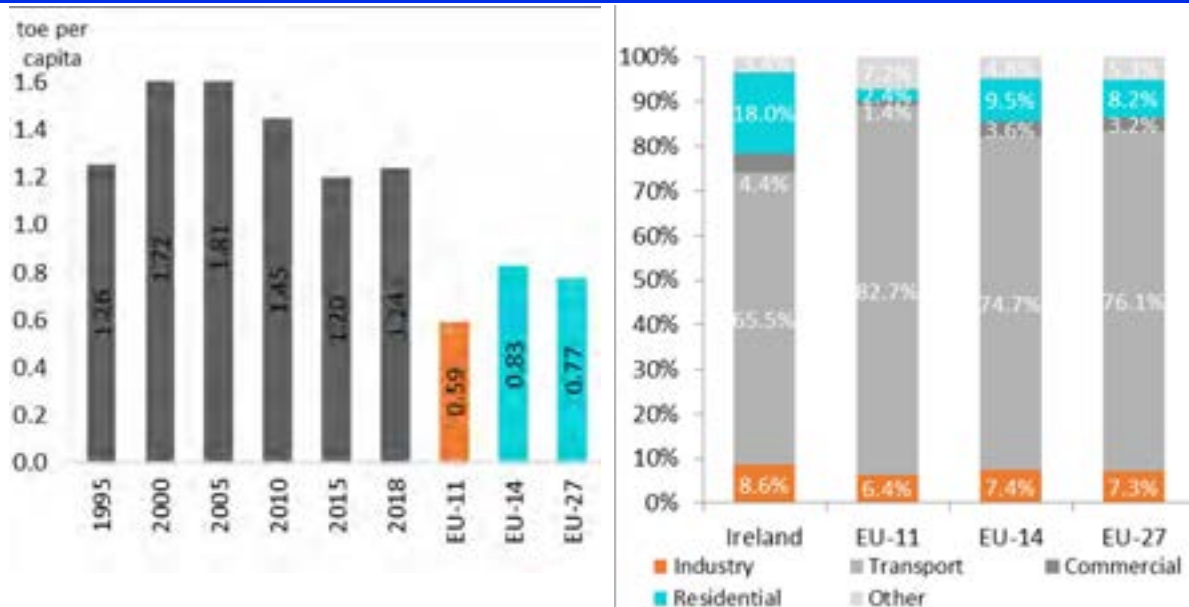
Oil consumption was dominated by transport sector, but its share was lower than EU-14 average - 65.5% versus 74.7% in EU-14 countries. Relatively more oil was used in industry - 8.6% versus 7.4% and in commercial sector - 4.4% versus 3.6%. The residential use of oil was also higher than EU-14 average - 18.0% versus 9.5%.

The relative consumption of oil in Ireland compared to EU-11 was lower in 2018 - 65.5% versus 82.7%. The use in industry was relatively higher - 8.6% versus 6.4%. At the same time commercial and residential sector were consuming relatively more oil in the country than EU-11 averages - 4.4% and 18.0% versus 1.4% and 2.4%.

Item 220: Final consumption of oil per capita in Ireland in 1995-2018 and oil final consumption by sectors in Ireland and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of oil per capita in Ireland (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Oil final consumption by sectors in Ireland and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Errors in summation to 100% are due to rounding

10.8 EU climate policy and its targets for Ireland

Ireland is subject to EU energy and climate regulations and therefore, specific targets were set and verified regarding greenhouse gas emission, share of energy from renewable energy sources and energy efficiency improvements (see Item 221).

Item 221: Energy and climate targets for Ireland for 2020 and 2030

| | Ireland 2020 targets | Ireland 2030 targets |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | EU wide target of 20% reduction from 1990 levels (14% from 2005 level) | EU wide target of 40% reduction from 1990 levels |
| Greenhouse gas emissions in ETS | EU wide target of 21% reduction from 2005 | EU wide target of 43% reduction from 2005 |
| National emission reduction targets in non-ETS - Effort Sharing Decision (ESD) | -20% in relation to their 2005 levels | - |
| National emission reduction targets in non-ETS - Effort Sharing Regulations (ESR) | - | -30% in relation to their 2005 levels |
| Share of energy from renewable energy sources | EU wide target of 20% energy from renewables | EU wide target of minimum 32% share for renewable energy |
| EU wide target of share of energy from renewable energy sources | EU wide target of 20% share of gross final energy consumption | EU wide target of 32% share of gross final energy consumption |
| National target of share of energy from renewable energy sources | 16% of gross final consumption | Not yet available |
| Improvement in energy efficiency | EU wide target of 20% improvement in energy efficiency | EU wide target of at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |
| Primary energy consumption | EU wide target < 1,483 Mtoe National target < 13.9 Mtoe | EU wide target of 1,273 Mtoe (< 1,128 Mtoe EU-27) National targets not available yet |
| Final energy consumption | EU wide target < 1,086 Mtoe National target < 11.7 Mtoe | EU wide target < 956 Mtoe (< 846 Mtoe EU-27) National targets not available yet |

Source: EU website

In following chapter, the overview of Ireland targets and performance are summarized.

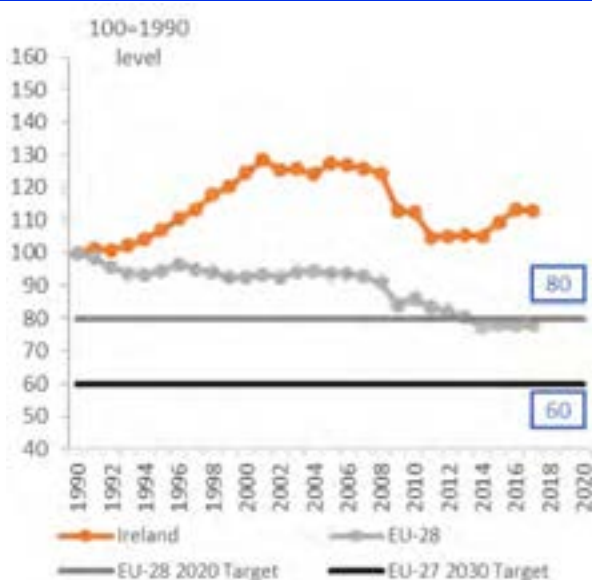
10.8.1 Greenhouse gas emissions

EU set a target for CO₂ reduction by 20% compared to 1990 level at EU level. Regardless the fact that the target was not binding for specific country, the level of CO₂ emission in Ireland was below EU wide target.

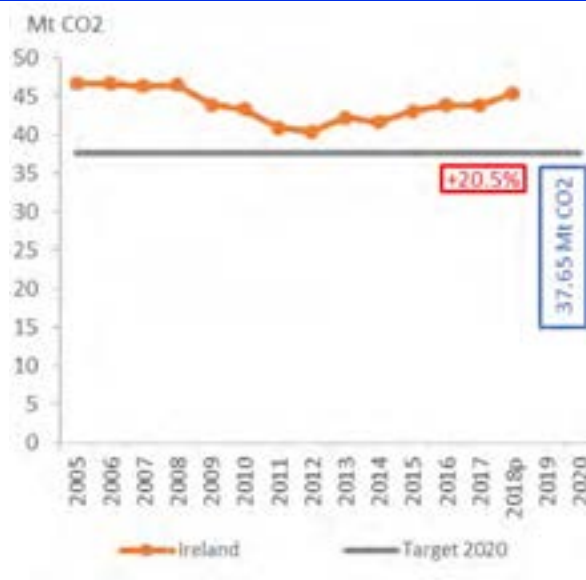
The non-ETS greenhouse gas emissions the binding national targets for Ireland as 37.65 Mt of CO₂ equivalent emissions. Comparing to 2018 provisional results the level of emissions exceeded the target by 20.5%.

Item 222: Energy efficiency target data for Ireland

Greenhouse gas emissions level in Ireland and EU-28, base year 1990, and EU 2020 target



Greenhouse gas emissions in Effort Sharing Decision (ESD) sectors



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Greenhouse gas emissions, base year 1990 [T2020_30], Greenhouse gas emissions in ESD sectors [T2020_35]

10.8.2 Renewable energy sources

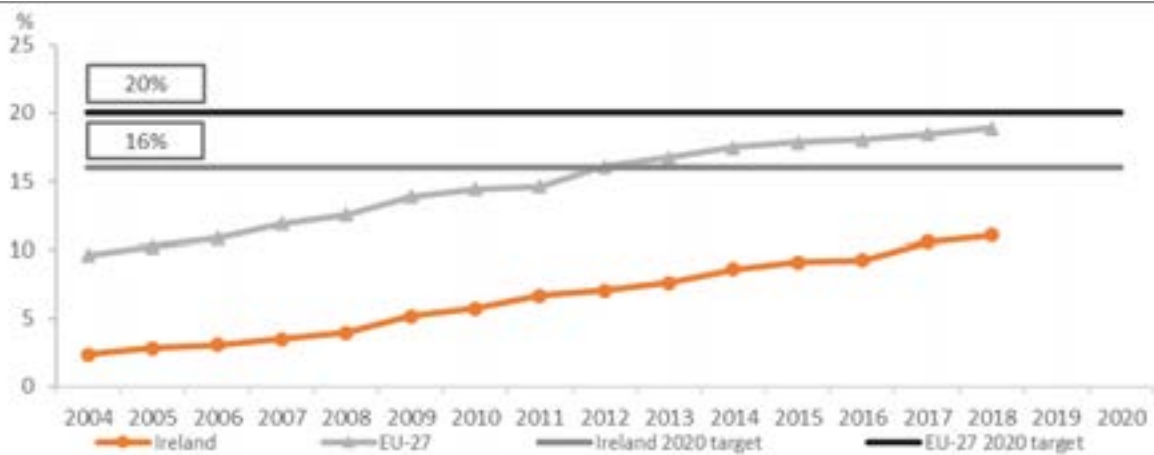
The following targets were set for Ireland regarding the share of energy from renewable energy sources in gross final energy consumption:

- a 20% share of gross final energy consumption by 2020,
- a 16% national target for share of energy from renewable sources in gross final consumption of energy in 2020.

The share of energy from renewable energy sources in Ireland was below EU wide and country specific targets in 2018.

Item 223: Share of energy from renewable energy sources in gross final energy consumption in Ireland

Share of energy from renewable energy sources in gross final energy consumption in Ireland in 2005-2018 and targets for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Share of energy from renewable sources [nrg_ind_ren]

10.8.3 Energy efficiency

The energy efficiency target set for Ireland were respectively:

- Primary Energy Consumption in 2020: 13.9 Mtoe
- Final energy consumption in 2020: 11.7 Mtoe

Following the information provided in Item 224 the results for 2018 were above the targets in both criteria, respectively +4.6% of primary energy consumption and 4.9% of final energy consumption. This does not exclude Ireland to achieve the targets in 2020.

Item 224: Energy efficiency target data for Ireland

Primary energy consumption and final energy consumption in Ireland in 2005-2018 and targets for 2020

Ratio of primary energy consumption to target for 2020 and final energy consumption to target for 2020 in Ireland, EU-11, EU-14 and EU-27 in 2018



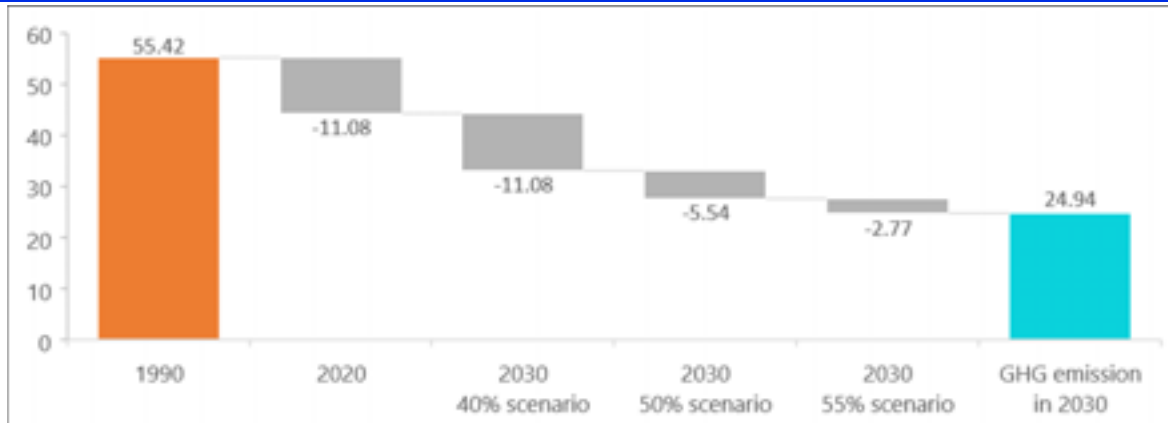
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Primary energy consumption - Primary energy consumption (Europe 2020-2030)(PEC2020-2030), final energy consumption - Final energy consumption (Europe 2020-2030) (FEC2020-2030). EU-11 and EU-14 data estimated based on Eurostat data

10.9 Review of potential impact of Green Deal propositions

At the current stage of discussions regarding the European Green Deal only partial information are available regarding the future targets. EU is proposing to increase the greenhouse gas emission reduction to 50% or 55% for 2030. This is a proposition included in the draft proposal of "Climate Law". Assuming the Ireland greenhouse gas emissions in 1990, an estimation of EU 2030 target emissions can be drafted. The 2020 target of 20% reduction resulted in 11.08 Mt CO₂ emission drop. Further increase of the target to 40% in 2030 require additional 11.08 Mt CO₂ reduction. If the 50% target proposed under European Green Deal is applied then additional 5.54 Mt CO₂ emission decrease is needed, or 8.31 Mt CO₂ decrease, if 55% target is adopted.

Item 225: Estimation regarding greenhouse gas emissions in Ireland under different scenarios (Mt CO₂)

Estimation regarding greenhouse gas emissions in Ireland under different scenarios (Mt CO₂)



Source: Eurostat data for 2018, extracted in 2020. Estimations delivered by the Author

Nevertheless, it is worth to highlight that, if the current structure of greenhouse gas emissions target is maintain, then the 50% target for 2030 is an EU wide target. It is not a binding element for specific countries. Country specific targets could be expected as per ESD and ESR but there is no way to anticipate the potential targets.

At the same time, the review of key EU regulations around climate and energy as:

- Emissions Trading System Directive;
- Effort Sharing Regulation;
- Land use, land use change and forestry Regulation;
- Energy Efficiency Directive;
- Renewable Energy Directive;
- CO₂ emissions performance standards for cars and vans
- Energy Taxation Directive

can bring some additional targets in area of share of energy from renewable energy sources and energy efficiency. For the moment, any estimation of potential targets is not available nor possible to estimate.



11 Italy

11.1 General information

Italy is the sixth biggest country within EU-14 group in terms of total country area and represents 9.8% of the area. At the same time, it is the 7th country in EU-27 with 7.1% of the area. It represents 17.7% of EU-14 population and 16.3% of EU-27 population, but 14.6% of its total nominal GDP of EU-14 and 13.1% of EU-27. Despite the robust economic growth in 1995-2018 period, in 2018 Italian GDP per capita amounted to 97% of the whole EU average (126% in 1995).

Item 226: Italy - key data



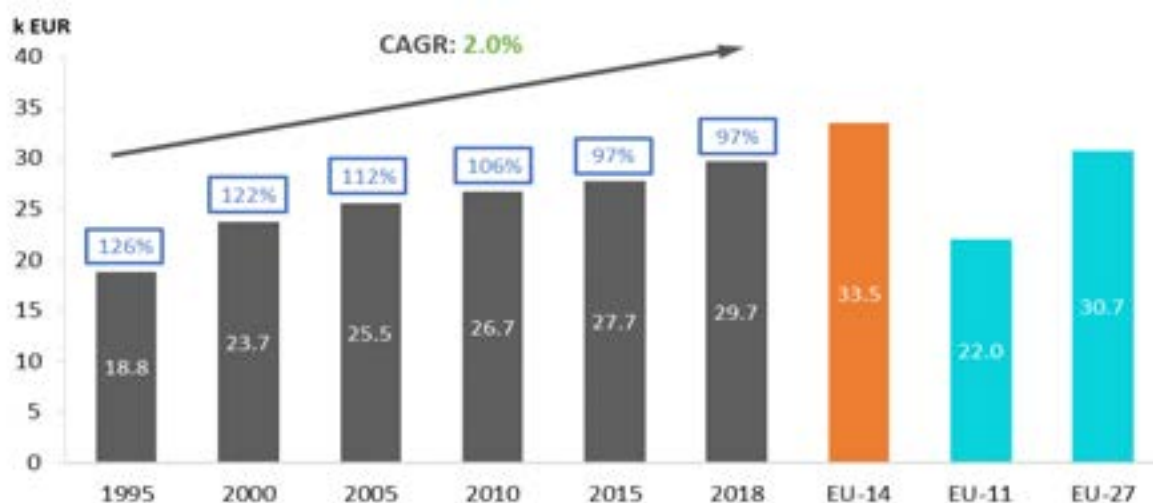
Key data

| | |
|------------------------------------------------------|--------|
| Population (M) | 60.5 |
| GDP per capita (EUR, nominal) | 29,210 |
| GDP per capita (EUR, PPS) | 29,670 |
| GDP as share of EU-14 | 14.6% |
| GDP as share of EU-27 | 13.1% |
| Energy intensity of the economy (kgoe per 1,000 EUR) | 90.8 |
| Greenhouse gas emissions (Mg per capita) | 7.1 |

Source: Eurostat data for 2018, extracted in 2020

With the compounded annual growth rate amounting to 2.0% Italian economy considerably grew in the period of 1995-2018 (see Item 227). Its GDP per capita was above EU-14 and EU-27 averages (equal to 89% and 97% of the respective averages). Its GDP per capita was also 135% of the average GDP per capita for EU-11 countries.

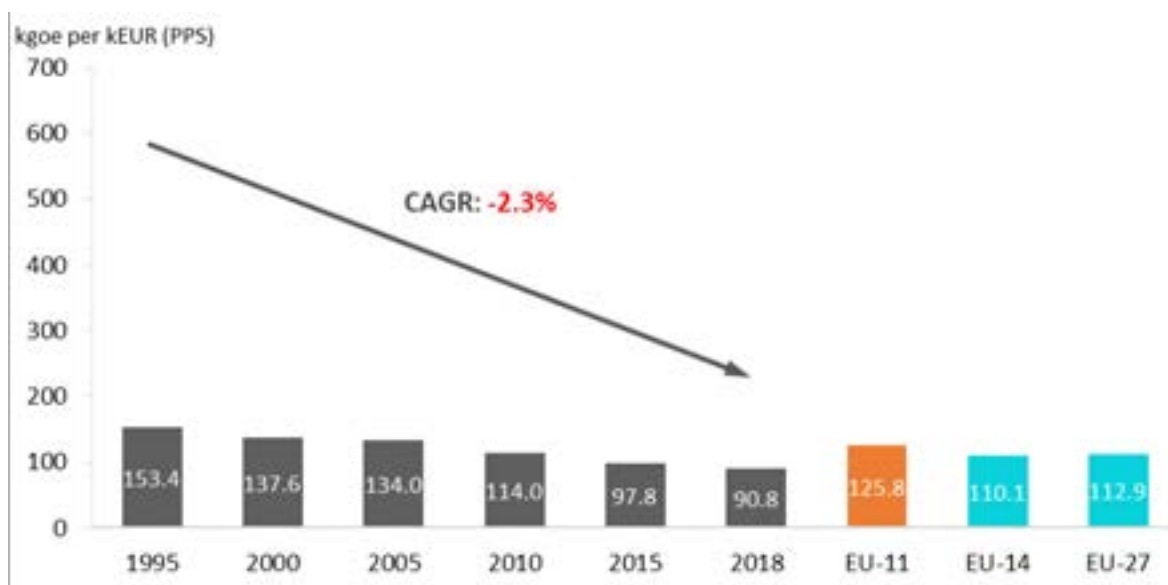
Item 227: GDP per capita in Italy for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in 2018 (kEUR, PPS) and share of Italy GDP per capita in relation to EU-27 average



Source: Eurostat data for 2018, extracted in 2020. Detail references: GDP per capita - Gross domestic product at market prices (B1GQ), Current prices, purchasing power standard per capita (CP_PPS_HAB)

The Italian economy energy intensity was about 90.8 kgoe per 1,000 EUR PPS in 2018, thanks to a decrease of the energy intensity indicator during the years 1995-2018. It dropped by 62.6 kgoe per 1,000 EUR PPS, i.e. it was reduced by about 41%. The energy intensity of Italy in 2018 represented 72% and 80% of EU-14 and EU-27 averages. At the same time, it represented 83% of EU-11 average.

Item 228: Energy intensity of the economy in Italy in 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)



Source: Eurostat data for 2018, extracted in 2020. Values for EU-11 and EU-14 were recalculated based on energy intensity and GDP data from Eurostat. Detail references: Energy intensity of GDP in purchasing power standards (PPS) - EI_GDP_PPS

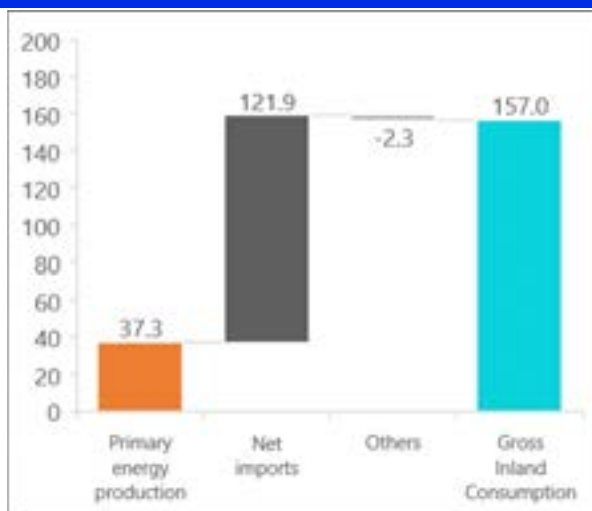
11.2 Energy balance of Italy

The energy balance of Italy in 2018 was presented in Item 229. The primary energy production was equal to 37.3 Mtoe in 2018. Net imports added 121.9 Mtoe to the balance. The total gross inland consumption accounted for 157.0 Mtoe. The level of import of energy to Italy grew slowly up to 2005 and then dropped to the level of 2018. At the same time the level of net import reported to the energy needs followed similar pattern to end up at the level of about 77% in 2018.

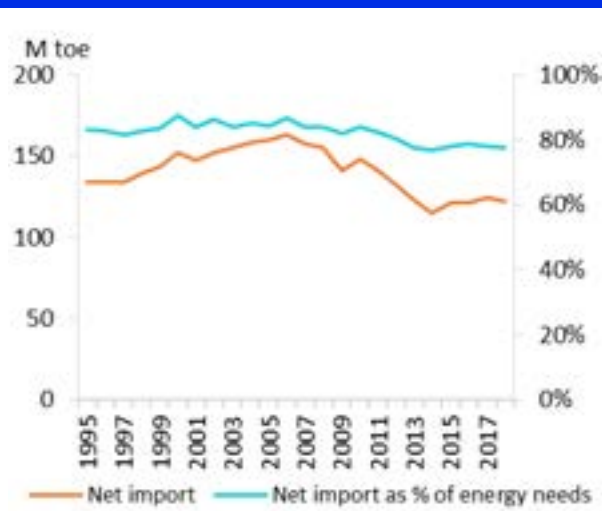
The primary energy production increased over past 23 years whereas gross energy consumption decreased. National production was meeting only 24% of the country gross consumption and this factor increased over last 23 years from 18%.

Item 229: Energy balance in Italy

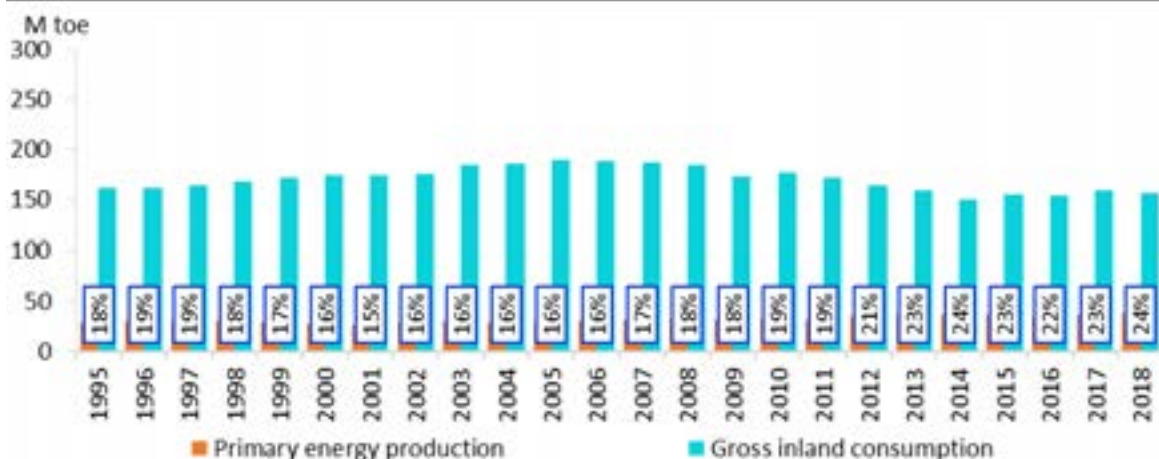
Energy balance in Italy in 2018 (Mtoe)



Net import of energy in Italy in 1995-2018 (Mtoe and as percentage of GIC)



Gross inland consumption, primary energy production (Mtoe) and ratio of primary energy production to gross inland consumption in 1995-2018 in Italy (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Gross inland consumption - GIC. Net imports = Import (IMP) - Export (EXP), Other = Change in stock (STK-CHG) - International maritime bunkers (INTMARB)

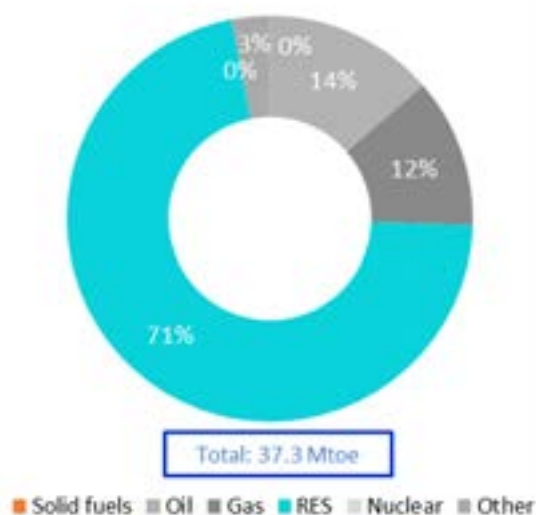
The primary energy production in Italy was dominated by renewable energy sources. About 71% of the total production came from RES. The mix was completed by 14% share of oil and 12% share of gas in the mix. Usage of solid fuels and nuclear energy was null.

When compared to the European averages, Italy was characterized by very high share of renewable energy sources in the energy mix - 71% versus 38% EU-14 average and 34% EU-27 average. The share of gas in the Italian fuel mix was higher than in EU-14 and EU-27 (12% versus 9% in EU-14 and EU-27). The share of oil was also higher in Italy than the averages for EU-14 and EU-27 (14% versus 4% and 5%). In opposite to EU averages Italy was not using solid fuels and nuclear energy for primary energy production.

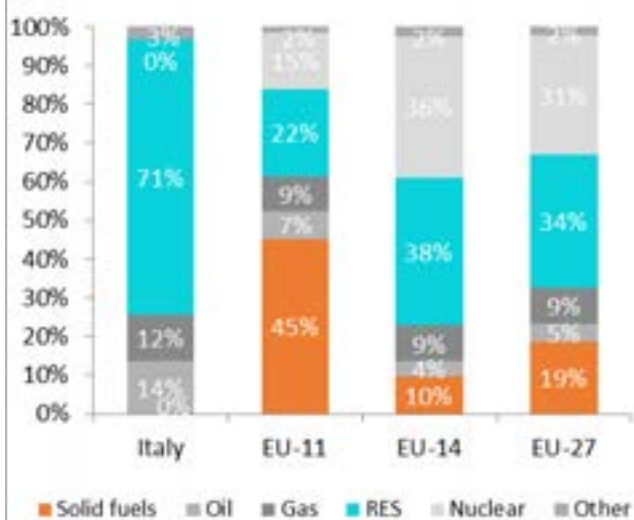
The comparison of Italy to EU-11 averages was mainly characterized by much higher share of RES (71% versus 22%), lack of solid fuels use in Italy (versus 45% in EU-11) and absence of nuclear energy in the energy mix (15% in EU-11). The shares of oil and gas were higher in Italy than in EU-11 countries.

Item 230: Primary energy structure in Italy

Primary energy structure in Italy in 2018 (%)



Primary energy production structure in Italy in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

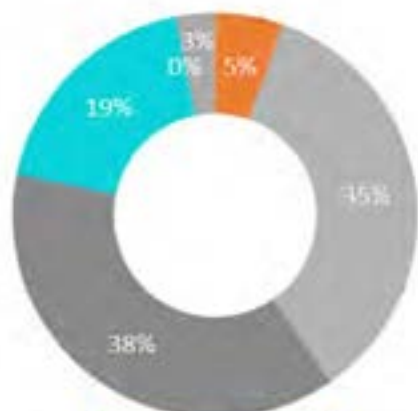
Gross inland consumption of energy in Italy was dominated by gas (38%), oil (35%) and renewable energy sources (19%). The mix was completed by 5% of solid fuels and 4% of other energy sources.

Comparing to European averages gross inland consumption of energy in Italy was marked by low share of solid fuels (5% versus 11% in EU-14 and 14% in EU-27). The share of oil was similar in Italy (35%) as in EU-14 (35%) and EU-27 (34%) whereas the share of gas was higher (38% versus 23% and 22%). Italy as characterized by higher share of renewable energy sources in the mix - 19% versus 16% and 15% in EU-14 and EU-27 respectively, and lack of nuclear energy in the mix (versus 14% in EU-14 and 13% in EU-27).

When compared to EU-11 the main difference was around much lower share of solid fuels consumption in Italy (5% versus 30% in EU-11) and higher share of renewable energy sources (19% versus 12%). The share of oil and gas use in Italy were also higher than in EU-11 countries (35% versus 29% and 38% versus 19% respectively). EU-11 average gross final consumption included nuclear energy at 8%. Italy was not using nuclear energy.

Item 231: Gross inland consumption structure in Italy

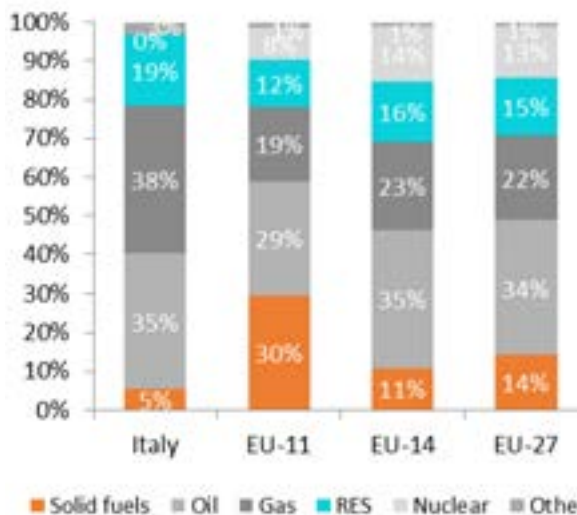
Gross inland consumption structure in Italy in 2018 (%)



Total: 157.0 Mtoe

Legend: Solid fuels, Oil, Gas, RES, Nuclear, Other

Gross inland consumption structure in Italy in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gross inland consumption - GIC, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

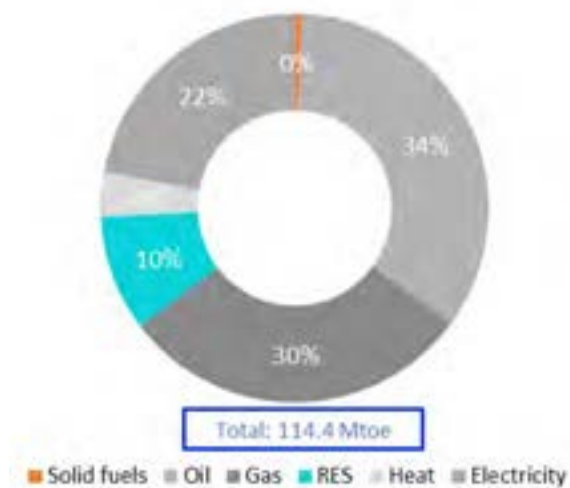
The final energy consumption in Italy was dominated by oil (37%), followed by gas (30%), electricity (22%) and renewable energy sources (10%). The mix was completed by heat (4%).

The sectoral final energy consumption in Italy was characterized by lower share of industrial and the same of transport sectors than in EU-14 and EU-27 (21% and 31% versus 26% and 31% in EU-14 and EU-27). The share of commercial and public services was higher in final energy consumption in Italy (17%) than in EU-14 (15%) and EU-27 (14%).

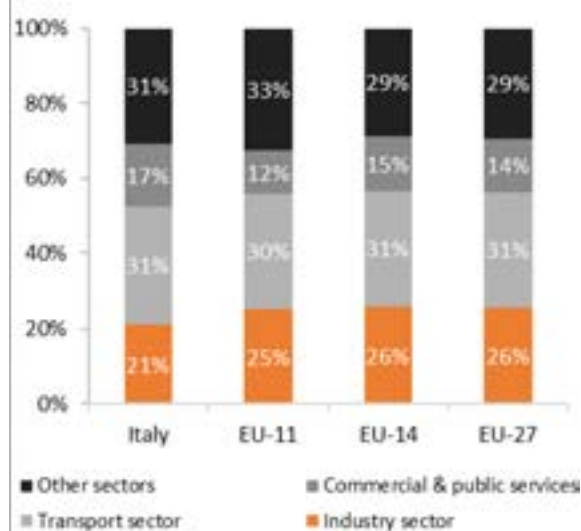
When compared to EU-11 Italy similar conclusions as related to EU-14 and EU-27 can be drawn.

Item 232: Final energy consumption structure in Italy

Final energy consumption structure in Italy in 2018 (%)



Final energy consumption structure in Italy in 2018 in comparison with EU-11, EU-14, and EU-27 averages



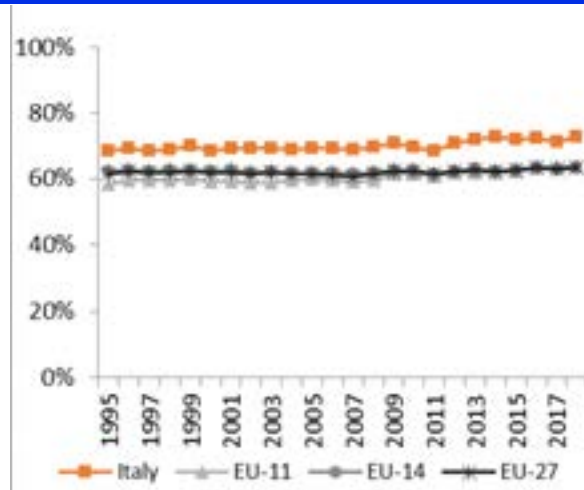
Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Heat (H8000), Electricity (E7000), Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial & public services - FC_OTH_CP_E, Other - FC_OTH_E-FC_OTH_CP_E. Errors in summation to 100% are due to rounding

Italian final energy consumption to gross inland consumption ratio which measure energy efficiency was higher than the averages for EU-11, EU-14 and EU-27. The situation remained stable for last 23 years.

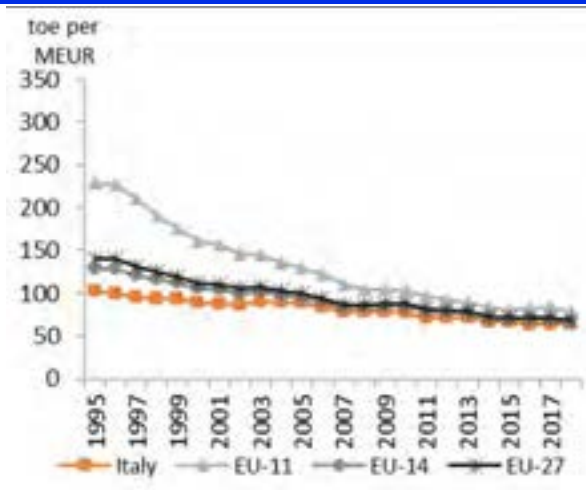
Simultaneously, a decrease of energy volume associated with generating gross domestic product was noticed in line with the averages for EU-14 and EU-27 averages but the starting values were lower.

Item 233: Final energy consumption in Italy in relation to selected indicators

Final energy consumption to gross inland consumption ratio in Italy in 1995-2018 (%)



Final energy consumption to gross domestic product ratio in Italy in 1995-2018 in comparison with EU-11, EU-14, and EU-27 averages (toe per M EUR)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final energy consumption - FEC, Gross inland consumption - GIC, Gross Domestic Product - Gross domestic product at market prices B1GQ, Current prices - CP-MEUR

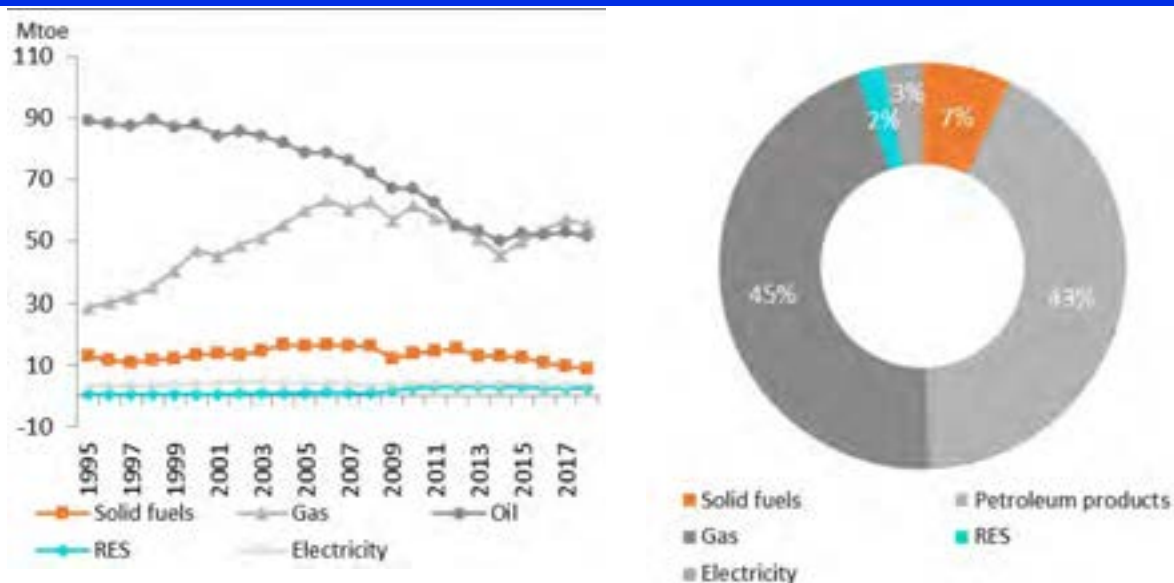
Net import of energy to Italy by fuels was characterized by a decrease of oil imports and an increase of gas import. The level of solid fuels import was slowly decreasing.

The import structure of energy to Italy was dominated by oil (43%) and gas (45%). The imports were completed by 7% of solid fuels, 3% of electricity and 2% of renewable energy sources.

Item 234: Net import of energy in Italy

Net import of energy by fuel in 1995-2018 (Mtoe)

Net import structure in 2018 (% , only fuels for which import is greater than export)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Electricity (E7000). Errors in summation to 100% are due to rounding

Solid fuels were imported to Italy mainly from Russia (34%), USA (24%), Colombia (19%) and several other countries.

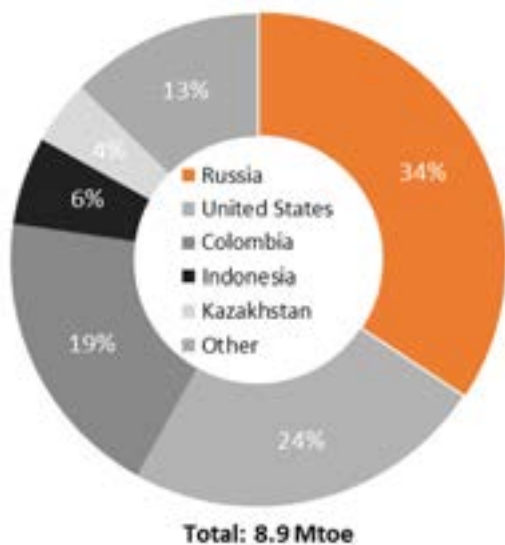
Main oil importers to Italy were Azerbaijan (15%), Saudi Arabia (12%), Iraq (11%) and Russia (11%). The remaining 51% were imported from various locations.

Italy was importing gas mainly from Russia (43%), Algeria (25%) and Qatar (17%). The remaining 15% were supplied from different locations.

Electricity as mainly imported from Switzerland (48%), France (33%) and Slovenia (14%). The electricity was imported also from Austria, Greece, and Malta.

Item 235: Foreign fuel suppliers

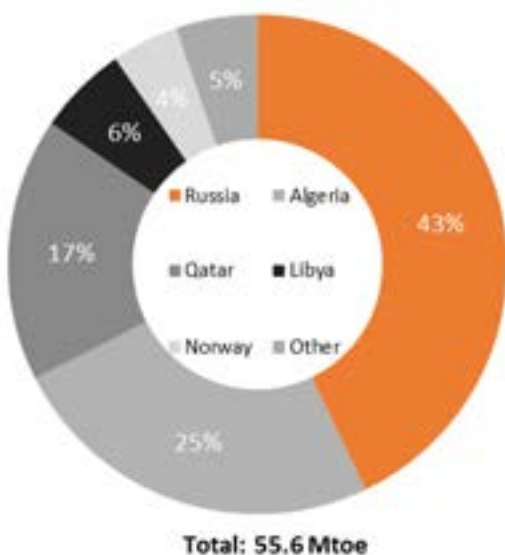
Foreign suppliers of solid fuels in Italy in 2018 (%)



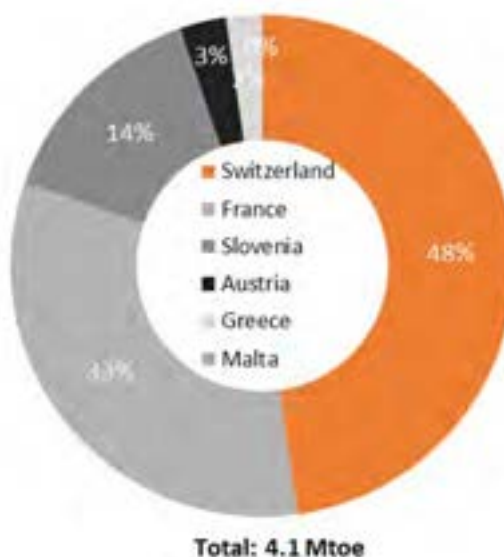
Foreign suppliers of crude oil in Italy in 2018(%)



Foreign suppliers of gas in Italy in 2018 (%)



Foreign suppliers of electricity in Italy in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fossil fuels - C000X0350-0370, Gas - Natural gas (G3000), Oil - Oil and petroleum products (excluding biofuel portion) (O4000XBIO), Electricity - E7000. Errors in summation to 100% are due to rounding

11.3 Greenhouse gas emissions

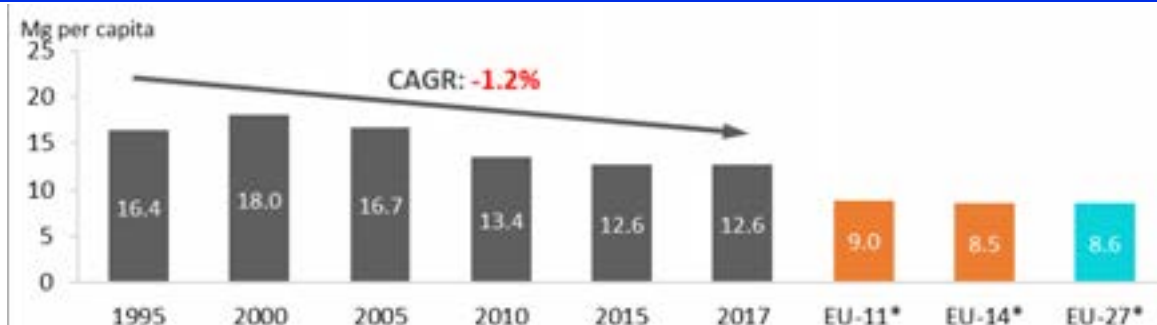
Between 1995-2017 greenhouse gases emissions in Italy were decreased - from over 517.8 Mt CO₂ in 1995 to 427.7 Mt CO₂ in 2017. Consequently, average emissions per capita decreased to 7.1 Mg CO₂ per capita in 2017 (from 9.4 Mg CO₂ per capita in 1995), which was lower comparing to EU-14 and EU-27 averages (8.5 Mg CO₂ per capita and 8.6 Mg CO₂ per capita, respectively), and also lower than in EU-11 (9.0 Mg CO₂ per capita)

There were some noteworthy changes in the Italian structure of greenhouse gas emissions over the period considered. The significance of manufacturing and construction emissions dropped swiftly by 44%, as well as emissions from energy industries 26%. All other sectors share of emissions of GHG also decreased over last 23 years.

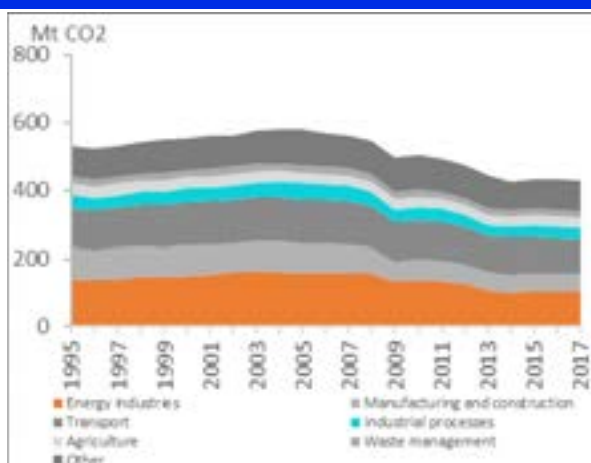
Comparing to EU-11, EU-14 and EU-27 countries, Italy had a very similar greenhouse gas emissions structure as the European averages.

Item 236: Greenhouse gas emissions in Italy

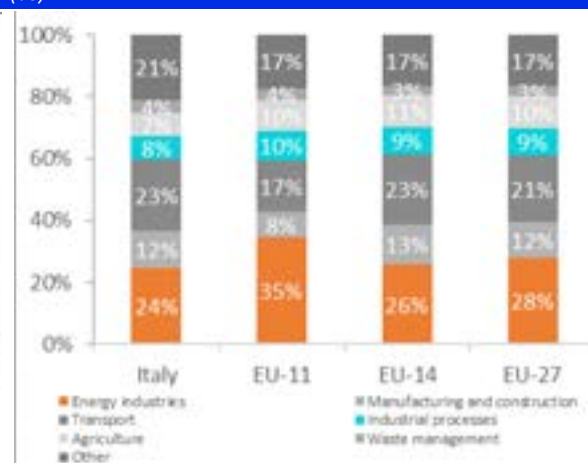
Greenhouse gas emissions per capita in Italy in 1995-2017 in comparison with EU-11, EU-14 and EU-27 averages in 2017 (Mg per capita)



Greenhouse gas emissions in Italy by sectors in 1995-2017 (Mt CO₂)



Greenhouse gas emissions in Italy by sectors in 2017 in comparison with EU-11, EU-14 and EU-27 averages (%)



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - * values for EU-11, EU-14 and EU-27 recalculated by the Author; Energy industry - Fuel combustion in energy industries (CRF1A1), Manufacturing and construction - Fuel combustion in manufacturing industries and construction (CRF1A2), Transport - Fuel combustion in transport (CRF1A3), Industrial processes - Industrial processes and product use (CRF2), Agriculture - Agriculture (CRF3), Waste management - Waste management (CRF5), Other = Other fuel combustion sectors (CRF1A4)+ Other fuel combustion sectors n.e.c. (CRF1A5) + Fuels - fugitive emissions (CRF1B)+Other sectors (CRF6); Total GHG emissions equal to All sectors (excluding LULUCF and memo items) (CRF1-6X4_MEMO) i.e. emission from all sectors excluding Land use, land use change, and

forestry (LULUCF), Transport and storage of CO₂ (memo item), International aviation (memo item), International navigation (memo item), Multilateral operations (memo item), Biomass - CO₂ emissions (memo item). Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. Errors in summation to 100% are due to rounding

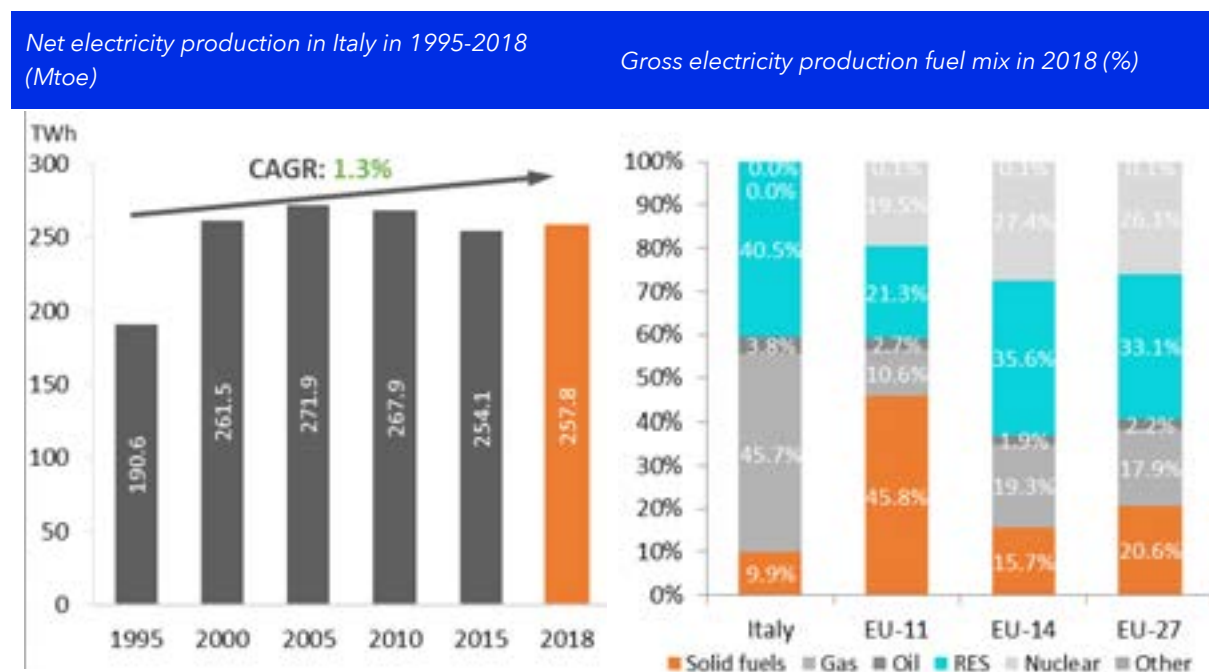
11.4 Overview of electricity sector

Item 237 presents electricity production and the current fuel mix of Italy. Over last 23 years net electricity production increased from 190.6 TWh in 1995 to 257.8 TWh in 2018 (CAGR 1.3%). As visible, net electricity production represented 12.0% of EU-14 total electricity production, which was lower compared to Italian GDP share of 14.6%.

The Italian fuel mix was dominated by gas and renewable energy sources with shares of 45.7% and 40.5% respectively. The mix was completed by 9.9% of solid fuels and 3.8% of oil. Compared to EU-14 and EU-27 countries, Italy had a much bigger share of renewable energy sources and gas in its energy mix. On other hand, the country produced relatively less electricity from solid fuels (9.9% versus 15.7%) but more from oil (3.8% versus 1.9%). Italy did not use nuclear energy to produce electricity whereas it represented 27.4% of EU-14 productions.

When compared to EU-11 average fuel mix one can notice much higher share of renewable energy sources and gas used in Italy than in EU-11 (40.5% and 45.7% versus 21.3% and 10.6%) and significantly lower use of solid fuels (9.9% versus 45.8%). The share of oil was higher (3.8% versus 2.7%). Italy did not use nuclear energy to produce electricity whereas it represents 19.5% of EU-11 productions.

Item 237: Net electricity production and gross electricity production fuel mix in Italy



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Electricity Production - NEP, Gross Electricity Production - GEP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear

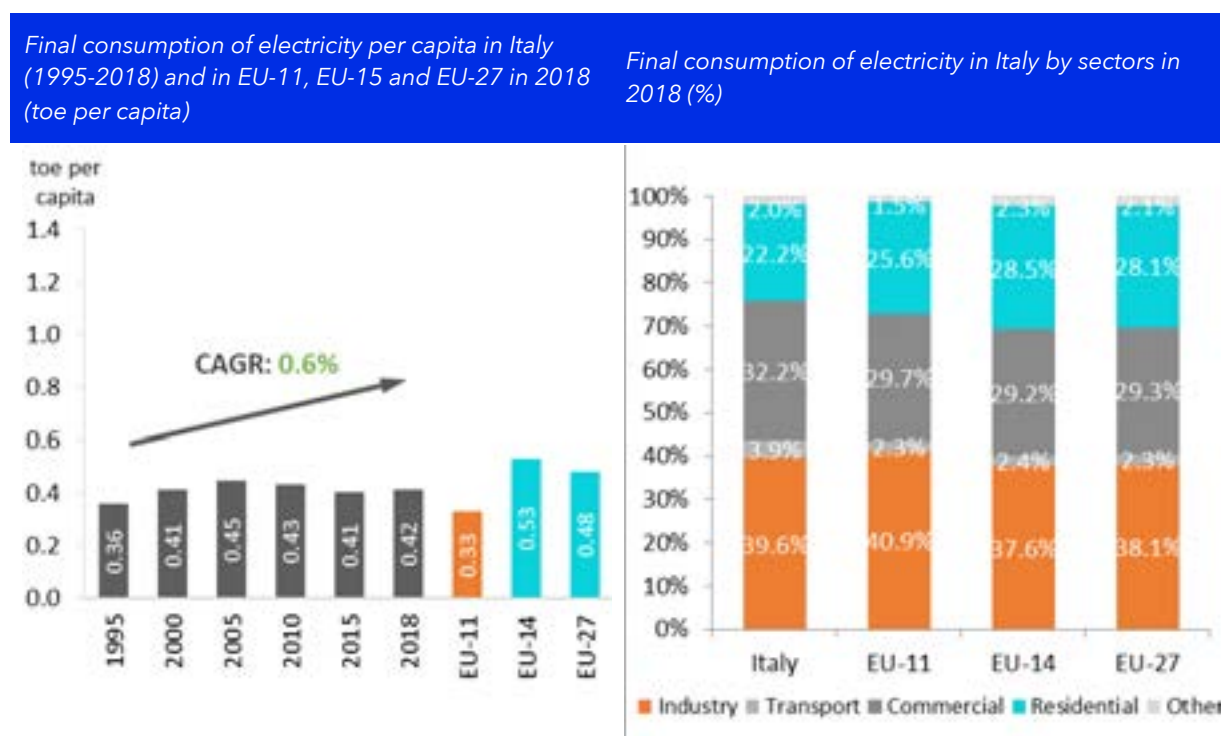
= Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

In Item 238 the evolution of final per capita consumption of electricity and its breakdown by economic sector is presented. In recent years final consumption of electricity in Italy increased (CAGR in the period of 1995-2019 was around 0.6%) and its level was lower compared to EU-14 and EU-27 countries. Italian final energy consumption per capita represented 78.5% of EU-14 level and 86.1% of EU-27 level.

The structure of final electricity consumption in Italy was dominated by industry (39.6% versus 37.6% in EU-14 countries). Relatively more energy was used in transport (3.9% versus 2.4%) and in commercial sector (32.2% versus 29.2%). Relatively less energy was used in the Italian residential sector than in EU-14 (22.2% versus 28.5%).

Italy was consuming relatively less electricity in industry sector than EU-11 countries (39.6% versus 40.9%) and residential one (22.2% versus 25.6%). At the same time, it used relatively more electricity in transport and commercial sectors (3.9% and 32.3% versus 2.3% and 29.7%).

Item 238: Final consumption of electricity in Italy



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Electricity E7000. Errors in summation to 100% are due to rounding

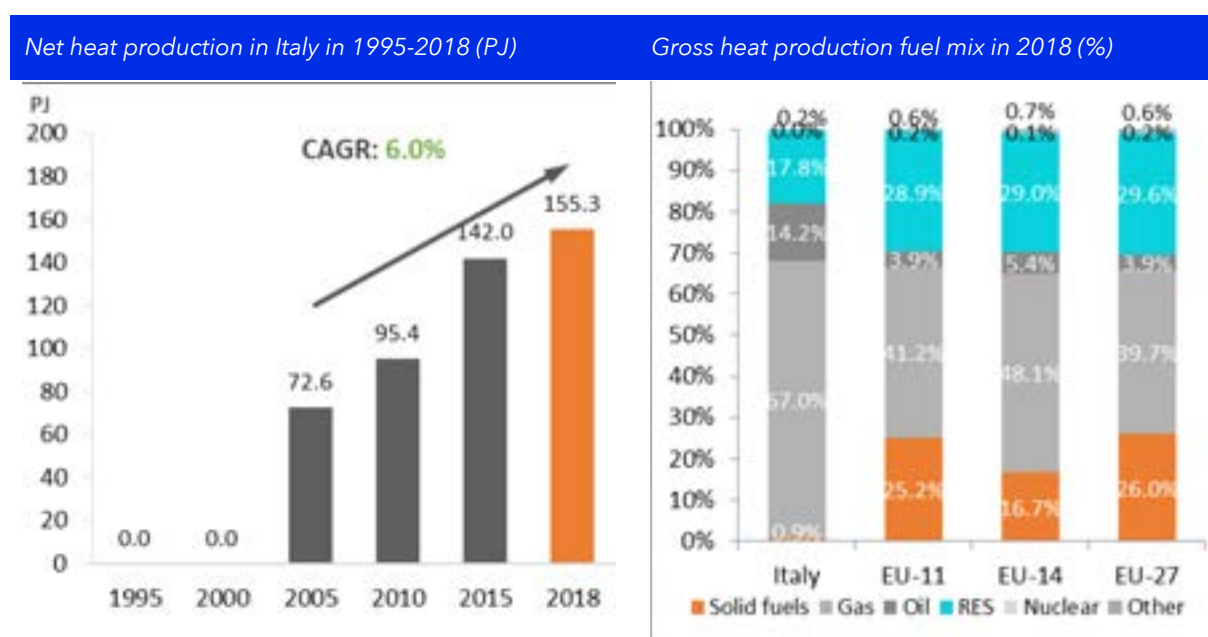
11.5 Overview of heat sector

Item 239 presents heat production and the current fuel mix of Italy. Over last 23 years net heat production increased from <0.1 PJ in 1995 to 155.3 PJ in 2018 (CAGR 6.0%).

The Italian fuel mix of heat production was dominated by gas with share of 67.0%. The mix was completed by 17.8% of renewable energy sources, 14.2% of oil and 0.9% of solid fuels. Compared to EU-14 and EU-27 countries, Italy had a much bigger share of gas in its heat production mix. On other hand, the country produced relatively less heat from solid fuels and renewable energy sources, respectively 0.9% and 17.8%. The share of oil was higher - 14.2% versus 5.4% in EU-14. Italy did not use nuclear energy for heat production where some heat was produced in nuclear facilities in EU-14 countries (0.1%).

When compared to EU-11 average fuel mix one can notice much higher share of gas used in Italy than in EU-11 (67.0% versus 41.2%) and significantly lower use of solid fuels (0.9% versus 25.2%). The share of oil was higher in Italy (14.2% versus 3.9%) but the share of renewable energy sources was lower (17.8% versus 28.9%). Italy was not using nuclear energy for heat generation in opposite to EU-11 where the share of nuclear was 0.2%.

Item 239: Net heat production and gross electricity production fuel mix in Italy



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Heat Production - NHP, Gross Heat Production - GHP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

Item 240 presents final heat consumption per capita and its breakdown by sectors.

The per capita demand for heat in Italy increased from <0.1 toe per capita in 1995 to 0.07 toe per capita in 2018. As a result, within the 23 years analyzed, heat consumption per capita increased at CAGR of 2.1%. The heat consumption remained lower than the averages for EU-11, EU-14 and EU-27, respectively 0.13 toe per capita, 0.10 toe per capita and 0.10 toe per capita.

The structure of final consumption of heat in Italy was characterized by lower share of commercial sector (16.9% compared to 21.3% in EU-14) and lower residential usage (29.4% compared to 40.1% in EU-14). The share of industry in heat consumption was higher than the averages (52.9% compared to 37.9% in EU-14).

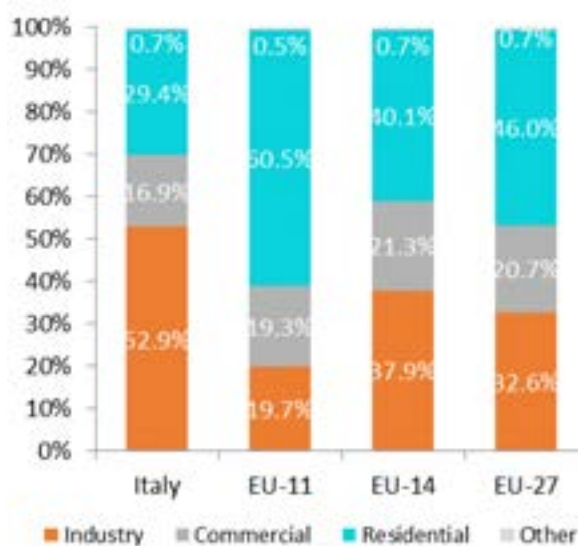
In relation to EU-11 countries, the structure of final heat consumption in Italy was characterized by lower share of residential sector (29.4% versus 60.5%) and lower share of commercial sector (16.9% versus 19.3%). The industrial use of heat consumes 52.9% of it in Italy whereas 19.7% in EU-11.

Item 240: Final consumption of heat in Italy

Final consumption of heat per capita in Italy (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)



Final consumption of heat in Italy by sectors in 2018 (%)



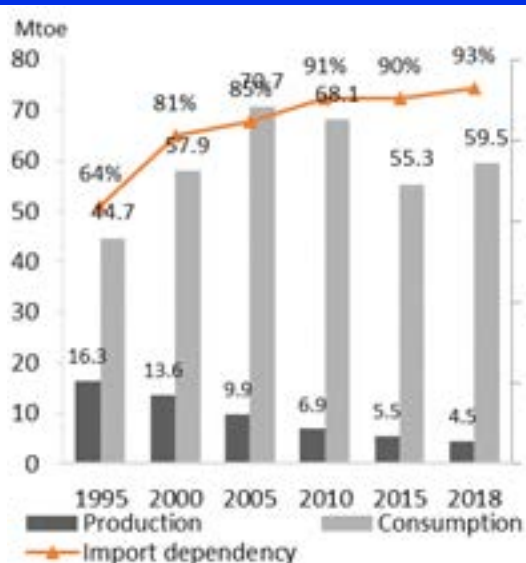
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Heat H8000. Errors in summation to 100% are due to rounding

11.6 Overview of gas sector

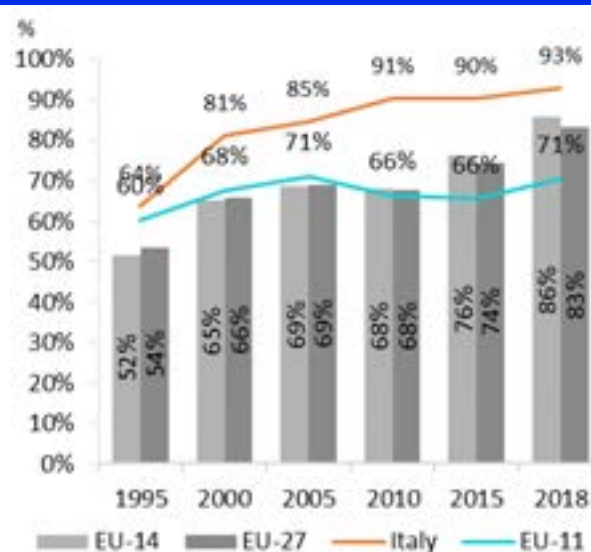
Italy consumed 59.5 Mtoe of gas in 2018. It increased from 44.7 Mtoe in 1995 to 68.1 Mtoe in 2010 and then decreased. National production accounted for 4.5 Mtoe and it decreased over past 23 years from 16.3 Mtoe to the current value. The remaining part of gas was imported. The country dependency on import was increasing from 64% to 93% over past 23 years. In 2018 the country was more dependent on import than EU-11, EU-14 and EU-27 average values.

Item 241: Gas sector in Italy

Gas production, gross consumption and import dependence in Italy in 1995-2018 (Mtoe)



Gas Import dependence in Italy and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gas production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Natural Gas G3000

The final consumption of gas per capita in Italy decreased from 0.59 toe per capita to 0.56 toe per capita over past 23 years. This value was higher than the average values for EU-14, EU-11 and EU-27 countries.

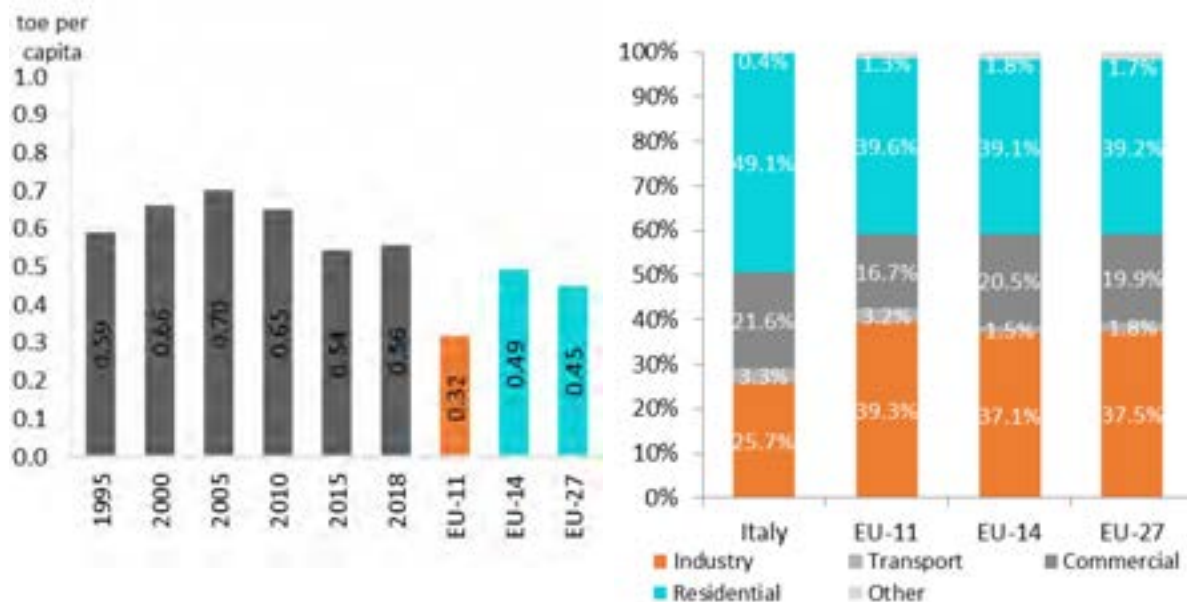
The structure of final gas consumption in Italy in 2018 was characterized by lower share of industry - 25.7% versus 37.1% in EU-14. The share of use of gas in transport, commercial and residential applications were lower than the averages for EU-14 countries, 3.3% versus 1.5%, 21.6% versus 20.5% and 49.1% versus 39.1% respectively.

When compared to EU-11 countries, Italy was using relatively less gas industry than EU-11 countries - 25.7% versus 39.3%. The country was using more gas in transport - 3.3% versus 3.2%. At the same time the share of gas used in commercial and residential sectors was higher than in EU-11 countries, 21.6% versus 16.7% and 49.1% versus 39.6% respectively.

Item 242: Final consumption of gas per capita in Italy in 1995-2018 and gas final consumption by sectors in Italy and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of gas per capita in Italy (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Gas final consumption by sectors in Italy and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Natural Gas G3000. Errors in summation to 100% are due to rounding

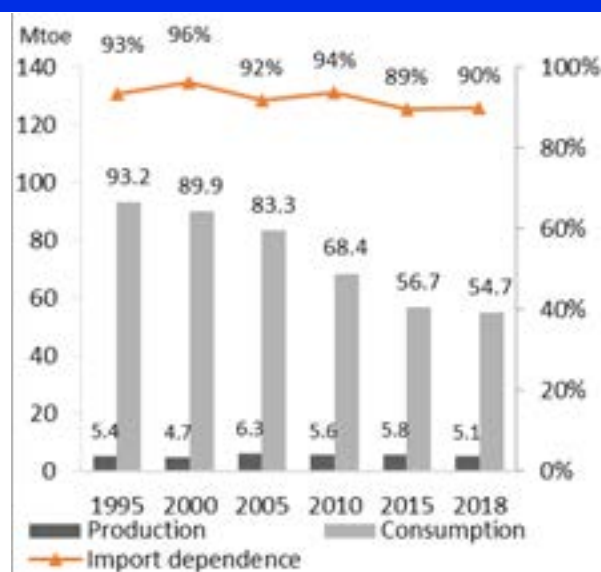
11.7 Overview of oil sector

The oil consumption of Italy dropped from 93.2 Mtoe in 1995 to 54.7 Mtoe in 2018. At the same time the national production dropped from 5.4 Mtoe to 5.1 Mtoe. Therefore, the level of import dependency was high - between 89% and 96%.

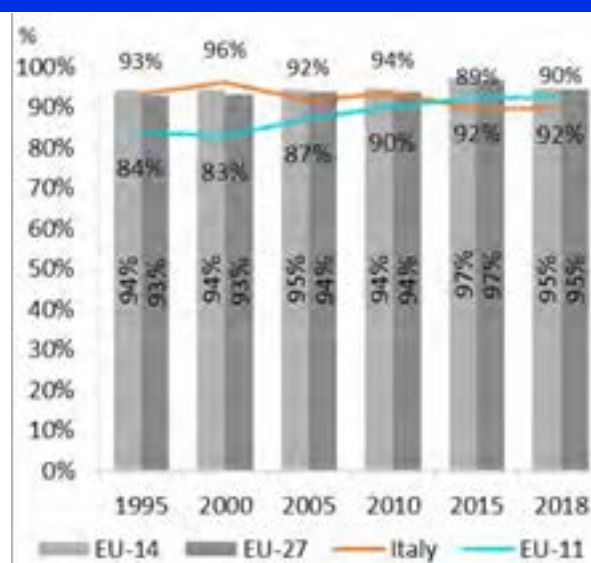
When compared to EU-14 and EU-27 average import dependency, the country had a lower import dependency of 90% versus 95% in EU-14 and EU-27 countries. At the same time, the import dependency of the country was lower than EU-11 average - 90% versus 92%.

Item 243: Oil sector in Italy

Oil production, gross consumption and import dependence in Italy in 1995-2018 (Mtoe)



Oil Import dependence in Italy and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Oil production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Import dependence above 100% has been rounded to 100%

The final consumption of oil per capita in Italy increased from 0.92 toe per capita in 1995 to 0.97 toe per capita in 2005 and then dropped to 0.65 toe per capita in 2018. The level of final consumption per capita remained higher than the one for EU-11 but lower than the averages for EU-14 and EU-27.

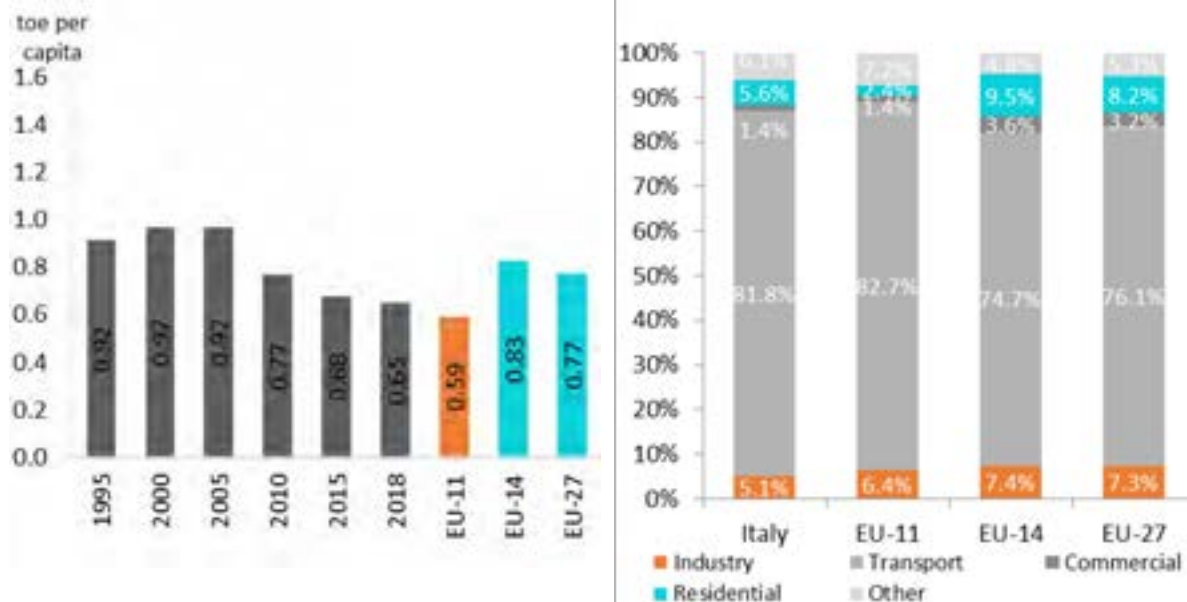
Oil consumption was dominated by transport sector - 81.8% versus 74.7% in EU-14 countries. Relatively less oil was used in industry - 5.1% versus 7.4% and in commercial sector - 1.4% versus 3.6%. The residential use of oil was also lower than EU-14 average - 5.6% versus 9.5%.

The relative consumption of oil in Italy compared to EU-11 was lower in 2018 - 81.8% versus 82.7%. The use in industry was also relatively lower - 5.1% versus 6.4%. At the same time residential sector was consuming relatively more oil in the country than EU-11 averages - 5.6% versus 2.4%. The share of oil consumption in commercial sector was the same as in EU-11 - 1.4%.

Item 244: Final consumption of oil per capita in Italy in 1995-2018 and oil final consumption by sectors in Italy and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of oil per capita in Italy (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Oil final consumption by sectors in Italy and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Errors in summation to 100% are due to rounding

11.8 EU climate policy and its targets for Italy

Italy is subject to EU energy and climate regulations and therefore, specific targets were set and verified regarding greenhouse gas emission, share of energy from renewable energy sources and energy efficiency improvements (see Item 245).

Item 245: Energy and climate targets for Italy for 2020 and 2030

| | Italy 2020 targets | Italy 2030 targets |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | EU wide target of 20% reduction from 1990 levels (14% from 2005 level) | EU wide target of 40% reduction from 1990 levels |
| Greenhouse gas emissions in ETS | EU wide target of 21% reduction from 2005 | EU wide target of 43% reduction from 2005 |
| National emission reduction targets in non-ETS - Effort Sharing Decision (ESD) | -13% in relation to their 2005 levels | - |
| National emission reduction targets in non-ETS - Effort Sharing Regulations (ESR) | - | -33% in relation to their 2005 levels |
| Share of energy from renewable energy sources | EU wide target of 20% energy from renewables | EU wide target of minimum 32% share for renewable energy |
| EU wide target of share of energy from renewable energy sources | EU wide target of 20% share of gross final energy consumption | EU wide target of 32% share of gross final energy consumption |
| National target of share of energy from renewable energy sources | 17% of gross final consumption | Not yet available |
| Improvement in energy efficiency | EU wide target of 20% improvement in energy efficiency | EU wide target of at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |
| Primary energy consumption | EU wide target < 1,483 Mtoe National target < 158.0 Mtoe | EU wide target of 1,273 Mtoe (< 1,128 Mtoe EU-27) National targets not available yet |
| Final energy consumption | EU wide target < 1,086 Mtoe National target < 124.0 Mtoe | EU wide target < 956 Mtoe (< 846 Mtoe EU-27) National targets not available yet |

Source: EU website

In following chapter, the overview of Italy targets and performance are summarized.

11.8.1 Greenhouse gas emissions

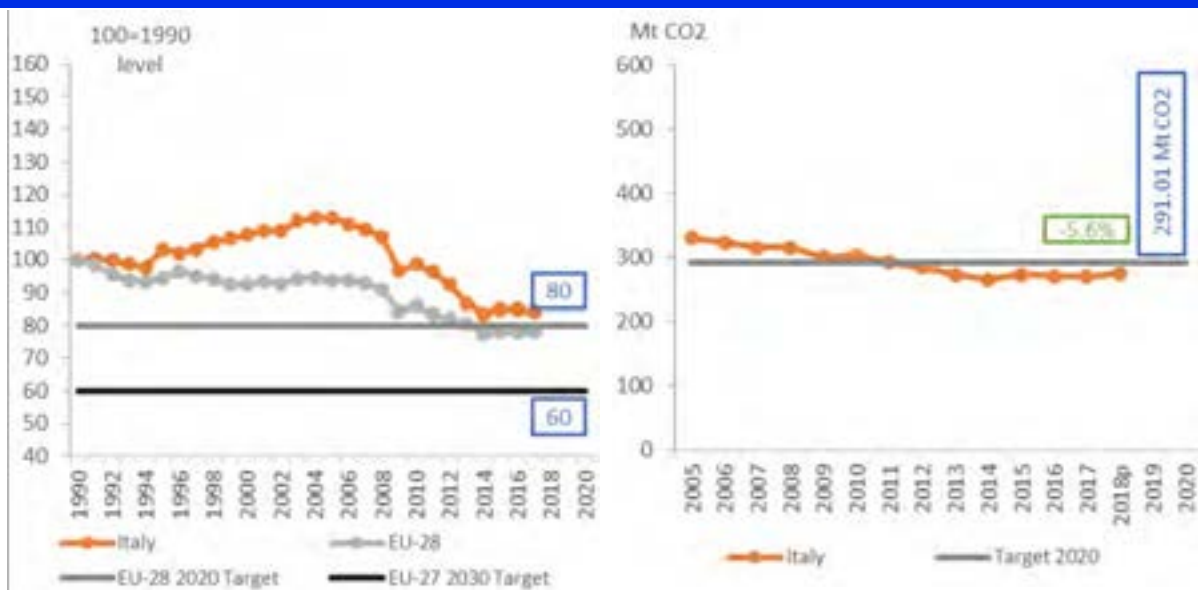
EU set a target for CO₂ reduction by 20% compared to 1990 level at EU level. Regardless the fact that the target was not binding for specific country, the level of CO₂ emission in Italy was below EU wide target.

The non-ETS greenhouse gas emissions the binding national targets for Italy was 291.01 Mt of CO₂ equivalent emissions. Comparing to 2018 provisional results the level of emissions overachieved the target by -5.6%.

Item 246: Energy efficiency target data for Italy

Greenhouse gas emissions level in Italy and EU-28, base year 1990, and EU 2020 target

Greenhouse gas emissions in Effort Sharing Decision (ESD) sectors



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Greenhouse gas emissions, base year 1990 [T2020_30], Greenhouse gas emissions in ESD sectors [T2020_35]

11.8.2 Renewable energy sources

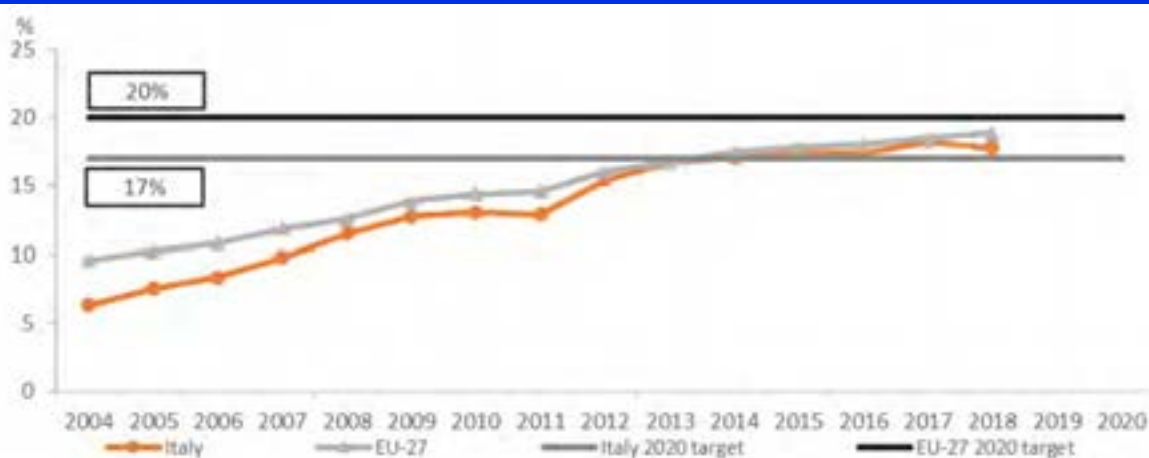
The following targets were set for Italy regarding the share of energy from renewable energy sources in gross final energy consumption:

- a 20% share of gross final energy consumption by 2020,
- a 17% national target for share of energy from renewable sources in gross final consumption of energy in 2020.

The share of energy from renewable energy sources in Italy was below EU wide and country specific targets in 2018.

Item 247: Share of energy from renewable energy sources in gross final energy consumption in Italy

Share of energy from renewable energy sources in gross final energy consumption in Italy in 2005-2018 and targets for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Share of energy from renewable sources [nrg_ind_ren]

11.8.3 Energy efficiency

The energy efficiency target set for Italy were respectively:

- Primary Energy Consumption in 2020: 158.0 Mtoe
- Final energy consumption in 2020: 124.0 Mtoe

Following the information provided in Item 248 the results for 2018 were below the targets in both criteria, respectively -6.8% of primary energy consumption and -6.1% of final energy consumption. This gives great chances to Italy to achieve the targets in 2020.

Item 248: Energy efficiency target data for Italy

Primary energy consumption and final energy consumption in Italy in 2005-2018 and targets for 2020

Ratio of primary energy consumption to target for 2020 and final energy consumption to target for 2020 in Italy, EU-11, EU-14 and EU-27 in 2018



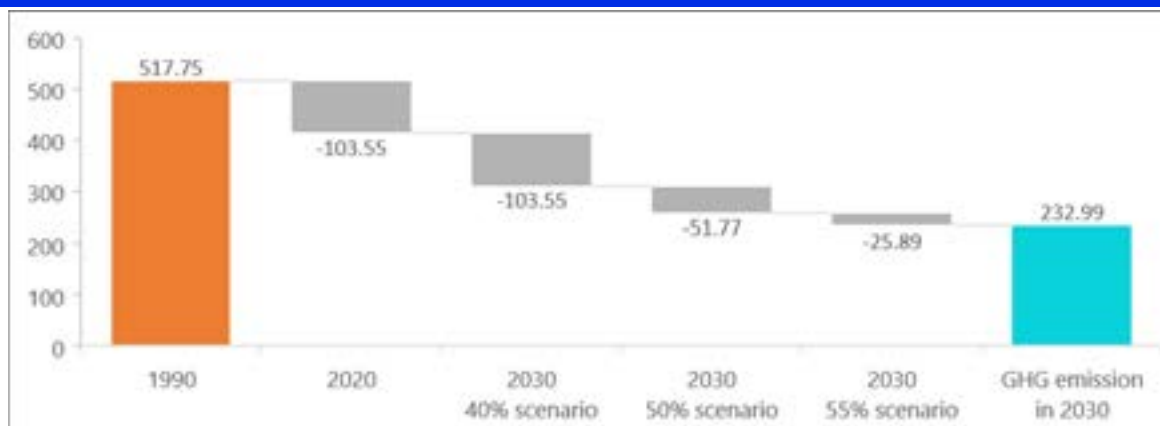
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Primary energy consumption - Primary energy consumption (Europe 2020-2030) (PEC2020-2030), final energy consumption - Final energy consumption (Europe 2020-2030) (FEC2020-2030). EU-11 and EU-14 data estimated based on Eurostat data

11.9 Review of potential impact of Green Deal propositions

At the current stage of discussions regarding the European Green Deal only partial information are available regarding the future targets. EU is proposing to increase the greenhouse gas emission reduction to 50% or 55% for 2030. This is a proposition included in the draft proposal of "Climate Law". Assuming the Italy greenhouse gas emissions in 1990, an estimation of EU 2030 target emissions can be drafted. The 2020 target of 20% reduction resulted in 103.55 Mt CO₂ emission drop. Further increase of the target to 40% in 2030 require additional 103.55 Mt CO₂ reduction. If the 50% target proposed under European Green Deal is applied then additional 51.77 Mt CO₂ emission decrease is needed, or 77.66 Mt CO₂ decrease, if 55% target is adopted.

Item 249: Estimation regarding greenhouse gas emissions in Italy under different scenarios (Mt CO₂)

Estimation regarding greenhouse gas emissions in Italy under different scenarios (Mt CO₂)



Source: Eurostat data for 2018, extracted in 2020. Estimations delivered by the Author

Nevertheless, it is worth to highlight that, if the current structure of greenhouse gas emissions target is maintain, then the 50% target for 2030 is an EU wide target. It is not a binding element for specific countries. Country specific targets could be expected as per ESD and ESR but there is no way to anticipate the potential targets.

At the same time, the review of key EU regulations around climate and energy as:

- Emissions Trading System Directive;
- Effort Sharing Regulation;
- Land use, land use change and forestry Regulation;
- Energy Efficiency Directive;
- Renewable Energy Directive;
- CO₂ emissions performance standards for cars and vans
- Energy Taxation Directive

can bring some additional targets in area of share of energy from renewable energy sources and energy efficiency. For the moment, any estimation of potential targets is not available nor possible to estimate.



12 Netherlands

12.1 General information

Netherlands is the third smallest country within EU-14 group in terms of total country area and represents 1.2% of the area. At the same time, it is the 22nd country in EU-27 with 0.9% of the area. It represents 5.0% of EU-14 population and 3.9% of EU-27 population, but 6.4% of its total nominal GDP of EU-14 and 5.7% of EU-27. Despite the robust economic growth in 1995-2018 period, in 2018 Netherlands GDP per capita amounted to 130% of the whole EU average (132% in 1995).

Item 250: Netherlands - key data



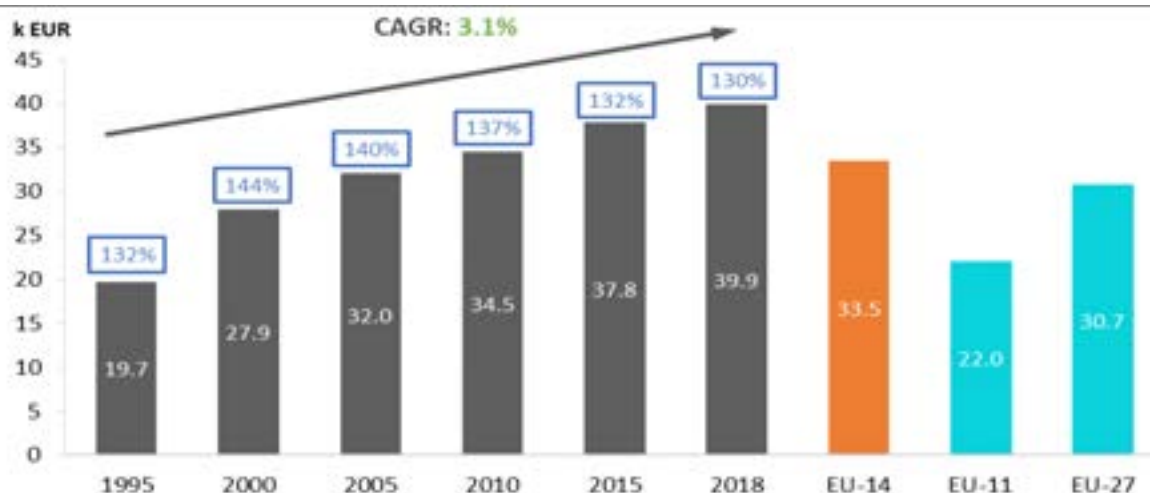
Key data

| | |
|------------------------------------------------------|--------|
| Population (M) | 17.2 |
| GDP per capita (EUR, nominal) | 44,920 |
| GDP per capita (EUR, PPS) | 39,920 |
| GDP as share of EU-14 | 6.4% |
| GDP as share of EU-27 | 5.7% |
| Energy intensity of the economy (kgoe per 1,000 EUR) | 132.0 |
| Greenhouse gas emissions (Mg per capita) | 11.3 |

Source: Eurostat data for 2018, extracted in 2020

With the compounded annual growth rate amounting to 3.1% Netherlands economy considerably grew in the period of 1995-2018 (see Item 251). Its GDP per capita was above EU-14 and EU-27 averages (equal to 119% and 130% of the respective averages). Its GDP per capita was also 181% of the average GDP per capita for EU-11 countries.

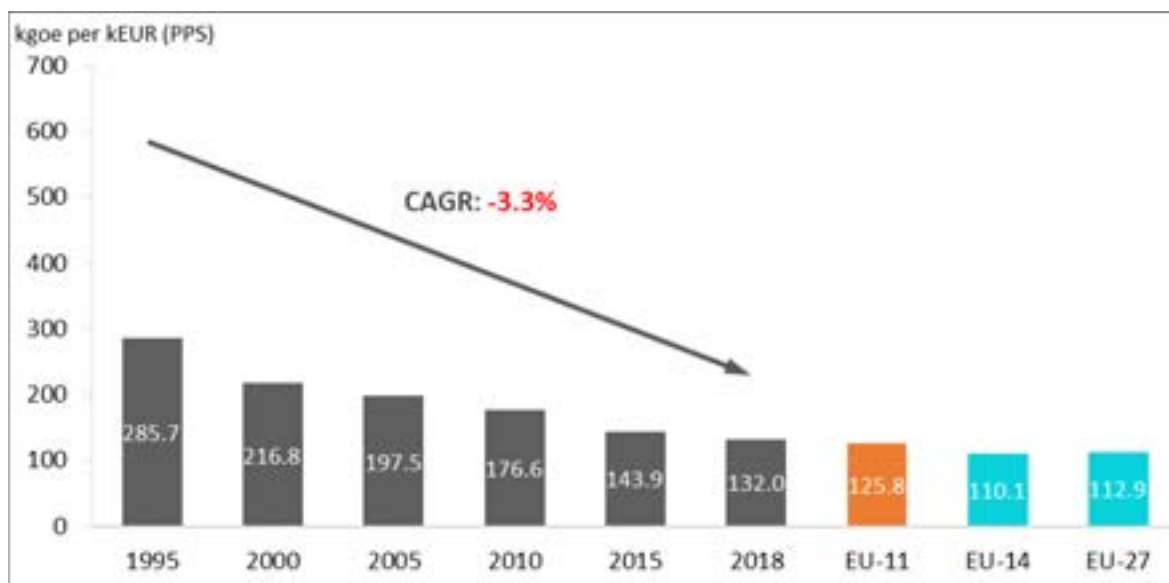
Item 251: GDP per capita in Netherlands for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in 2018 (kEUR, PPS) and share of Netherlands GDP per capita in relation to EU-27 average



Source: Eurostat data for 2018, extracted in 2020. Detail references: GDP per capita - Gross domestic product at market prices (B1GQ), Current prices, purchasing power standard per capita (CP_PPS_HAB)

The Netherlands economy energy intensity was about 132.0 kgoe per 1,000 EUR PPS, thanks to a decrease of the energy intensity indicator during the years 1995-2018. It dropped by 153.7 kgoe per 1,000 EUR PPS, i.e. it was reduced by about 54%. The energy intensity of Netherlands in 2018 represented 105% and 117% of EU-14 and EU-27 averages. At the same time, it represented 120% of EU-11 average.

Item 252: Energy intensity of the economy in Netherlands in 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)



Source: Eurostat data for 2018, extracted in 2020. Values for EU-11 and EU-14 were recalculated based on energy intensity and GDP data from Eurostat. Detail references: Energy intensity of GDP in purchasing power standards (PPS) - EI_GDP_PPS

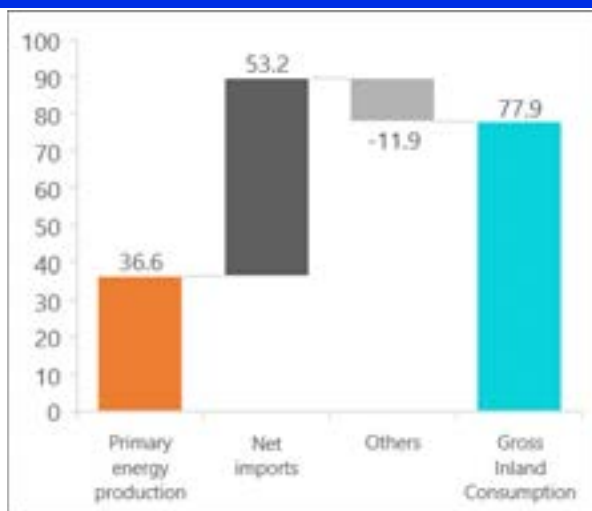
12.2 Energy balance of Netherlands

The energy balance of Netherlands in 2018 is presented in Item 253. The primary energy production was equal to 36.6 Mtoe in 2018. Net imports added 53.2 Mtoe to the balance. The total gross inland consumption accounted for 77.9 Mtoe. The level of import of energy to Netherlands increased during last 23 years. At the same time the level of net import reported to the energy needs also increase, especially since 2013. It reached the level of 70%

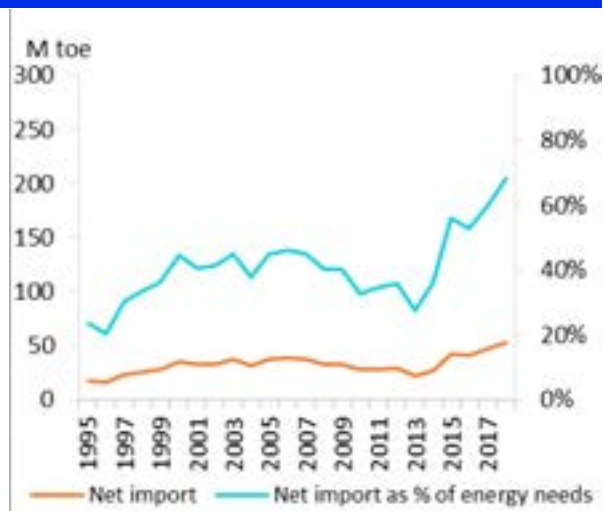
The primary energy production decreased over past 23 years whereas gross energy consumption increased. National production was meeting only 47% of the country gross consumption and this factor decreased over last 23 years from 88%.

Item 253: Energy balance in Netherlands

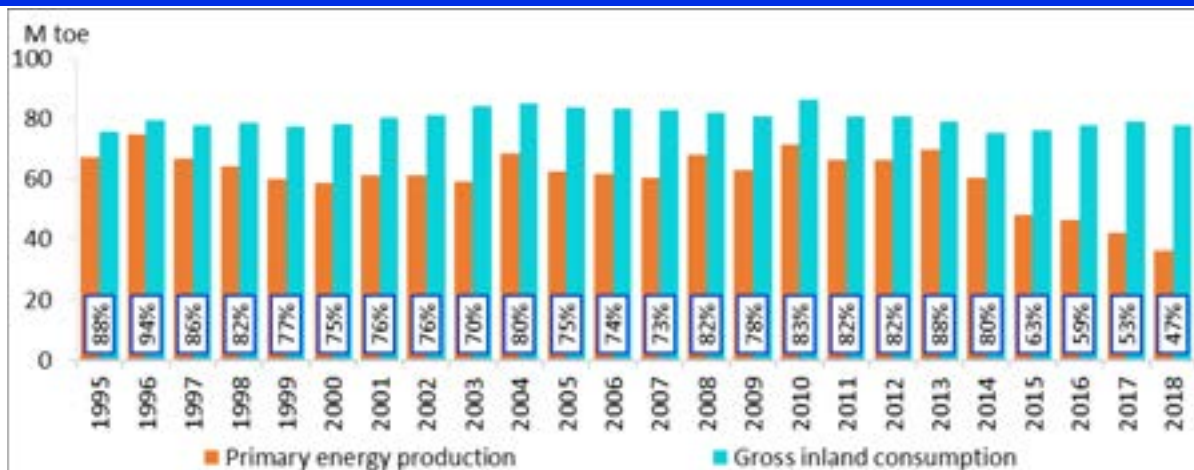
Energy balance in Netherlands in 2018 (Mtoe)



Net import of energy in Netherlands in 1995-2018 (Mtoe and as percentage of GIC)



Gross inland consumption, primary energy production (Mtoe) and ratio of primary energy production to gross inland consumption in 1995-2018 in Netherlands (%)



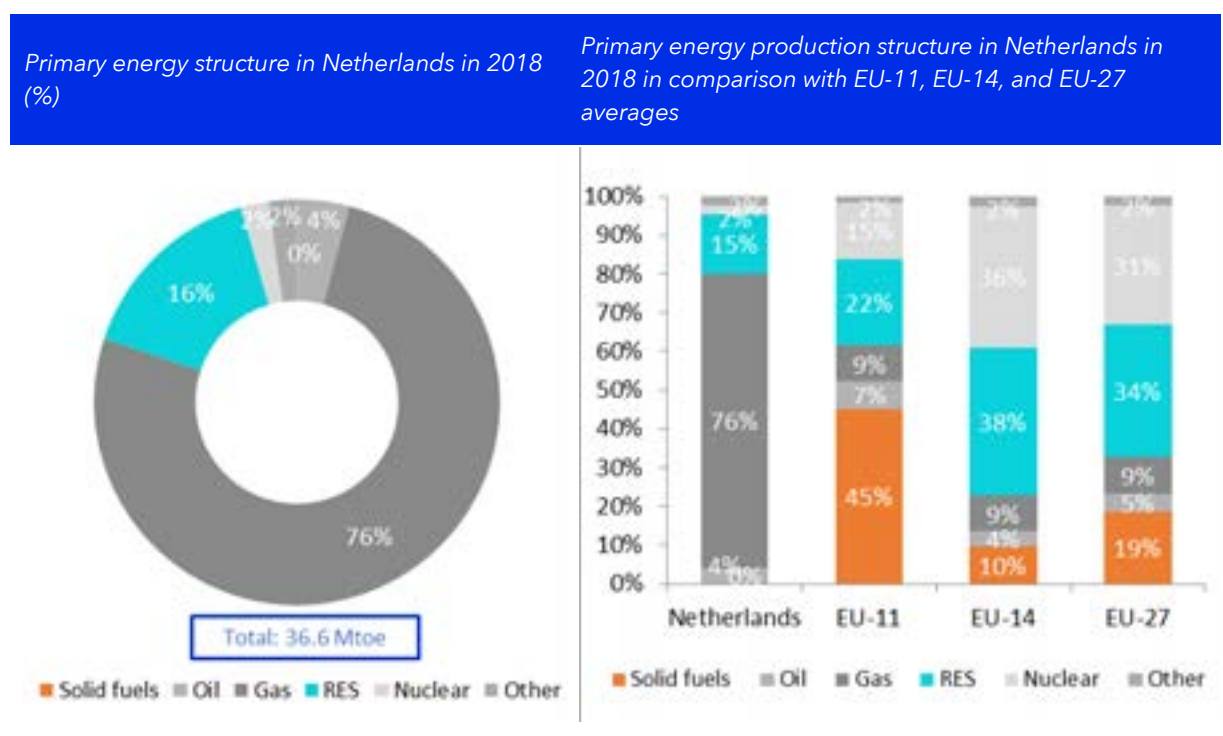
Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Gross inland consumption - GIC. Net imports = Import (IMP) - Export (EXP), Other = Change in stock (STK-CHG) - International maritime bunkers (INTMARB)

The primary energy production in Netherlands was dominated by gas. About 76% of the total production comes from it. The mix was completed by 16% share of renewable energy sources, 4% of oil, 2% share of nuclear and other energy sources in the mix. Usage of solid fuels was null.

When compared to the European averages, Netherlands were characterized by very high share of gas in the energy mix - 76% versus 9% EU-14 average and 99% EU-27 average. The share of renewable energy sources in the Netherlands fuel mix was lower than in EU-14 and EU-27 (15% versus 38% in EU-14 and 34% in EU-27). The share of nuclear energy was also lower 2% versus 36% and 31% in EU-14 and EU-27). In opposite the share of oil was close to averages - 4% versus 4% in EU-11 and 5% EU-27. Netherlands were not using solid fuels for primary energy production.

The comparison of Netherlands to EU-11 averages was mainly characterized by much higher share of gas (76% versus 9%), lack of solid fuels use (versus 45% in EU-11) and small share of nuclear energy and RES in the energy mix (2%, 15% versus 15%, 22% respectively in EU-11).

Item 254: Primary energy structure in Netherlands



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy – Primary Production (PPRD), Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H) , Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

Gross inland consumption of energy in Netherlands was dominated by oil (41%), gas (39%) and solid fuels (11%). The mix was completed by 6% of renewable energy sources, 1% of nuclear energy and 2% of other energy sources.

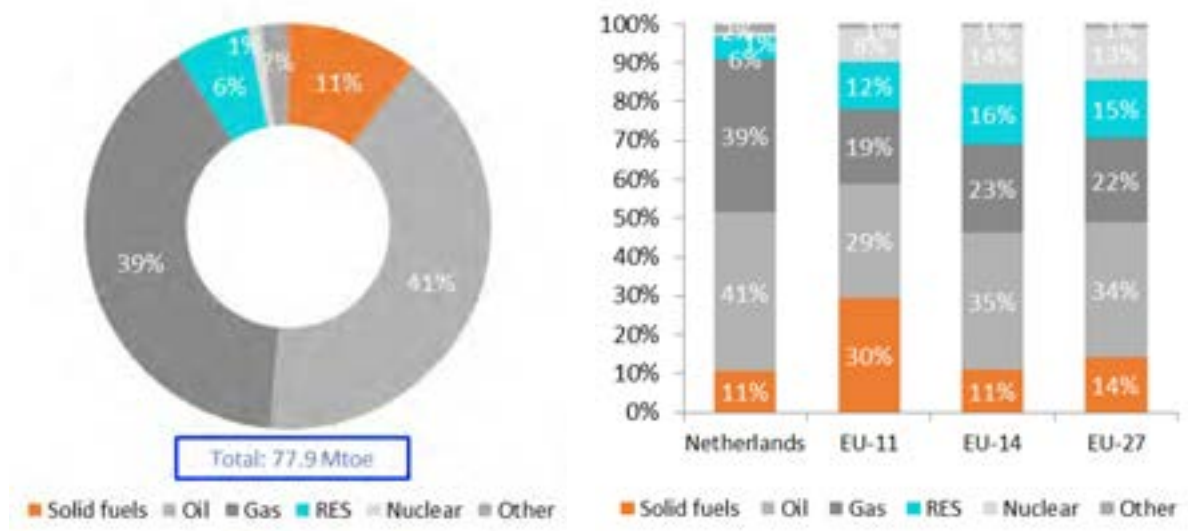
Comparing to European averages gross inland consumption of energy in Netherlands was marked by low share of solid fuels (11% versus 11% in EU-14 and 14% in EU-27). The share of oil was higher in the Netherlands (41%) than in EU-14 (35%) and EU-27 (34%) as well as the share of gas (39% versus 23% and 22% in EU-14 and EU-27). Netherlands were characterized by lower share of renewable energy sources in the mix - 6% versus 16% and 15% in EU-14 and EU-27 respectively, and small one of nuclear energy in the mix (1% versus 14% in EU-14 and 13% in EU-27).

When compared to EU-11 the main difference was around much lower share of solid fuels consumption in Netherlands (11% versus 30% in EU-11) and lower share of renewable energy sources (6% versus 12%). The share of oil and gas use in Netherlands were higher than in EU-11 countries (41% versus 29% and 39% versus 19% respectively). EU-11 average

gross final consumption included nuclear energy at 8% whereas it was only 1% in Netherlands.

Item 255: Gross inland consumption structure in Netherlands

Gross inland consumption structure in Netherlands in 2018 (%) Gross inland consumption structure in Netherlands in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gross inland consumption - GIC, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion)(O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

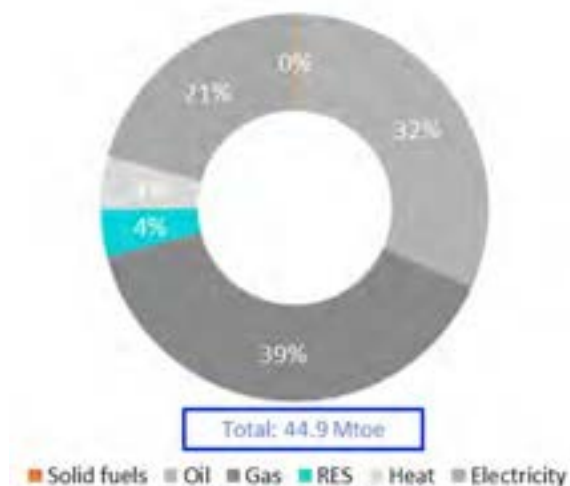
The final energy consumption in Netherlands was dominated by gas (39%), oil (32%), electricity (21%), and renewable energy sources (4%). The mix was completed by heat (4%).

The sectoral final energy consumption in Netherlands was characterized by higher share of industrial but lower of transport sectors than in EU-14 and EU-27 (30% and 24% versus 26% and 31% in EU-14 and EU-27). The share of commercial and public services in final energy consumption in Netherlands (15%) was like the one in EU-14 (15%) and EU-27 (14%).

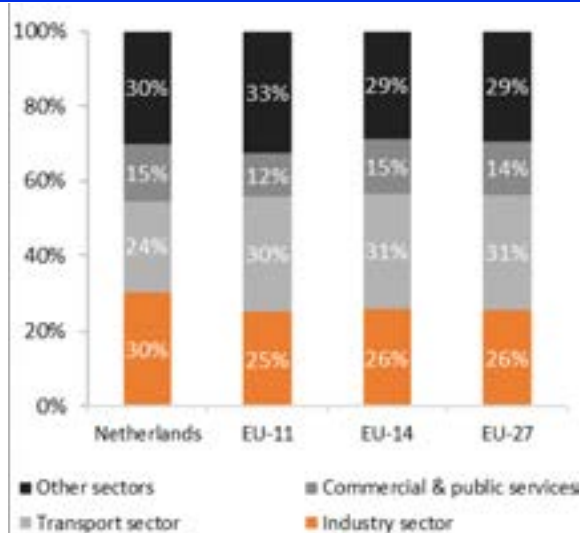
When compared to EU-11 Netherlands similar conclusions as related to EU-14 and EU-27 can be drawn.

Item 256: Final energy consumption structure in Netherlands

Final energy consumption structure in Netherlands in 2018 (%)



Final energy consumption structure in Netherlands in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Heat (H8000), Electricity (E7000), Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial & public services - FC_OTH_CP_E, Other - FC_OTH_E-FC_OTH_CP_E. Errors in summation to 100% are due to rounding

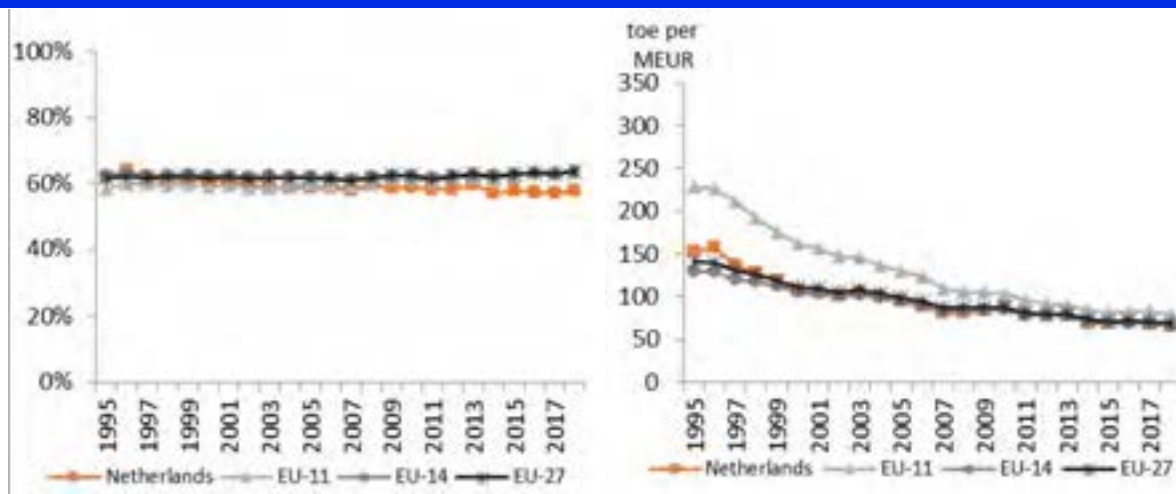
Netherlands final energy consumption to gross inland consumption ratio which measure energy efficiency was lower than the averages for EU-11, EU-14 and EU-27.

Simultaneously, a decrease of energy volume associated with generating gross domestic product was noticed in line with the averages for EU-14 and EU-27 averages.

Item 257: Final energy consumption in Netherlands in relation to selected indicators

Final energy consumption to gross inland consumption ratio in Netherlands in 1995-2018 (%)

Final energy consumption to gross domestic product ratio in Netherlands in 1995-2018 in comparison with EU-11, EU-14, and EU-27 averages (toe per M EUR)



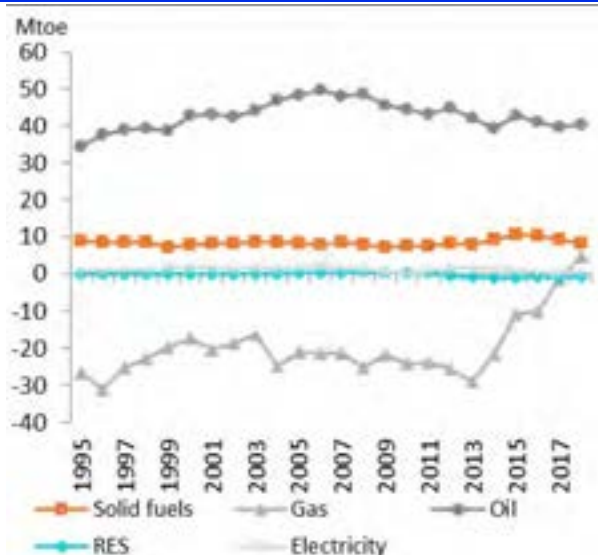
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final energy consumption - FEC, Gross inland consumption - GIC, Gross Domestic Product - Gross domestic product at market prices B1GQ, Current prices - CP-MEUR

Net import of energy to Netherlands by fuels was characterized by an increase of oil fuels imports and gas import. The level of solid fuels import was stable. Netherlands were a gas exporter until 2017.

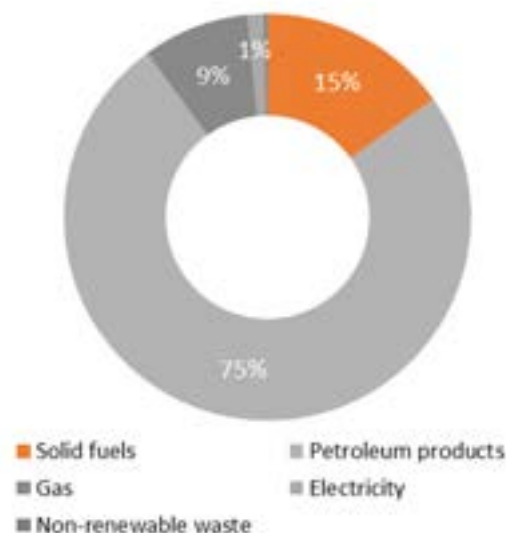
The import structure of energy to Netherlands was dominated by oil (75%) and solid fuels (15%). The imports were completed by 9% of gas, 1% of electricity and less than 1% of non-renewable waste.

Item 258: Net import of energy in Netherlands

Net import of energy by fuel in 1995-2018 (Mtoe)



Net import structure in 2018 (% only fuels for which import is greater than export)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Electricity (E7000). Errors in summation to 100% are due to rounding

Solid fuels were imported to Netherlands mainly from Russia (39%), USA (29%), Australia (16%), Colombia (8%) and several other countries.

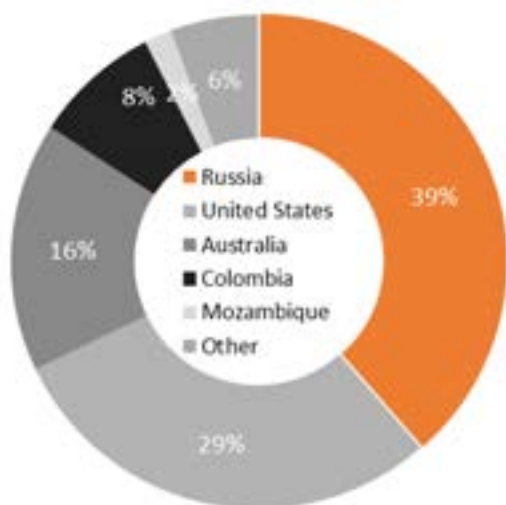
Main oil importers to Netherlands were Russia (31%), United Kingdom (11%), Belgium (10%) and Norway (6%). The remaining 42% were imported from various locations.

Netherlands were importing gas mainly from Norway (55%), Russia (21%) and United Kingdom (10%). The remaining 14% were supplied from different locations.

Electricity was mainly imported from Germany (78%), Norway (14%), Belgium (7%) and United Kingdom (1%).

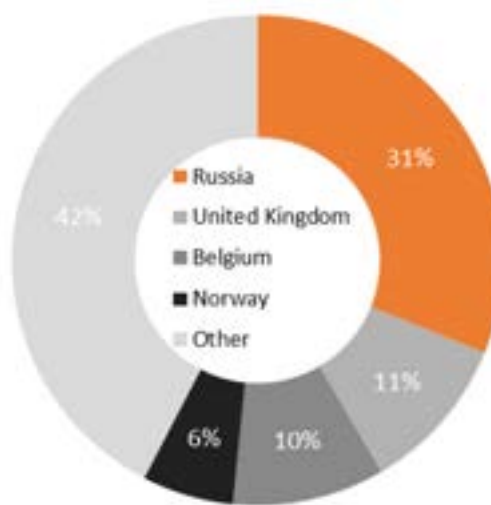
Item 259: Foreign fuel suppliers

Foreign suppliers of solid fuels in Netherlands in 2018 (%)



Total: 8.3 Mtoe

Foreign suppliers of crude oil in Netherlands in 2018(%)



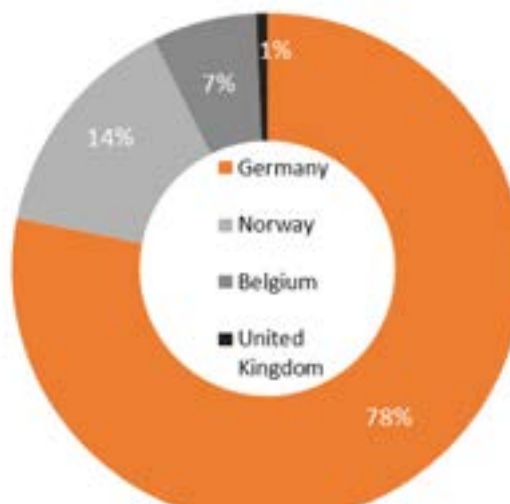
Total: 150.9 Mtoe

Foreign suppliers of gas in Netherlands in 2018 (%)



Total: 43.6 Mtoe

Foreign suppliers of electricity in Netherlands in 2018 (%)



Total: 2.3 Mtoe

Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fossil fuels - C000X0350-0370, Gas - Natural gas (G3000), Oil - Oil and petroleum products (excluding biofuel portion) (O4000XBIO), Electricity - E7000. Errors in summation to 100% are due to rounding

12.3 Greenhouse gas emissions

Between 1995-2017 greenhouse gases emissions in Netherlands were decreased - from over 220.8 Mt CO₂ in 1995 to 193.3 Mt CO₂ in 2017. Consequently, average emissions per capita decreased to 11.3 Mg CO₂ per capita in 2017 (from 14.9 Mg CO₂ per capita in 1995), which was higher comparing to EU-14 and EU-27 averages (8.5 Mg CO₂ per capita and 8.6 Mg CO₂ per capita, respectively), and also higher than in EU-11 (9.0 Mg CO₂ per capita)

There were some noteworthy changes in the Netherlands structure of greenhouse gas emissions over the period considered. The significance of waste management and industrial processes sectors emissions dropped swiftly by 76% and 56%. The emissions from energy industries increased 1.2% as well as emissions from transport - 2.0%

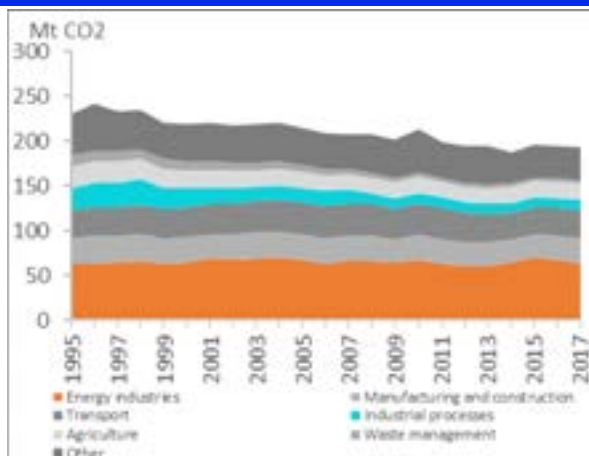
Comparing to EU-11, EU-14 and EU-27 countries, Netherlands as characterized by higher share of emissions from energy industries. Share of emissions from other sectors were similar than the averages.

Item 260: Greenhouse gas emissions in Netherlands

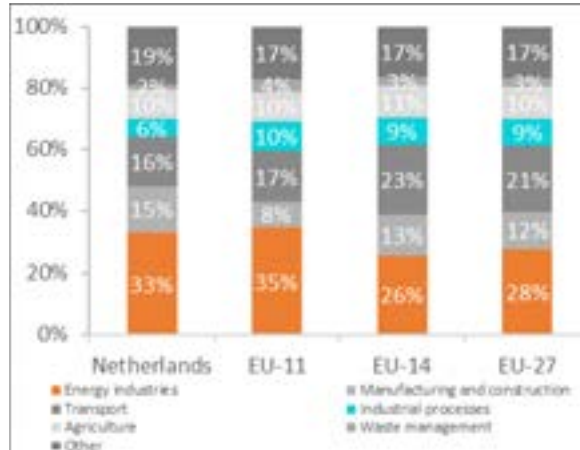
Greenhouse gas emissions per capita in Netherlands in 1995-2017 in comparison with EU-11, EU-14 and EU-27 averages in 2017 (Mg per capita)



Greenhouse gas emissions in Netherlands by sectors in 1995-2017 (Mt CO₂)



Greenhouse gas emissions in Netherlands by sectors in 2017 in comparison with EU-11, EU-14 and EU-27 averages (%)



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - * values for EU-11, EU-14 and EU-27 recalculated by the Author; Energy industry - Fuel combustion in energy industries (CRF1A1), Manufacturing and construction - Fuel combustion in manufacturing industries and construction (CRF1A2), Transport - Fuel combustion in transport (CRF1A3), Industrial processes - Industrial processes and product use (CRF2), Agriculture - Agriculture (CRF3), Waste management - Waste management (CRF5), Other = Other fuel combustion sectors (CRF1A4)+ Other fuel combustion sectors n.e.c. (CRF1A5) + Fuels - fugitive emissions (CRF1B)+Other sectors (CRF6); Total GHG emissions equal to All sectors (excluding LULUCF)

and memo items) (CRF1-6X4_MEMO) i.e. emission from all sectors excluding Land use, land use change, and forestry (LULUCF), Transport and storage of CO₂ (memo item), International aviation (memo item), International navigation (memo item), Multilateral operations (memo item), Biomass - CO₂ emissions (memo item). Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. Errors in summation to 100% are due to rounding

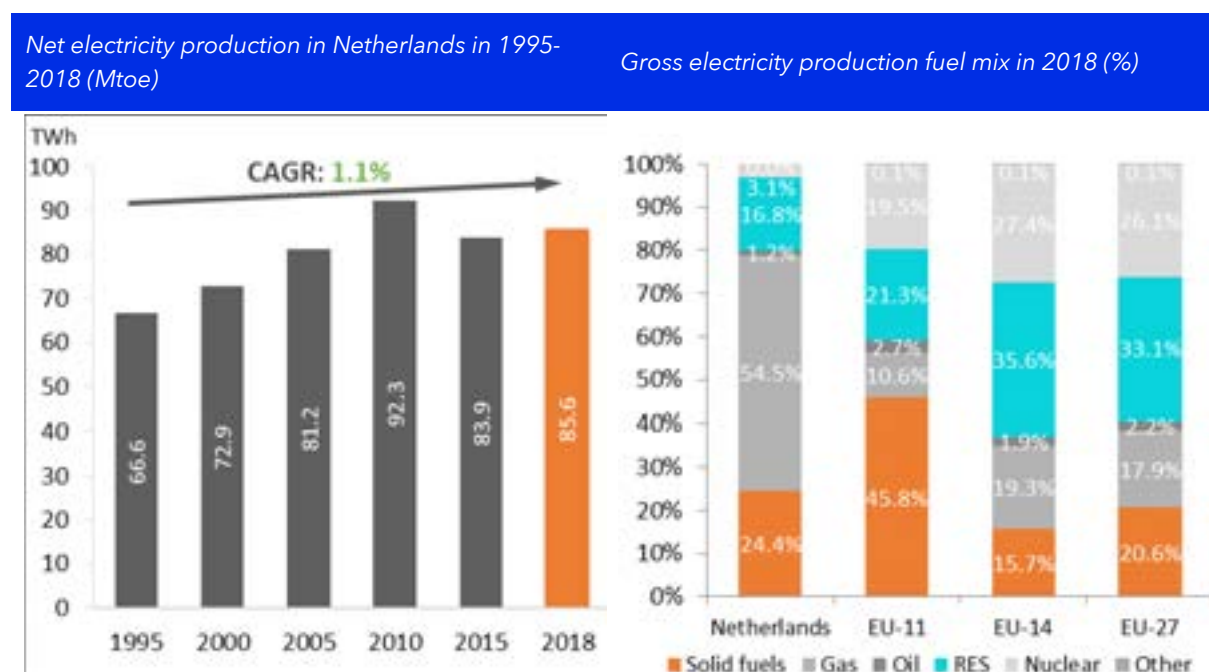
12.4 Overview of electricity sector

Item 261 presents electricity production and the current fuel mix of Netherlands. Over last 23 years net electricity production increased from 66.6 TWh in 1995 to 85.6 TWh in 2018 (CAGR 1.1%). As visible, net electricity production represented 4.0% of EU-14 total electricity production, as was lower compared to Netherlands GDP share of 6.4%.

The Netherlands fuel mix was dominated by gas and solid fuels with shares of 54.5% and 24.4% respectively. The mix was completed by 16.8% of renewable energy sources and small shares of nuclear energy (3.1%) and oil (1.2%). Compared to EU-14 and EU-27 countries, Netherlands had a much bigger share of gas and solid fuels in its energy mix. On other hand, the country produced relatively less electricity from oil, renewable energy sources and nuclear sources, respectively 1.2%, 16.8% and 3.1%.

When compared to EU-11 average fuel mix one can notice much higher share of gas used in Netherlands than in EU-11 (54.5% versus 10.6%) and significantly lower use of solid fuels (24.4% versus 45.8%). The share of oil was lower (1.2% versus 2.7%). Netherlands were less relying on renewable energy sources than EU-11 countries with a share of 16.8% versus 21.3% in EU-11, as well as on nuclear energy (3.1% versus 19.5%).

Item 261: Net electricity production and gross electricity production fuel mix in Netherlands



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Electricity Production - NEP, Gross Electricity Production - GEP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear

= Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

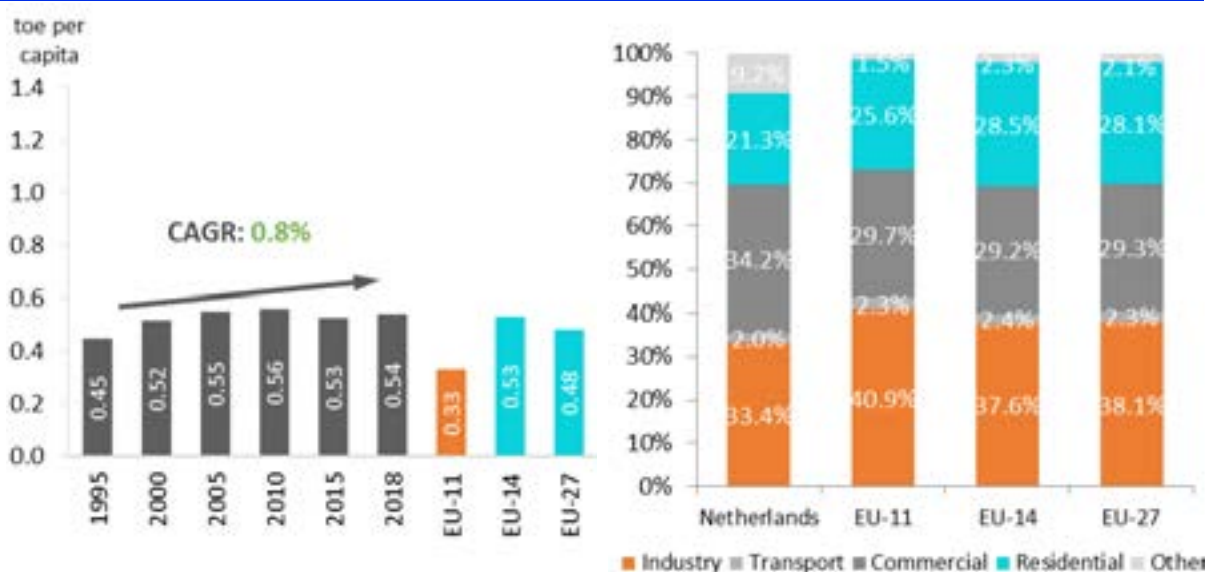
In Item 262 the evolution of final per capita consumption of electricity and its breakdown by economic sector is presented. In recent years final consumption of electricity in Netherlands increased (CAGR in the period of 1995-2019 was around 0.8%) and its level was higher compared to EU-14 and EU-27 countries. Netherlands final energy consumption per capita represented 101.8% of EU-14 level and 111.6% of EU-27 level.

The structure of final electricity consumption in Netherlands was dominated by commercial sector (34.2% versus 29.2% in EU-14 countries). Relatively less energy was used in transport (2.0% versus 2.4%) and less in industry and residential sectors (33.4% and 21.3% versus 37.6 and 28.5%).

Netherlands were consuming relatively less electricity in industry sector than EU-11 countries (33.4% versus 40.9%) and transport (2.0% versus 2.3%). At the same time, it used relatively more electricity in commercial sectors (34.2% versus 29.7%). The share of residential use of electricity in the Netherlands was lower than in EU-11 countries (21.3% versus 25.6%).

Item 262: Final consumption of electricity in Netherlands

Final consumption of electricity per capita in Netherlands (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita) Final consumption of electricity in Netherlands by sectors in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Electricity E7000. Errors in summation to 100% are due to rounding

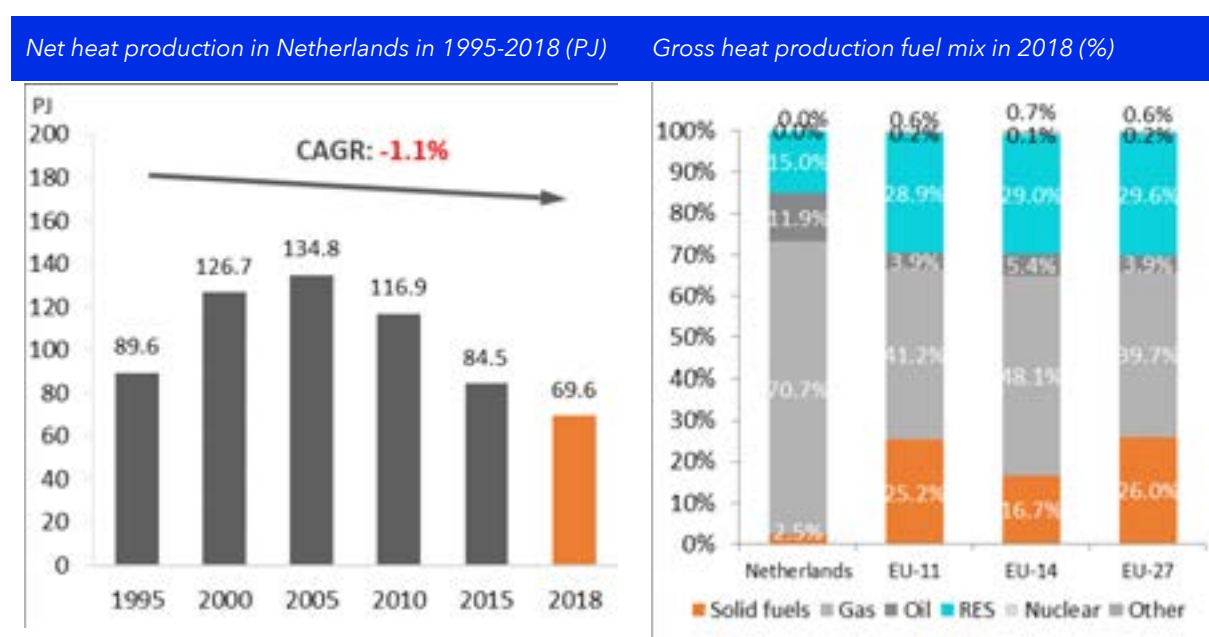
12.5 Overview of heat sector

Item 263 presents heat production and the current fuel mix of Netherlands. Over last 23 years net heat production decreased from 89.6 PJ in 1995 to 69.6 PJ in 2018 (CAGR -1.1%).

The Netherlands fuel mix of heat production was dominated by gas with share of 70.7%. The mix was completed by 15.0% of renewable energy sources, 2.5% of solid fuels and 11.9% of oil. Compared to EU-14 and EU-27 countries, Netherlands had a much bigger share of gas in its heat production mix. On other hand, the country produced relatively less heat from solid fuels and renewable energy sources, respectively 2.5% and 15.0%. The share of oil was higher - 11.9% versus 5.4% in EU-14. Netherlands did not use nuclear energy for heat production where some heat was produced in nuclear facilities in EU-14 countries (0.1%).

When compared to EU-11 average fuel mix one can notice much higher share of gas used in Netherlands than in EU-11 (70.7% versus 41.2%) and significantly lower use of solid fuels (2.5% versus 25.2%). The share of oil was higher in Netherlands (11.9% versus 3.9%) but the share of renewable energy sources was lower (15.0% versus 28.9%). Netherlands were not using nuclear energy for heat generation in opposite to EU-11 where the share of nuclear was 0.2%.

Item 263: Net heat production and gross electricity production fuel mix in Netherlands



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Heat Production - NHP, Gross Heat Production - GHP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

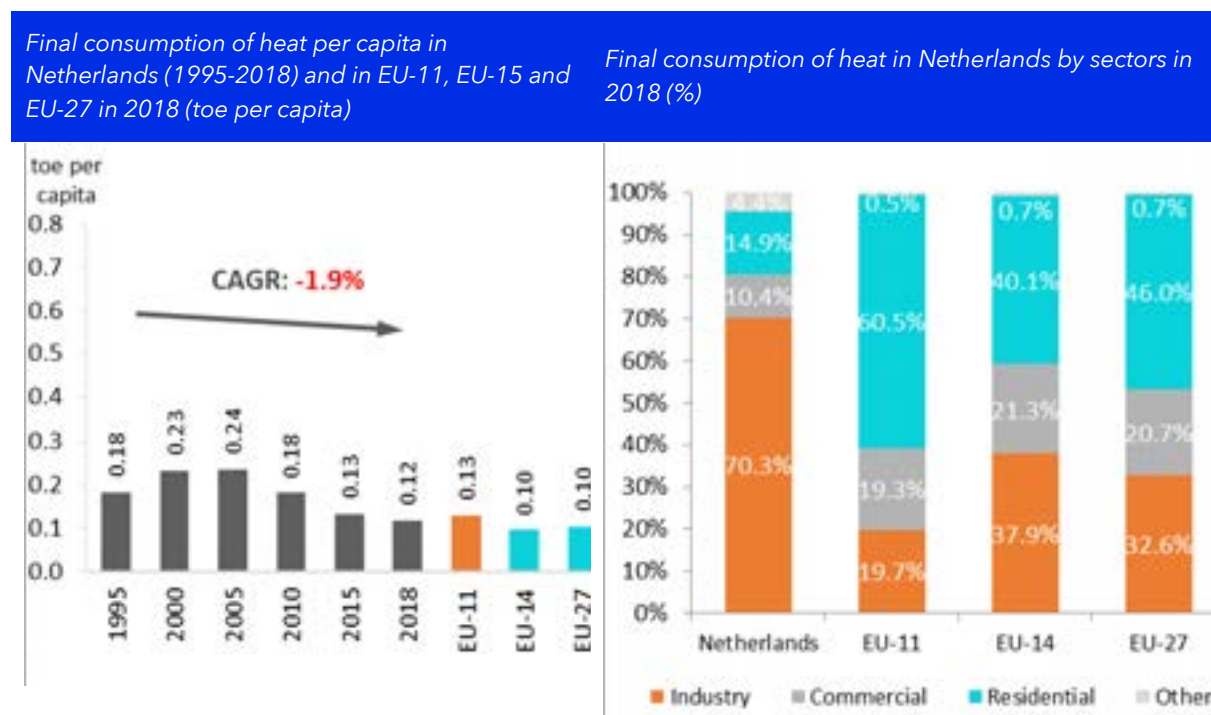
Item 264 presents final heat consumption per capita and its breakdown by sectors.

The per capita demand for heat in Netherlands decreased from 0.18 toe per capita in 1995 to 0.122 toe per capita in 2018. As a result, within the 23 years analyzed, heat consumption per capita increased at CAGR of -1.9%. The heat consumption remained higher than the averages for EU-14 and EU-27, respectively 0.10 toe per capita and 0.10 toe per capita. At the same time, it was lower than EU-11 average (0.13 toe per capita).

The structure of final consumption of heat in Netherlands was characterized by lower share of commercial sector (10.4% compared to 21.3% in EU-14) and residential usage (14.9% compared to 40.1% in EU-14). The share of industry in heat consumption was higher than the averages (70.3% compared to 37.9% in EU-14).

In relation to EU-11 countries, the structure of final heat consumption in Netherlands was characterized by lower share of residential sector (14.9% versus 60.5%) and lower share of commercial sector (10.4% versus 19.3%). The industrial use of heat consumed 70.3% of it in Netherlands whereas 19.7% in EU-11.

Item 264: Final consumption of heat in Netherlands



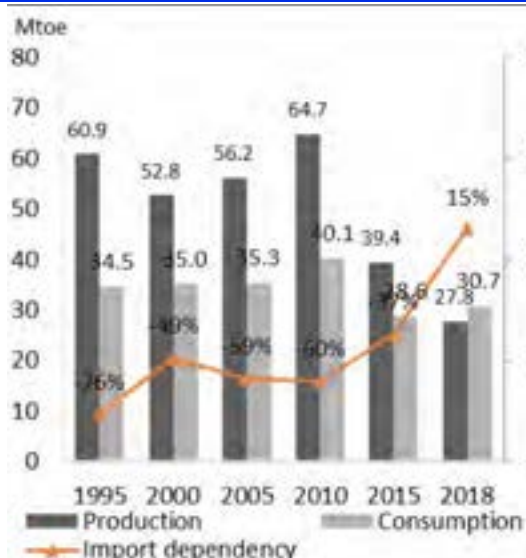
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Heat H8000. Errors in summation to 100% are due to rounding

12.6 Overview of gas sector

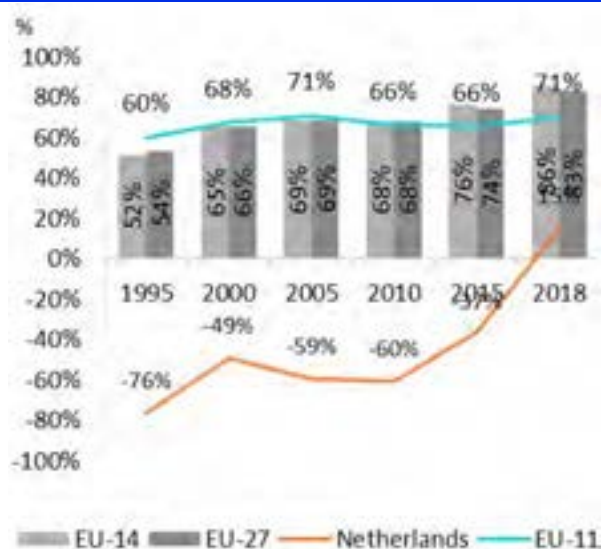
Netherlands consumed 30.7 Mtoe of gas in 2018. It increased from 34.5 Mtoe in 1995 to 40.1 Mtoe in 2010 and then decreased. National production accounted for 27.8 Mtoe and it decreased from 64.7 Mtoe in 2010 to the current value. Previously the production was fluctuating between 52.8 Mtoe and 60.9 Mtoe. The remaining part of gas was imported. The country was a gas exporter in the period of 1995-2015 but starting from 2018 it became an imported. In 2018 the country was less dependent (15%) on import than EU-11, EU-14 and EU-27 average values.

Item 265: Gas sector in Netherlands

Gas production, gross consumption and import dependence in Netherlands in 1995-2018 (Mtoe)



Gas Import dependence in Netherlands and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gas production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Natural Gas G3000

The final consumption of gas per capita in Netherlands decreased from 1.48 toe per capita to 1.00 toe per capita over past 23 years. This value was higher than the average values for EU-14, EU-11 and EU-27 countries.

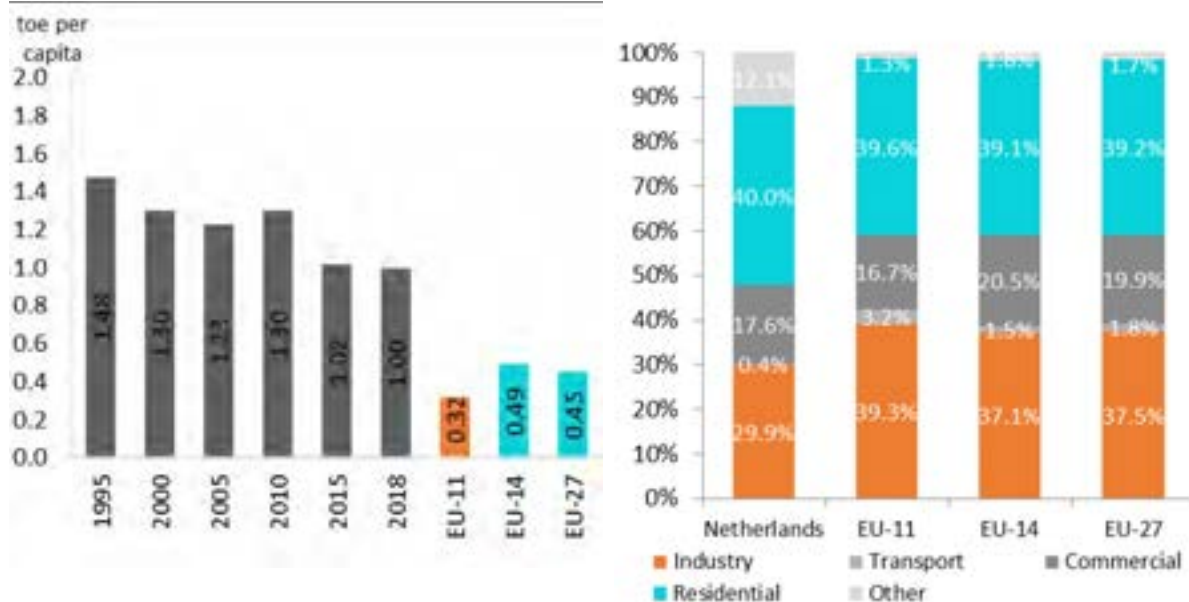
The structure of final gas consumption in Netherlands in 2018 was characterized by lower share of industry - 29.9% versus 37.1% in EU-14. The share of use of gas in transport and commercial sectors were also lower than the averages for EU-14 countries but the residential use of gas represented 40.0% versus 39.1% in EU-14. It is interesting to notice a relatively high share of other application - 12.1% versus usually <2% in other countries or the European averages.

When compared to EU-11 countries, Netherlands were using relatively less gas industry than EU-11 countries - 29.9% versus 39.3%. The country was also using less gas in transport - 0.4% versus 3.2%. On other hand, the share of gas used in commercial and residential sectors was higher than in EU-11 countries, 17.6% versus 16.7% and 40.0% versus 39.6% respectively.

Item 266: Final consumption of gas per capita in Netherlands in 1995-2018 and gas final consumption by sectors in Netherlands and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of gas per capita in Netherlands (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Gas final consumption by sectors in Netherlands and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Natural Gas G3000. Errors in summation to 100% are due to rounding

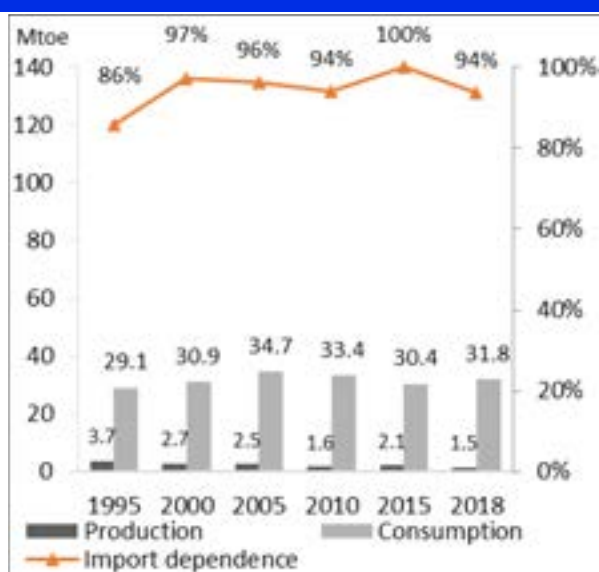
12.7 Overview of oil sector

The oil consumption of Netherlands grew from 29.1 Mtoe in 1995 to 31.8 Mtoe in 2018. At the same time the national production dropped from 3.7 Mtoe to 1.5 Mtoe. Therefore, the level of import dependency was high - between 86% and 100%.

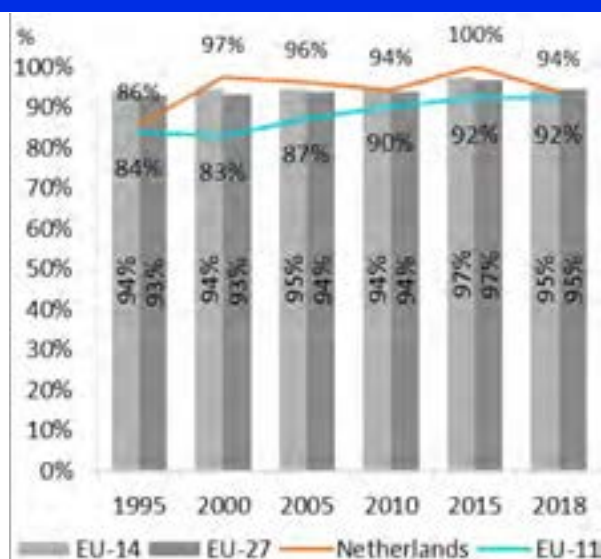
When compared to EU-14 and EU-27 average import dependency, the country had a lower import dependency of 94% versus 95% in EU-14 and EU-27 countries. At the same time, the import dependency of the country was higher than EU-11 average - 94% versus 92%.

Item 267: Oil sector in Netherlands

Oil production, gross consumption and import dependence in Netherlands in 1995-2018 (Mtoe)



Oil Import dependence in Netherlands and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Oil production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Import dependence above 100% has been rounded to 100%

The final consumption of oil per capita in Netherlands increased from 0.86 toe per capita in 1995 to 0.92 toe per capita in 2010 and then dropped to 0.82 toe per capita in 2018. The level of final consumption per capita remained higher than the one for EU-11 and EU-27 but lower than the average for EU-14.

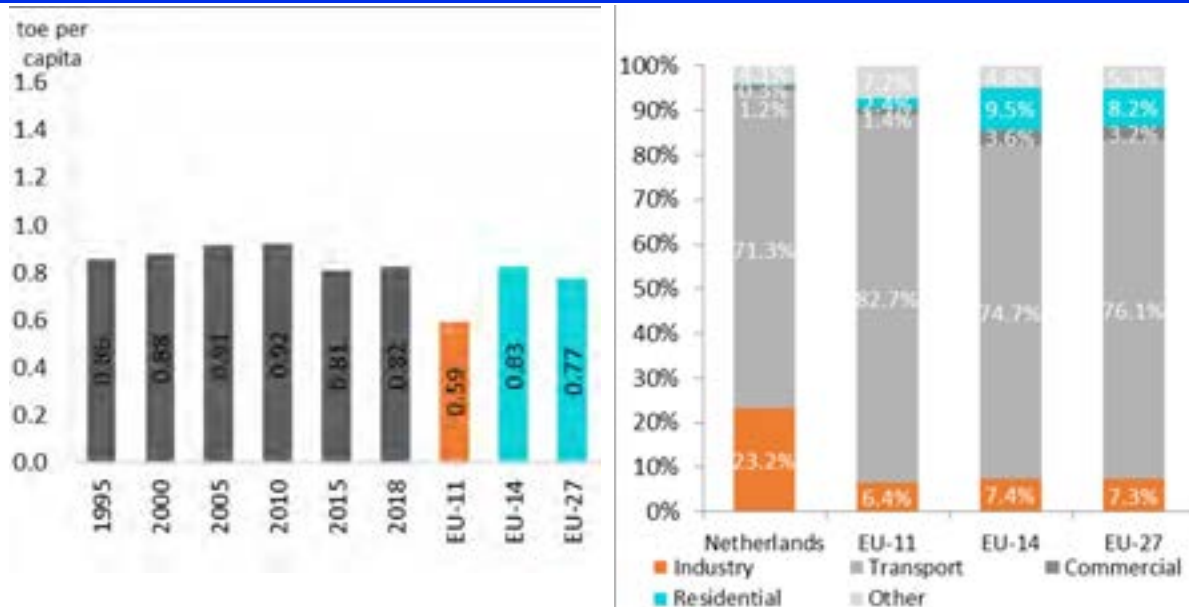
Oil consumption was dominated by transport sector, but its share was lower than the average for EU-14 - 71.3% versus 74.7% in EU-14 countries. Relatively more oil was used in industry - 23.2% versus 7.4%. The residential and commercial sectors use of oil was lower than EU-14 average - 1.2% and 0.3% 9.8% versus 3.6% and 9.5%.

The relative consumption of oil in Netherlands compared to EU-11 was lower in 2018 - 71.3% versus 82.7%. The use in industry was relatively higher - 23.2% versus 6.4%. At the same time commercial and residential sector were consuming relatively less oil in the country than EU-11 averages - 1.2% and 0.3% versus 1.4% and 2.4%.

Item 268: Final consumption of oil per capita in Netherlands in 1995-2018 and oil final consumption by sectors in Netherlands and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of oil per capita in Netherlands (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Oil final consumption by sectors in Netherlands and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Errors in summation to 100% are due to rounding

12.8 EU climate policy and its targets for Netherlands

Netherlands are subject to EU energy and climate regulations and therefore, specific targets were set and verified regarding greenhouse gas emission, share of energy from renewable energy sources and energy efficiency improvements (see Item 269).

Item 269: Energy and climate targets for Netherlands for 2020 and 2030

| | Netherlands 2020 targets | Netherlands 2030 targets |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | EU wide target of 20% reduction from 1990 levels (14% from 2005 level) | EU wide target of 40% reduction from 1990 levels |
| Greenhouse gas emissions in ETS | EU wide target of 21% reduction from 2005 | EU wide target of 43% reduction from 2005 |
| National emission reduction targets in non-ETS - Effort Sharing Decision (ESD) | -16% in relation to their 2005 levels | - |
| National emission reduction targets in non-ETS - Effort Sharing Regulations (ESR) | - | -36% in relation to their 2005 levels |
| Share of energy from renewable energy sources | EU wide target of 20% energy from renewables | EU wide target of minimum 32% share for renewable energy |
| EU wide target of share of energy from renewable energy sources | EU wide target of 20% share of gross final energy consumption | EU wide target of 32% share of gross final energy consumption |
| National target of share of energy from renewable energy sources | 14% of gross final consumption | Not yet available |
| Improvement in energy efficiency | EU wide target of 20% improvement in energy efficiency | EU wide target of at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |
| Primary energy consumption | EU wide target < 1,483 Mtoe National target < 60.7 Mtoe | EU wide target of 1,273 Mtoe (< 1,128 Mtoe EU-27) National targets not available yet |
| Final energy consumption | EU wide target < 1,086 Mtoe National target < 52.2 Mtoe | EU wide target < 956 Mtoe (< 846 Mtoe EU-27) National targets not available yet |

Source: EU website

In following chapter, the overview of Netherlands targets and performance are summarized.

12.8.1 Greenhouse gas emissions

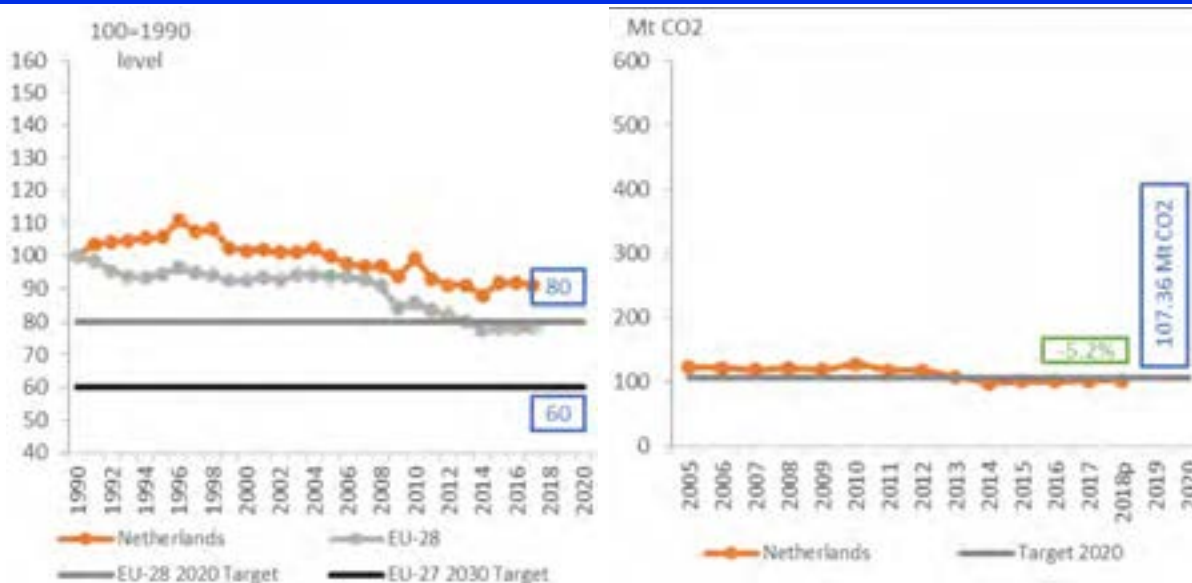
EU set a target for CO₂ reduction by 20% compared to 1990 level at EU level. Regardless the fact that the target was not binding for specific country, the level of CO₂ emission in Netherlands was below EU wide target.

The non-ETS greenhouse gas emissions the binding national targets for Netherlands was 107.36 Mt of CO₂ equivalent emissions. Comparing to 2018 provisional results the level of emissions overachieved the target by 5.2%.

Item 270: Energy efficiency target data for Netherlands

Greenhouse gas emissions level in Netherlands and EU-28, base year 1990, and EU 2020 target

Greenhouse gas emissions in Effort Sharing Decision (ESD) sectors



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Greenhouse gas emissions, base year 1990 [T2020_30], Greenhouse gas emissions in ESD sectors [T2020_35]

12.8.2 Renewable energy sources

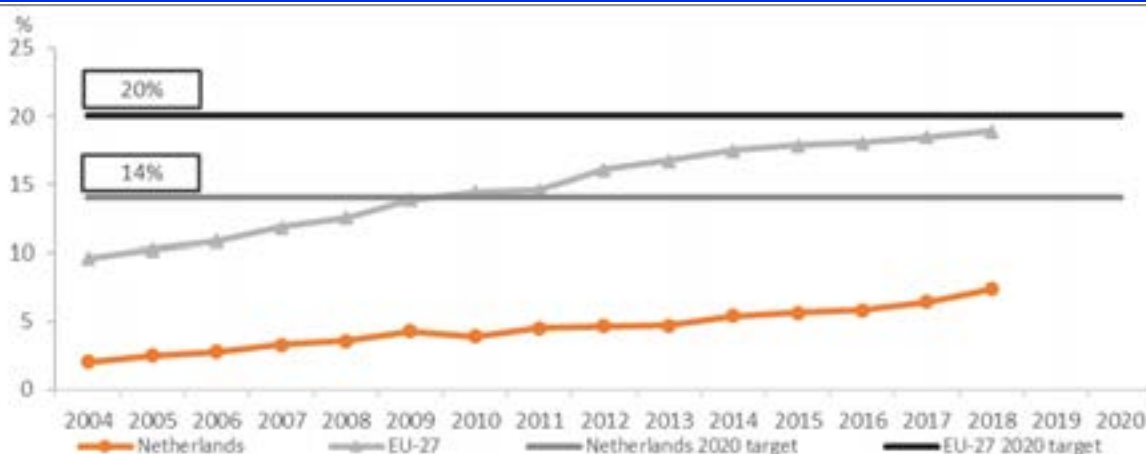
The following targets were set for Netherlands regarding the share of energy from renewable energy sources in gross final energy consumption:

- a 20% share of gross final energy consumption by 2020,
- a 14% national target for share of energy from renewable sources in gross final consumption of energy in 2020.

The share of energy from renewable energy sources in Netherlands was below EU wide and country specific targets in 2018.

Item 271: Share of energy from renewable energy sources in gross final energy consumption in Netherlands

Share of energy from renewable energy sources in gross final energy consumption in Netherlands in 2005-2018 and targets for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Share of energy from renewable sources [nrg_ind_ren]

12.8.3 Energy efficiency

The energy efficiency target set for Netherlands were respectively:

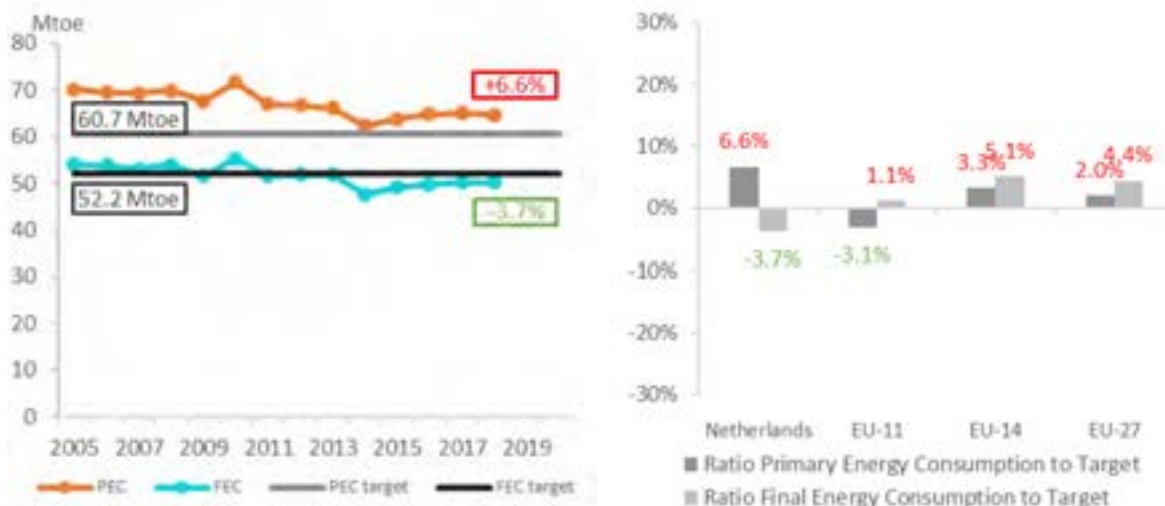
- Primary Energy Consumption in 2020: 60.7 Mtoe
- Final energy consumption in 2020: 52.2 Mtoe

Following the information provided in Item 272 the results for 2018 were above the targets in +6.6% of primary energy consumption but below target -3.7% of final energy consumption. This does not exclude Netherlands to achieve the targets in 2020.

Item 272: Energy efficiency target data for Netherlands

Primary energy consumption and final energy consumption in Netherlands in 2005-2018 and targets for 2020

Ratio of primary energy consumption to target for 2020 and final energy consumption to target for 2020 in Netherlands, EU-11, EU-14 and EU-27 in 2018



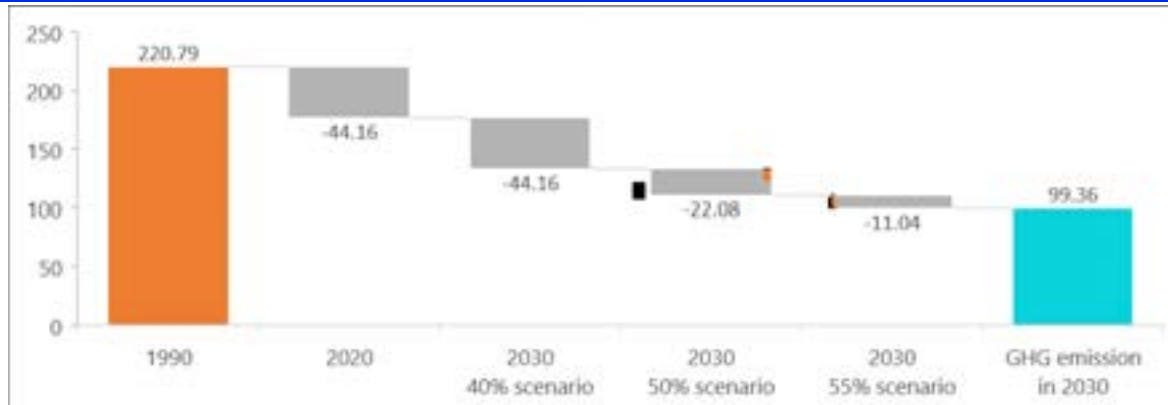
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Primary energy consumption - Primary energy consumption (Europe 2020-2030)(PEC2020-2030), final energy consumption - Final energy consumption (Europe 2020-2030) (FEC2020-2030). EU-11 and EU-14 data estimated based on Eurostat data

12.9 Review of potential impact of Green Deal propositions

At the current stage of discussions regarding the European Green Deal only partial information are available regarding the future targets. EU is proposing to increase the greenhouse gas emission reduction to 50% or 55% for 2030. This is a proposition included in the draft proposal of "Climate Law". Assuming the Netherlands greenhouse gas emissions in 1990, an estimation of EU 2030 target emissions can be drafted. The 2020 target of 20% reduction resulted in 44.16 Mt CO₂ emission drop. Further increase of the target to 40% in 2030 require additional 44.16 Mt CO₂ reduction. If the 50% target proposed under European Green Deal is applied then additional 22.08 Mt CO₂ emission decrease is needed, or 33.12 Mt CO₂ decrease, if 55% target is adopted.

Item 273: Estimation regarding greenhouse gas emissions in Netherlands under different scenarios (Mt CO₂)

Estimation regarding greenhouse gas emissions in Netherlands under different scenarios (Mt CO₂)



Source: Eurostat data for 2018, extracted in 2020. Estimations delivered by the Author

Nevertheless, it is worth to highlight that, if the current structure of greenhouse gas emissions target is maintain, then the 50% target for 2030 is an EU wide target. It is not a binding element for specific countries. Country specific targets could be expected as per ESD and ESR but there is no way to anticipate the potential targets.

At the same time, the review of key EU regulations around climate and energy as:

- Emissions Trading System Directive;
- Effort Sharing Regulation;
- Land use, land use change and forestry Regulation;
- Energy Efficiency Directive;
- Renewable Energy Directive;
- CO₂ emissions performance standards for cars and vans
- Energy Taxation Directive

can bring some additional targets in area of share of energy from renewable energy sources and energy efficiency. For the moment, any estimation of potential targets is not available nor possible to estimate.



13 Portugal

13.1 General information

Portugal is the eighth biggest country within EU-14 group in terms of total country area and represents 3.0% of the area. At the same time, it is the 12th country in EU-27 with 2.2% of the area. It represents 3.0% of EU-14 population and 2.3% of EU-27 population, but 1.7% of its total nominal GDP of EU-14 and 1.5% of EU-27. Despite the robust economic growth in 1995-2018 period, in 2018 Portuguese GDP per capita amounted to 77% of the whole EU average (81% in 1995).

Item 274: Portugal - key data



Key data

| | |
|------------------------------------------------------|--------|
| Population (M) | 10.3 |
| GDP per capita (EUR, nominal) | 19,870 |
| GDP per capita (EUR, PPS) | 23,810 |
| GDP as share of EU-14 | 1.7% |
| GDP as share of EU-27 | 1.5% |
| Energy intensity of the economy (kgoe per 1,000 EUR) | 103.8 |
| Greenhouse gas emissions (Mg per capita) | 6.8 |

Source: Eurostat data for 2018, extracted in 2020

With the compounded annual growth rate amounting to 3.0% Portuguese economy considerably grew in the period 1995-2018 (see Item 275). Its GDP per capita was below EU-14 and EU-27 averages (equal to 71% and 77% of the respective averages). Its GDP per capita was also 108% of the average GDP per capita for EU-11 countries.

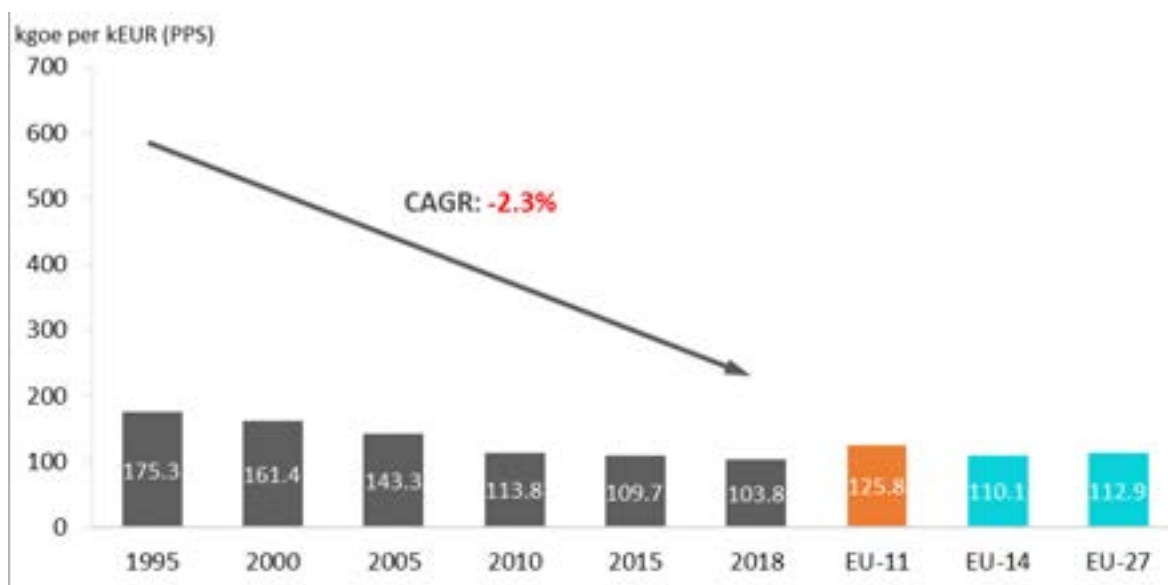
Item 275: GDP per capita in Portugal for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in 2018 (kEUR, PPS) and share of Portugal GDP per capita in relation to EU-27 average



Source: Eurostat data for 2018, extracted in 2020. Detail references: GDP per capita - Gross domestic product at market prices (B1GQ), Current prices, purchasing power standard per capita (CP_PPS_HAB)

The Portuguese economy energy intensity was about 103.8 kgoe per 1,000 EUR PPS in 2018, thanks to a decrease of the energy intensity indicator during the years 1995-2018. It dropped by 71.5 kgoe per 1,000 EUR PPS, i.e. it was reduced by about 41%. The energy intensity of Portugal in 2018 represented 83% and 92% of EU-14 and EU-27 averages. At the same time, it represented 94% of EU-11 average.

Item 276: Energy intensity of the economy in Portugal in 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)



Source: Eurostat data for 2018, extracted in 2020. Values for EU-11 and EU-14 were recalculated based on energy intensity and GDP data from Eurostat. Detail references: Energy intensity of GDP in purchasing power standards (PPS) - EI_GDP_PPS

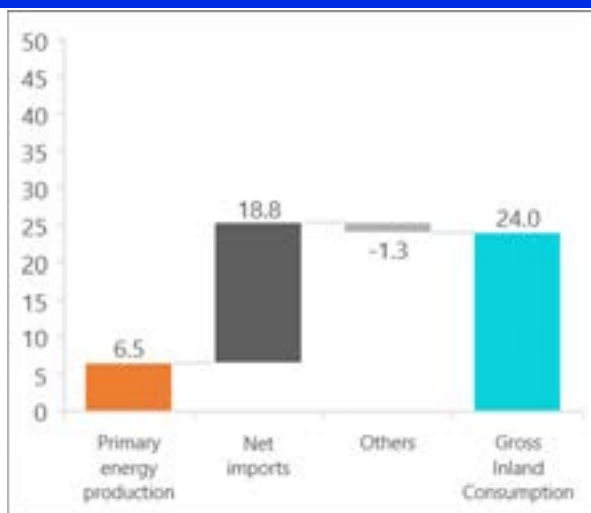
13.2 Energy balance of Portugal

The energy balance of Portugal in 2018 is presented in 284. The primary energy production was equal to 6.5 Mtoe in 2018. Net imports added 18.8 Mtoe to the balance. The total gross inland consumption accounted for 24.0 Mtoe. The level of import of energy to Portugal grew slowly up to 2005 and then decrease to the similar value as in 1995. At the same time the level of net import reported to the energy needs decreased slowly and it was about 77%.

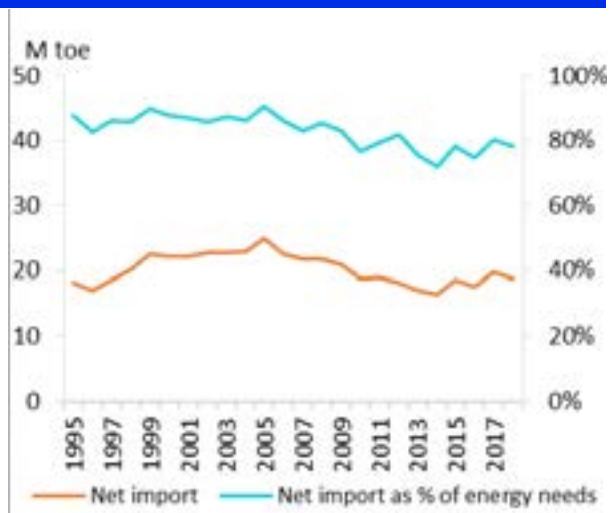
The primary energy production increased over past 23 years, as well as gross energy consumption. National production is meeting only 27% of the country gross consumption and this factor increased over last 23 years from 16%.

Item 277: Energy balance in Portugal

Energy balance in Portugal in 2018 (Mtoe)



Net import of energy in Portugal in 1995-2018 (Mtoe and as percentage of GIC)



Gross inland consumption, primary energy production (Mtoe) and ratio of primary energy production to gross inland consumption in 1995-2018 in Portugal (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Gross inland consumption - GIC. Net imports = Import (IMP) - Export (EXP), Other = Change in stock (STK-CHG) - International maritime bunkers (INTMARB)

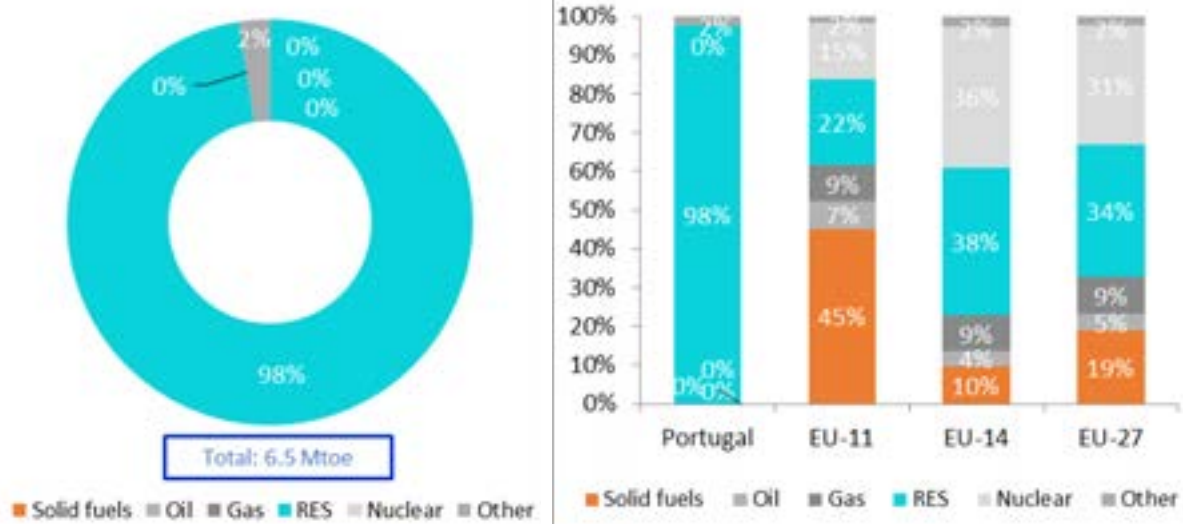
The primary energy production in Portugal was dominated by renewable energy sources. About 98% of the total production came from RES. The mix was completed by 2% share of other sources in the mix. Usage of solid fuels, oil, gas, and nuclear energy was null.

When compared to the European averages, Portugal was characterized by very high share of renewable energy sources in the energy mix - 98% versus 38% EU-14 average and 34% EU-27 average. The share of solid fuels, gas, oil and nuclear were null compared to European averages.

The comparison of Portugal to EU-11 averages was mainly characterized by much higher share of RES (98% versus 22%), and lack of solid fuels, oil, gas, and nuclear energy use in Portugal.

Item 278: Primary energy structure in Portugal

Primary energy structure in Portugal in 2018 (%) Primary energy production structure in Portugal in 2018 in comparison with EU-11, EU-14, and EU-27 averages



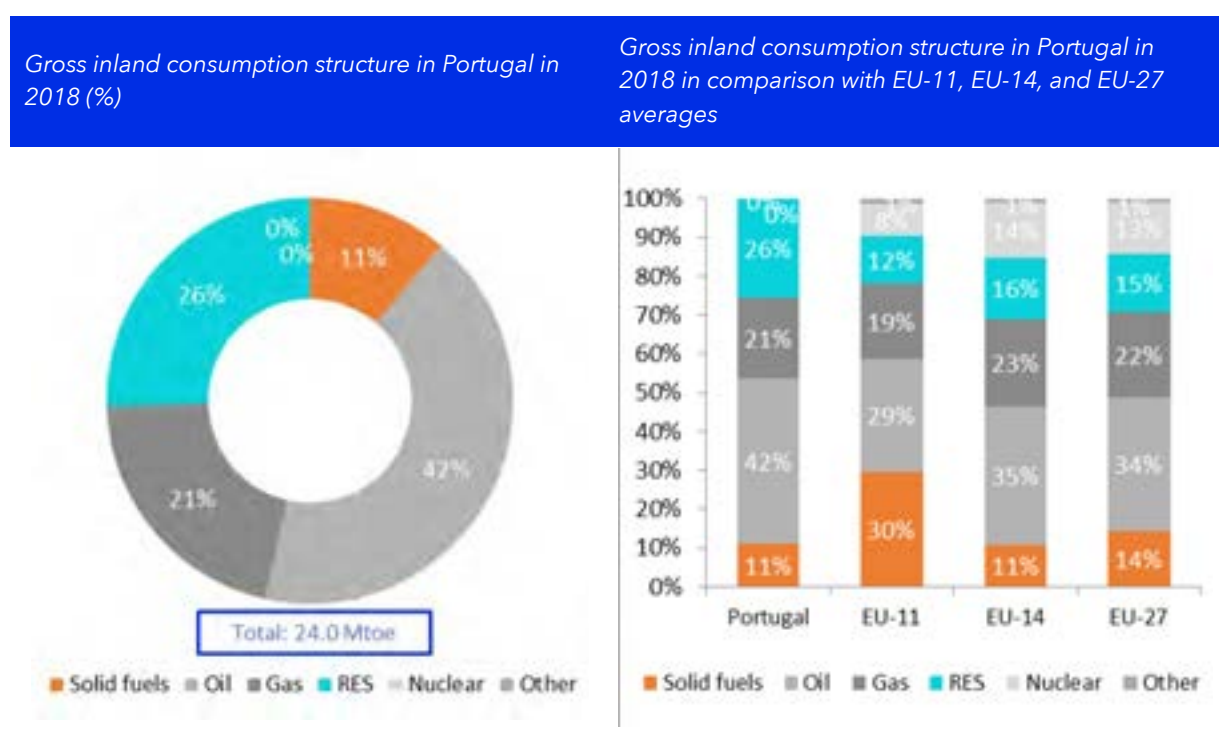
Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H) , Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

Gross inland consumption of energy in Portugal was dominated by oil (42%), gas (21%) and renewable energy sources (26%). The mix was completed by 11% of solid fuels.

Comparing to European averages gross inland consumption of energy in Portugal was marked by low share of solid fuels (11% versus 11% in EU-14 and 14% in EU-27). The share of oil was higher in Portugal (42%) than in EU-14 (35%) and EU-27 (34%) whereas the share of gas was almost the same (21% versus 22-23%). Portugal was characterized by much higher share of renewable energy sources in the mix - 26% versus 16% and 15% in EU-14 and EU-27 respectively, and lack of nuclear energy in the mix (versus 14% in EU-14 and 13% in EU-27).

When compared to EU-11 the main difference was around much lower share of solid fuels consumption in Portugal (11% versus 30% in EU-11) and higher share of renewable energy sources (26% versus 12%). The share of oil and gas use in Portugal were also higher than in EU-11 countries (42% versus 29% and 21% versus 19% respectively). EU-11 average gross final consumption included nuclear energy at 8%. Portugal was not using nuclear energy.

Item 279: Gross inland consumption structure in Portugal



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gross inland consumption - GIC, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion)(O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

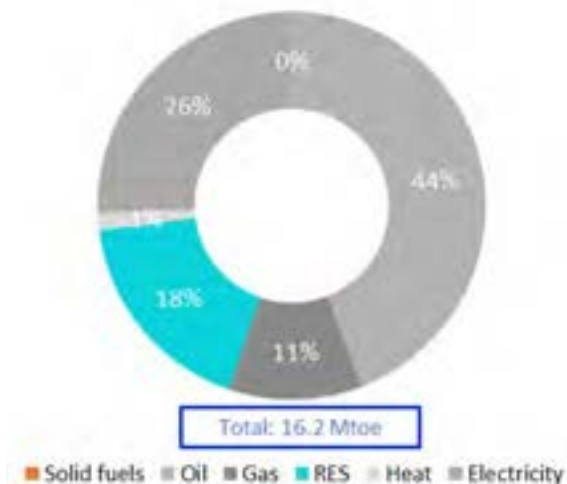
The final energy consumption in Portugal was dominated by oil (44%), followed by electricity (26%), renewable energy sources (18%) and gas (11%). The mix was completed by heat (1%).

The sectoral final energy consumption in Portugal was characterized by higher share of industrial and transport sectors than in EU-14 and EU-27 (28% and 36% versus 26% and 31% in EU-14 and EU-27). The share of commercial and public services in final energy consumption in Portugal (15%) was close to the one in EU-14 (15%) and EU-27 (14%).

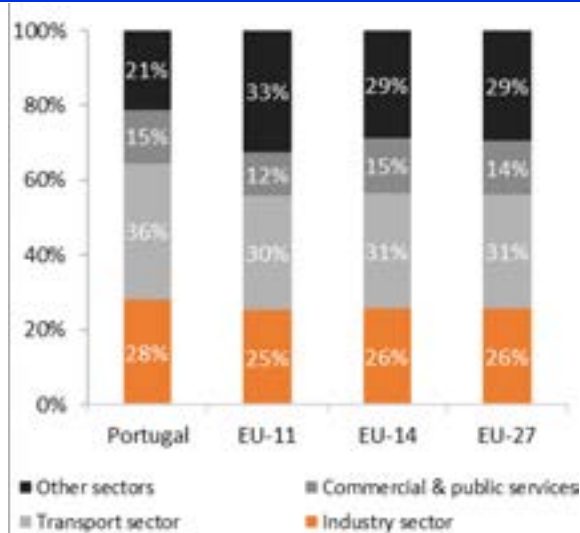
When compared to EU-11 Portugal similar conclusions as related to EU-14 and EU-27 can be drawn.

Item 280: Final energy consumption structure in Portugal

Final energy consumption structure in Portugal in 2018 (%)



Final energy consumption structure in Portugal in 2018 in comparison with EU-11, EU-14, and EU-27 averages



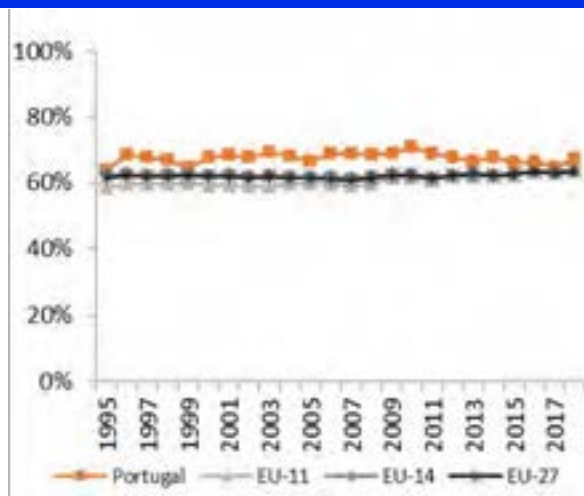
Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Heat (H8000), Electricity (E7000), Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial & public services - FC_OTH_CP_E, Other - FC_OTH_E-FC_OTH_CP_E. Errors in summation to 100% are due to rounding

Portuguese final energy consumption to gross inland consumption ratio which measure energy efficiency was higher than the averages for EU-11, EU-14 and EU-27. The situation remains stable for last 23 years.

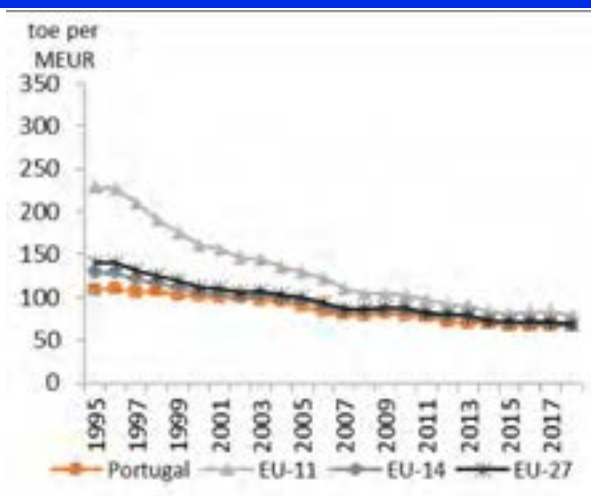
Simultaneously, a decrease of energy volume associated with generating gross domestic product was noticed in line with the averages for EU-14 and EU-27 averages.

Item 281: Final energy consumption in Portugal in relation to selected indicators

Final energy consumption to gross inland consumption ratio in Portugal in 1995-2018 (%)



Final energy consumption to gross domestic product ratio in Portugal in 1995-2018 in comparison with EU-11, EU-14, and EU-27 averages (toe per M EUR)



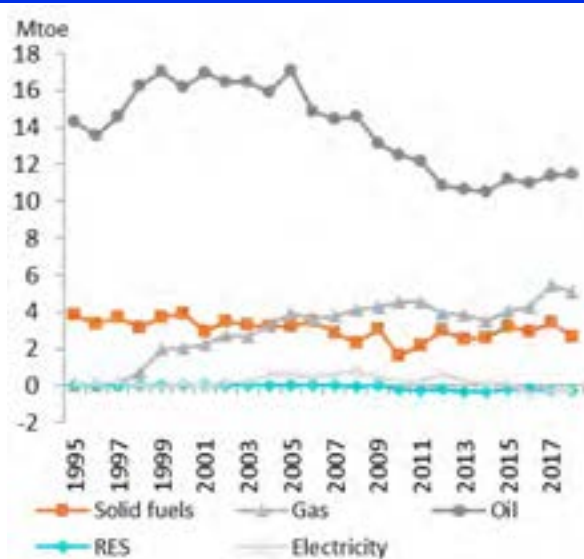
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final energy consumption - FEC, Gross inland consumption - GIC, Gross Domestic Product - Gross domestic product at market prices B1GQ, Current prices - CP-MEUR

Net import of energy to Portugal by fuels was characterized by a decrease of oil and solid fuels imports and an increase of gas import.

The import structure of energy to Portugal was dominated by oil (60%) and gas (26%). The imports were completed by 14% of solid fuels.

Item 282: Net import of energy in Portugal

Net import of energy by fuel in 1995-2018 (Mtoe)



Net import structure in 2018 (% , only fuels for which import is greater than export)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil

and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Electricity (E7000). Errors in summation to 100% are due to rounding

Solid fuels were imported to Portugal mainly from Colombia (82%), USA (15%) and several other countries.

Main oil importers to Portugal were Russia (18%), Angola (13%), Azerbaijan (10%) and Spain (9%). The remaining 50% were imported from various locations.

Portugal was importing gas mainly from Nigeria (49%), Algeria (17%) and Qatar (14%). The remaining 20% were supplied from different locations.

Electricity was only imported from Spain.

Item 283: Foreign fuel suppliers

Foreign suppliers of solid fuels in Portugal in 2018 (%)



Total: 2.7 Mtoe

Foreign suppliers of crude oil in Portugal in 2018(%)



Total: 16.9 Mtoe

Foreign suppliers of gas in Portugal in 2018 (%)



Total: 5.1 Mtoe

Foreign suppliers of electricity in Portugal in 2018 (%)



Total: 0.5 Mtoe

Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fossil fuels - C000X0350-0370, Gas - Natural gas (G3000), Oil - Oil and petroleum products (excluding biofuel portion) (O4000XBIO), Electricity - E7000. Errors in summation to 100% are due to rounding

13.3 Greenhouse gas emissions

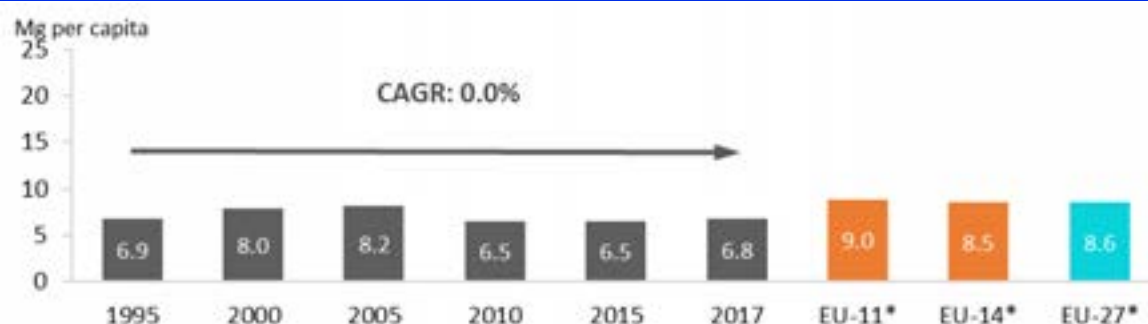
Between 1995-2017 greenhouse gases emissions in Portugal were increased - from over 59.1 Mt CO₂ in 1995 to 70.6 Mt CO₂ in 2017, but average emissions per capita decreased to 6.8 Mg CO₂ per capita in 2017 (from 6.9 Mg CO₂ per capita in 1995), which was lower comparing to EU-14 and EU-27 averages (8.5 Mg CO₂ per capita and 8.6 Mg CO₂ per capita, respectively), and also lower than in EU-11 (9.0 Mg CO₂ per capita)

There were some noteworthy changes in the Portuguese structure of greenhouse gas emissions over the period considered. The significance of manufacturing and construction and waste management sectors emissions dropped swiftly by 31% and 11%. Emissions from energy industries increased by 5%, as well as emissions from transport (27%) and industrial processes sector (25%).

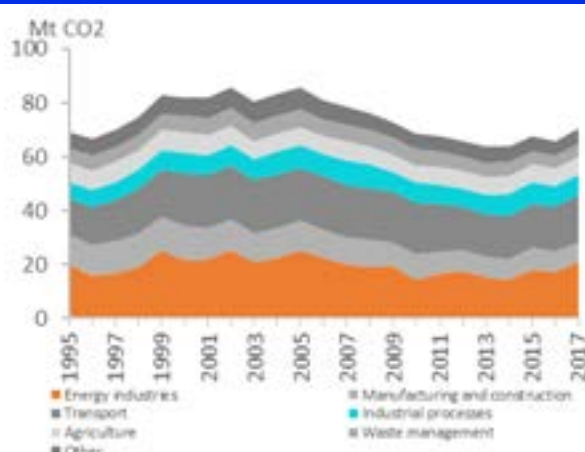
Comparing to EU-11, EU-14 and EU-27 countries, Portugal was characterized by higher share of emissions from transport (24% versus 17%, 23% and 21%). The shares of other sectors emissions remained at EU averages levels.

Item 284: Greenhouse gas emissions in Portugal

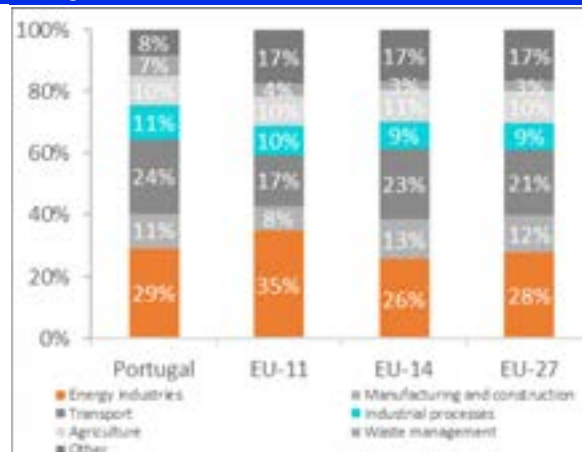
Greenhouse gas emissions per capita in Portugal in 1995-2017 in comparison with EU-11, EU-14 and EU-27 averages in 2017 (Mg per capita)



Greenhouse gas emissions in Portugal by sectors in 1995-2017 (Mt CO₂)



Greenhouse gas emissions in Portugal by sectors in 2017 in comparison with EU-11, EU-14 and EU-27 averages (%)



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - * values for EU-11, EU-14 and EU-27 recalculated by the Author; Energy industry - Fuel combustion in energy industries (CRF1A1), Manufacturing and construction - Fuel combustion in manufacturing industries and construction (CRF1A2), Transport - Fuel combustion in transport (CRF1A3), Industrial processes - Industrial processes and product use (CRF2), Agriculture - Agriculture (CRF3), Waste management - Waste management (CRF5), Other = Other fuel combustion sectors (CRF1A4)+ Other fuel combustion sectors n.e.c. (CRF1A5) + Fuels

- fugitive emissions (CRF1B)+Other sectors (CRF6); Total GHG emissions equal to All sectors (excluding LULUCF and memo items) (CRF1-6X4_MEMO) i.e. emission from all sectors excluding Land use, land use change, and forestry (LULUCF), Transport and storage of CO₂ (memo item), International aviation (memo item), International navigation (memo item), Multilateral operations (memo item), Biomass - CO₂ emissions (memo item). Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. Errors in summation to 100% are due to rounding

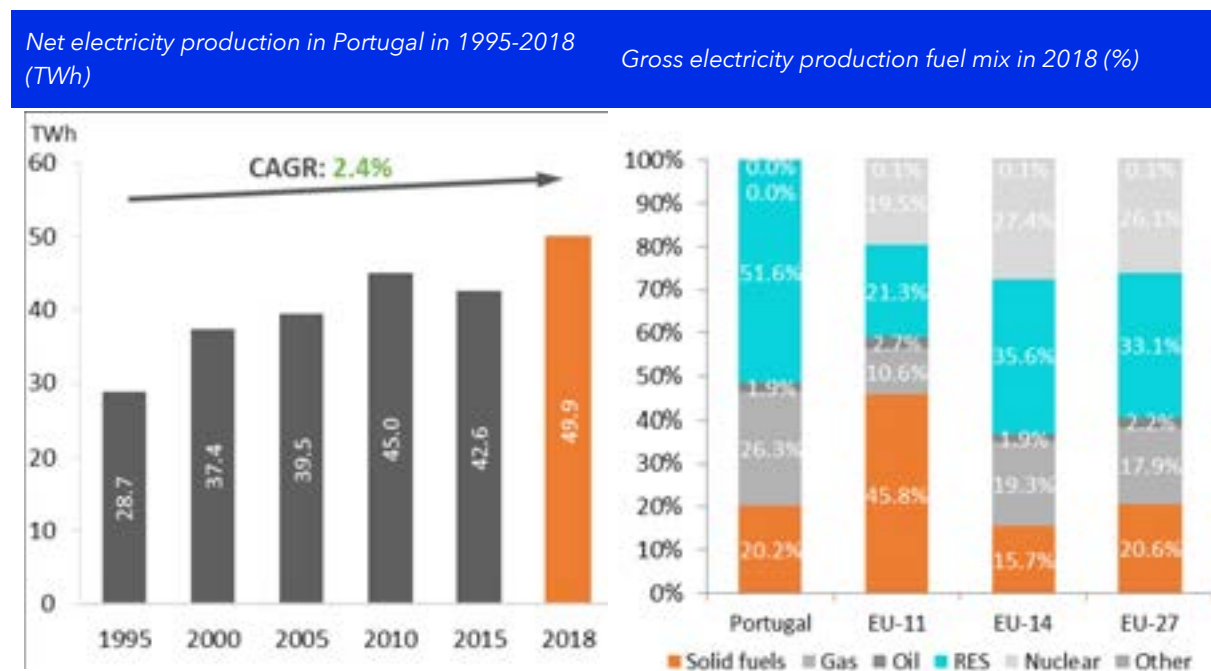
13.4 Overview of electricity sector

Item 285 presents electricity production and the current fuel mix of Portugal. Over last 23 years net electricity production increased from 28.7 TWh in 1995 to 49.9 TWh in 2018 (CAGR 2.4%). As visible, net electricity production represented 2.3% of EU-14 total electricity production, which was higher compared to Portuguese GDP share of 1.7%.

The Portuguese fuel mix was dominated by renewable energy sources and gas with shares of 51.6% and 26.3% respectively. The mix was completed by 20.2% of solid fuels and 1.9% of oil. Compared to EU-14 and EU-27 countries, Portugal had a much bigger share of renewable energy sources and gas in its energy mix. It also produced relatively more electricity from solid fuels (20.2% versus 15.7%) and it had the same share of oil (1.9%). Portugal was not using nuclear energy which produced 27.4% of electricity in EU-14 countries.

When compared to EU-11 average fuel mix one can notice much higher share of renewable energy sources and gas used in Portugal than in EU-11 (51.6% and 26.3% versus 21.4% and 10.6%) and significantly lower use of solid fuels (20.2% versus 45.8%). The share of oil was lower (1.9% versus 2.7%). Portugal was not producing electricity from nuclear energy whereas EU-11 countries produced 19.5% of electricity from this source.

Item 285: Net electricity production and gross electricity production fuel mix in Portugal



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Electricity Production - NEP, Gross Electricity Production - GEP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000),

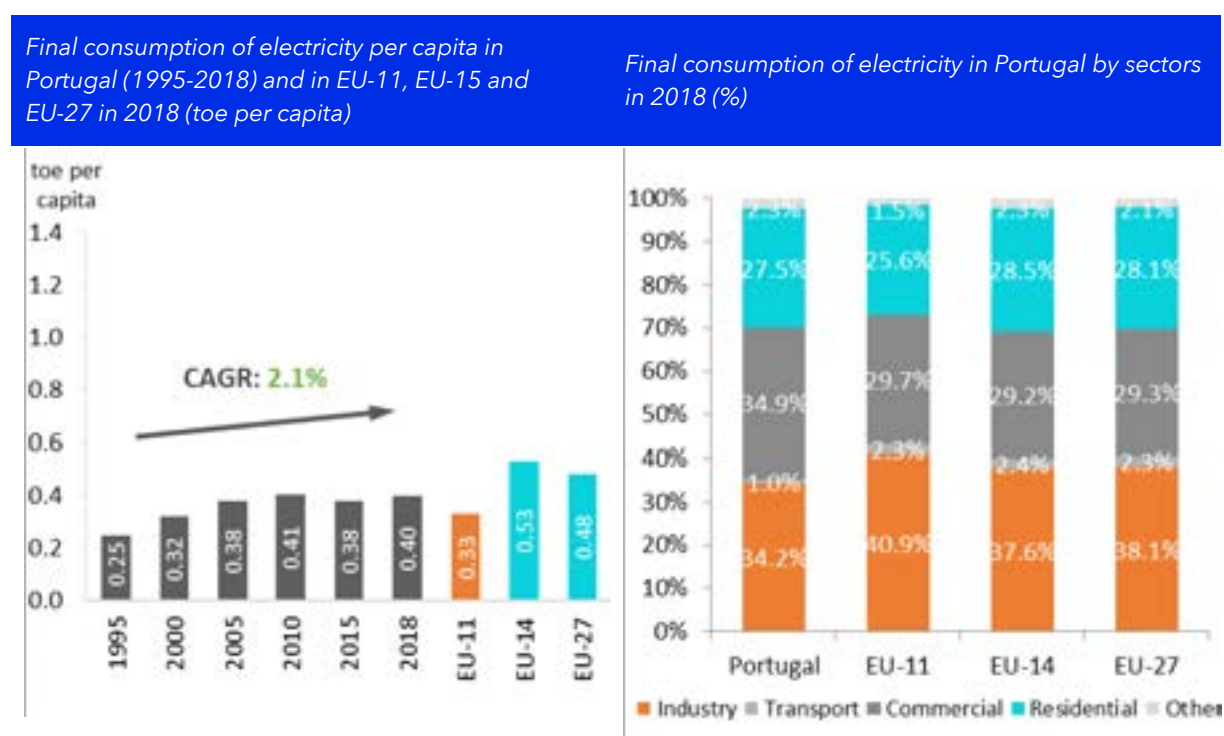
Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

In Item 286 the evolution of final per capita consumption of electricity and its breakdown by economic sector is presented. In recent years final consumption of electricity in Portugal increased (CAGR in the period of 1995-2019 was around 2.1%) and its level was lower compared to EU-14 and EU-27 countries. Portuguese final energy consumption per capita represented 75.5% of EU-14 level and 82.8% of EU-27 level.

The structure of final electricity consumption in Portugal was dominated by commercial sector (34.9% versus 29.2% in EU-14 countries). Relatively less energy was used in transport (1.0% versus 2.4%) and less in industry and residential sectors (34.2% and 27.5% versus 37.6% and 28.5%).

Portugal was consuming relatively more electricity in commercial sector than EU-11 countries (34.9% versus 29.7%) residential one (27.5% versus 25.6%). At the same time, it used relatively less electricity in industry and transport (34.2% and 1.0% versus 40.9% and 2.3%).

Item 286: Final consumption of electricity in Portugal



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Electricity E7000. Errors in summation to 100% are due to rounding

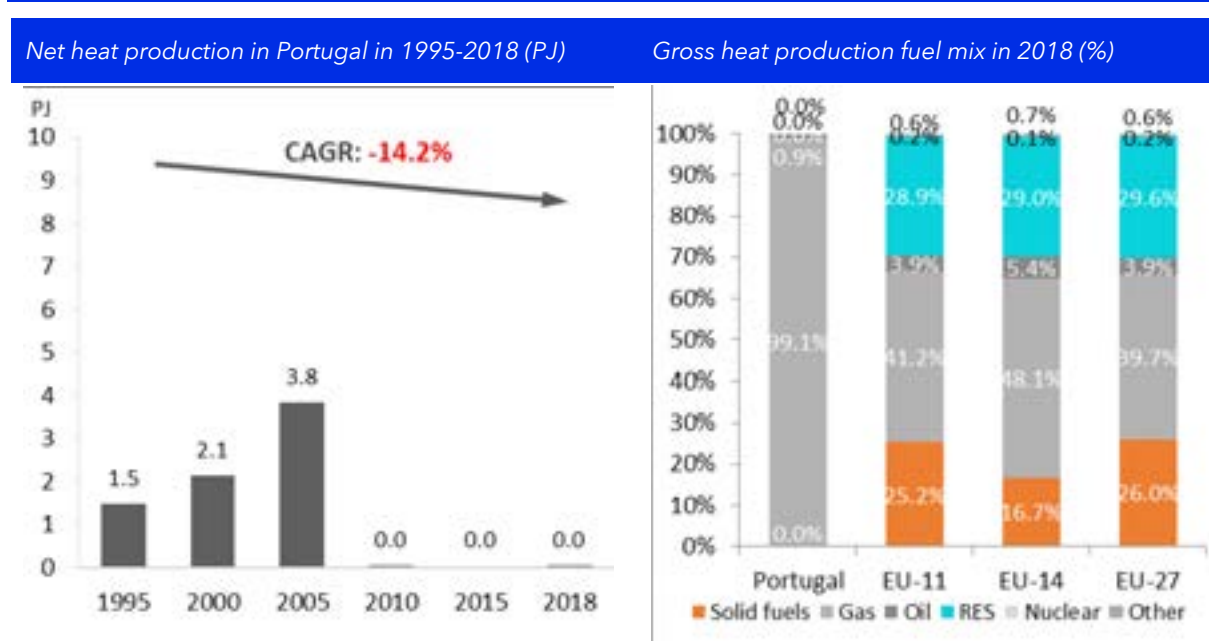
13.5 Overview of heat sector

Item 287 presents heat production and the current fuel mix of Portugal. Over last 23 years net heat production decreased from 1.5 PJ in 1995 to <0.1 PJ in 2018 (CAGR -14.2%).

The Portuguese fuel mix of heat production was dominated by gas with share of 99.1%. The mix was completed by 0.9% of oil. Compared to EU-14 and EU-27 countries, Portugal had a much bigger share of gas in its heat production mix. On other hand, the country was practically not using other sources of energy to produce heat.

When compared to EU-11 average fuel mix one can notice much higher share of gas used in Portugal than in EU-11 (99.1% versus 41.2%). On other hand, the country was practically not using other sources of energy to produce heat.

Item 287: Net heat production and gross electricity production fuel mix in Portugal



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Heat Production - NHP, Gross Heat Production - GHP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

Item 288 presents final heat consumption per capita and its breakdown by sectors.

The per capita demand for heat in Portugal increased from <0.01 toe per capita in 1995 to 0.02 toe per capita in 2018. As a result, within the 23 years analyzed, heat consumption per capita increased at CAGR of 8.2%. The heat consumption remained lower than the averages for EU-11, EU-14 and EU-27, respectively 0.13 toe per capita, 0.10 toe per capita and 0.10 toe per capita.

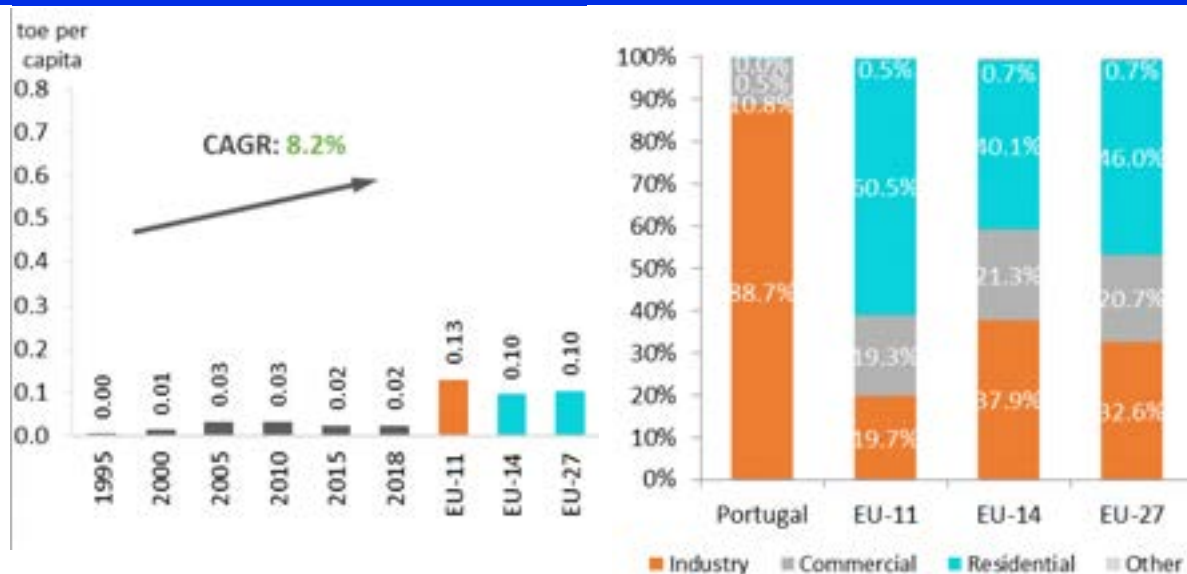
The structure of final consumption of heat in Portugal was characterized by lower share of commercial (10.8% compared to 21.3% in EU-14) and residential usage (0.5% compared to 40.1% in EU-14). The share of industry in heat consumption was higher than the averages (88.7% compared to 37.9% in EU-14).

In relation to EU-11 countries, the structure of final heat consumption in Portugal was characterized by lower share of residential sector (0.5% versus 60.5%) and lower share of commercial sector (10.8% versus 19.3%). The industrial use of heat consumed 88.7% of it in Portugal whereas 19.7% in EU-11.

Item 288: Final consumption of heat in Portugal

Final consumption of heat per capita in Portugal (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Final consumption of heat in Portugal by sectors in 2018 (%)

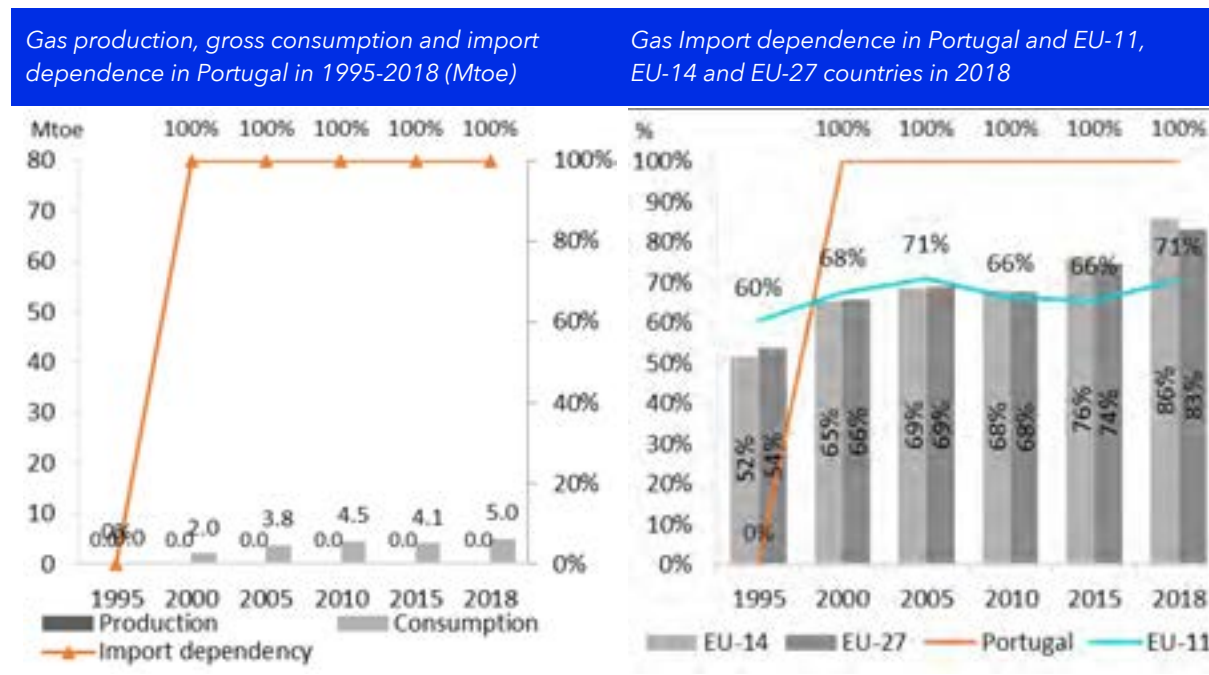


Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Heat H8000. Errors in summation to 100% are due to rounding

13.6 Overview of gas sector

Portugal consumed 5.0 Mtoe of gas in 2018. It increased from null in 1995 to the current value in 2018. National production was null in the country over the whole period of last 23 years. Gas was imported. The country dependency on import therefore, 100%. In 2018 the country was more dependent on import than EU-11, EU-14 and EU-27 average values.

Item 289: Gas sector in Portugal



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gas production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Natural Gas G3000

The final consumption of gas per capita in Portugal increased from 0.0 toe per capita to 0.18 toe per capita over past 23 years. This value was lower than the average values for EU-14, EU-11 and EU-27 countries.

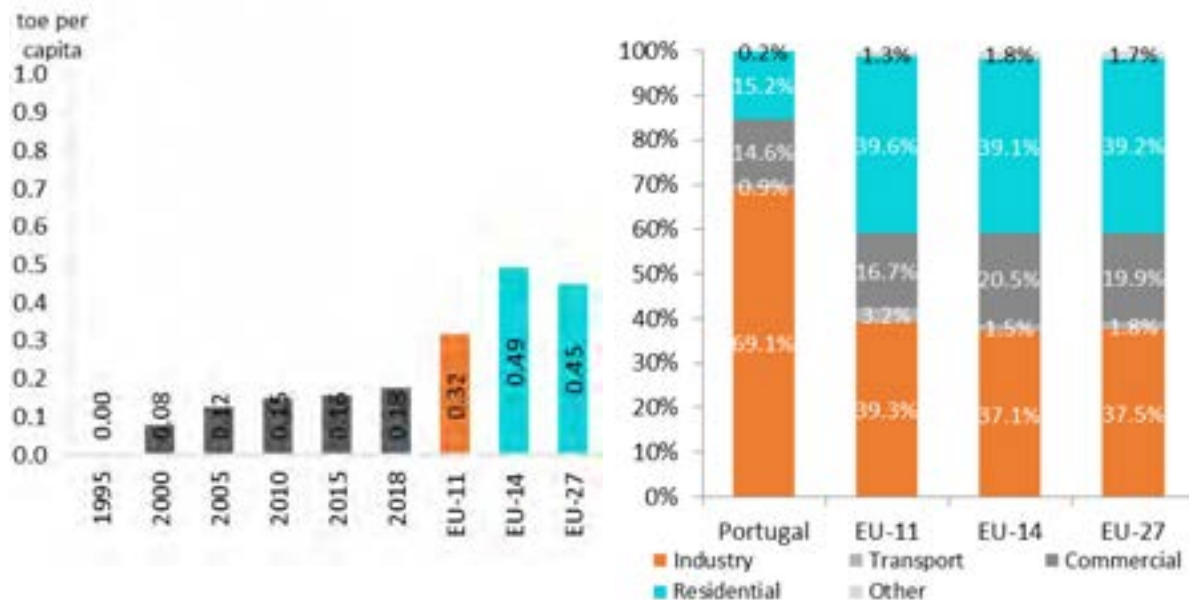
The structure of final gas consumption in Portugal in 2018 was characterized by high share of industry - 69.1% versus 37.1% in EU-14. The share of use of gas in transport, commercial and residential applications were lower than the averages for EU-14 countries.

When compared to EU-11 countries, Portugal was using relatively more gas industry than EU-11 countries - 69.1% versus 39.3%. The country was using less gas in transport - 5.7% versus 3.2%, as well as in commercial and residential sectors - 6.7% versus 16.7% and 28.6% versus 39.6% respectively.

Item 290: Final consumption of gas per capita in Portugal in 1995-2018 and gas final consumption by sectors in Portugal and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of gas per capita in Portugal (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Gas final consumption by sectors in Portugal and EU-11, EU-14 and EU-27 countries in 2018



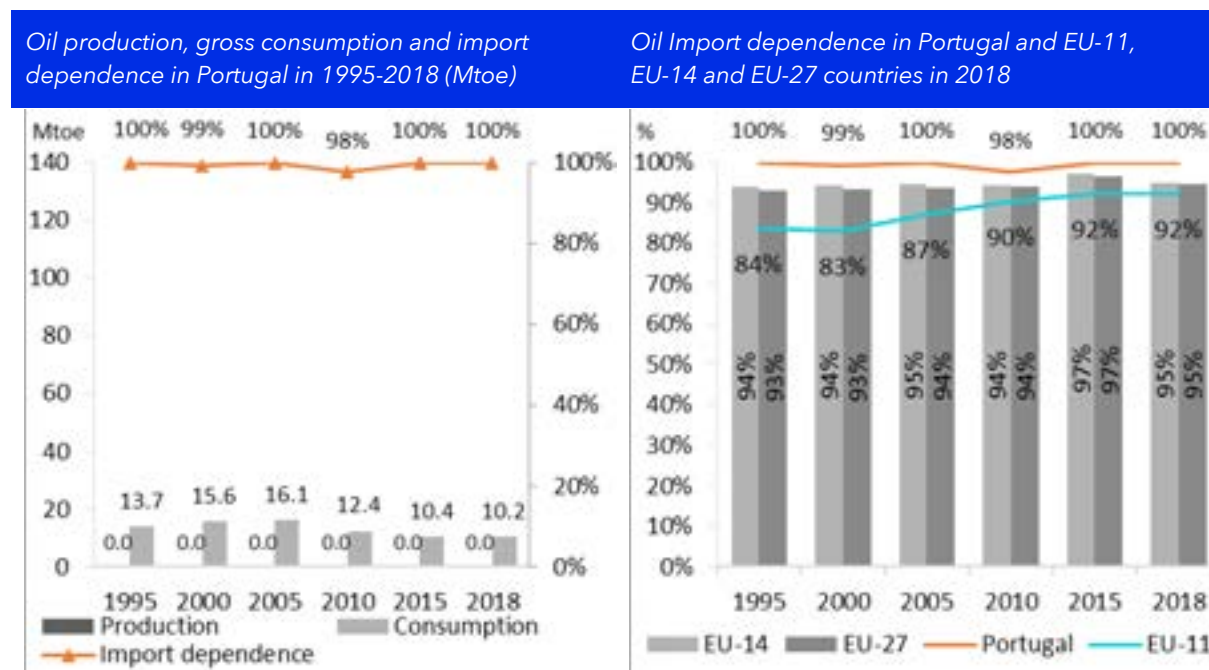
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Natural Gas G3000. Errors in summation to 100% are due to rounding

13.7 Overview of oil sector

The oil consumption of Portugal dropped from 13.7 Mtoe in 1995 to 10.2 Mtoe in 2018. At the same time the national production remained null. Therefore, the level of import dependency was high - between 98% and 100%.

When compared to EU-14 and EU-27 average import dependency, the country had a higher import dependency of 100% versus 95% in EU-14 and EU-27 countries. At the same time, the import dependency of the country was higher than EU-11 average - 100% versus 92%.

Item 291: Oil sector in Portugal



Source: Eurostat data for 2018, extracted in 2020. Detail references: Oil production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Import dependence above 100% has been rounded to 100%

The final consumption of oil per capita in Portugal increased from 0.78 toe per capita in 1995 to 0.98 toe per capita in 2000 and then dropped to 0.69 toe per capita in 2018. The level of final consumption per capita remained higher than the one for EU-11 but lower than the averages for EU-14 and EU-27.

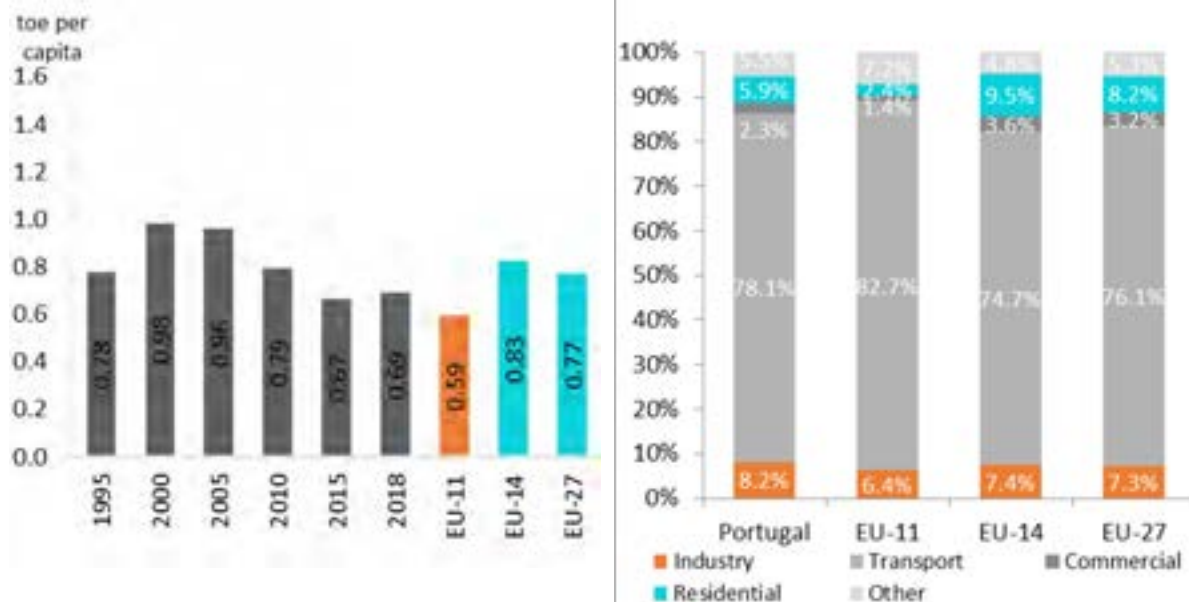
Oil consumption was dominated by transport sector - 78.1% versus 74.7% in EU-14 countries. Relatively more oil was used in industry - 8.2% versus 7.4% but less in commercial sector - 2.3% versus 3.6%. The residential use of oil was also lower than EU-14 average - 5.9% versus 9.5%.

The relative consumption of oil in Portugal compared to EU-11 was lower in 2018 - 78.1% versus 82.7%. The use in industry was relatively higher - 8.2% versus 6.4%. At the same time commercial and residential sector were consuming relatively more oil in the country than EU-11 averages - 2.3% and 5.9% versus 1.4% and 2.4%.

Item 292: Final consumption of oil per capita in Portugal in 1995-2018 and oil final consumption by sectors in Portugal and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of oil per capita in Portugal (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Oil final consumption by sectors in Portugal and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Errors in summation to 100% are due to rounding

13.8 EU climate policy and its targets for Portugal

Portugal is subject to EU energy and climate regulations and therefore, specific targets were set and verified regarding greenhouse gas emission, share of energy from renewable energy sources and energy efficiency improvements (see Item 293).

Item 293: Energy and climate targets for Portugal for 2020 and 2030

| | Portugal 2020 targets | Portugal 2030 targets |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | EU wide target of 20% reduction from 1990 levels (14% from 2005 level) | EU wide target of 40% reduction from 1990 levels |
| Greenhouse gas emissions in ETS | EU wide target of 21% reduction from 2005 | EU wide target of 43% reduction from 2005 |
| National emission reduction targets in non-ETS - Effort Sharing Decision (ESD) | +1% in relation to their 2005 levels | - |
| National emission reduction targets in non-ETS - Effort Sharing Regulations (ESR) | - | -17% in relation to their 2005 levels |
| Share of energy from renewable energy sources | EU wide target of 20% energy from renewables | EU wide target of minimum 32% share for renewable energy |
| EU wide target of share of energy from renewable energy sources | EU wide target of 20% share of gross final energy consumption | EU wide target of 32% share of gross final energy consumption |
| National target of share of energy from renewable energy sources | 31% of gross final consumption | Not yet available |
| Improvement in energy efficiency | EU wide target of 20% improvement in energy efficiency | EU wide target of at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |
| Primary energy consumption | EU wide target < 1,483 Mtoe National target < 22.5 Mtoe | EU wide target of 1,273 Mtoe (< 1,128 Mtoe EU-27) National targets not available yet |
| Final energy consumption | EU wide target < 1,086 Mtoe National target < 17.4 Mtoe | EU wide target < 956 Mtoe (< 846 Mtoe EU-27) National targets not available yet |

Source: EU website

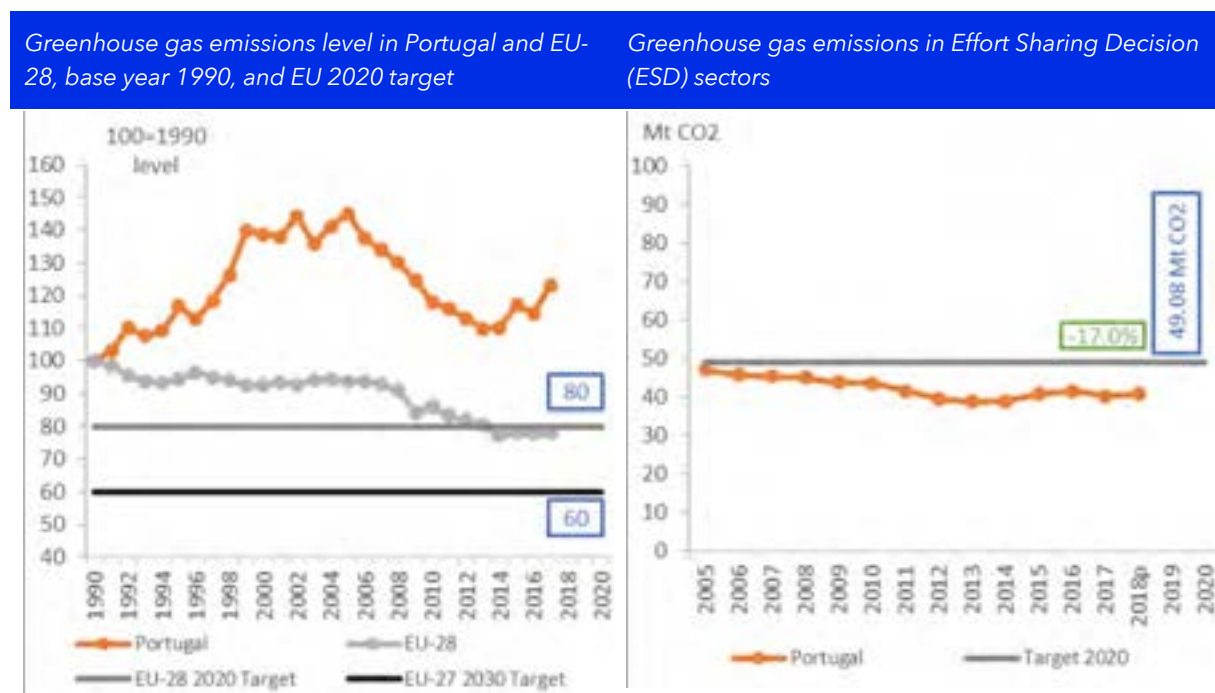
In following chapter, the overview of Portugal targets and performance are summarized.

13.8.1 Greenhouse gas emissions

EU set a target for CO₂ reduction by 20% compared to 1990 level at EU level. Regardless the fact that the target was not binding for specific country, the level of CO₂ emission in Portugal was below EU wide target.

The non-ETS greenhouse gas emissions the binding national targets for Portugal was 49.08 Mt of CO₂ equivalent emissions. Comparing to 2018 provisional results the level of emissions overachieved the target by 17.0%.

Item 294: Energy efficiency target data for Portugal



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Greenhouse gas emissions, base year 1990 [T2020_30], Greenhouse gas emissions in ESD sectors [T2020_35]

13.8.2 Renewable energy sources

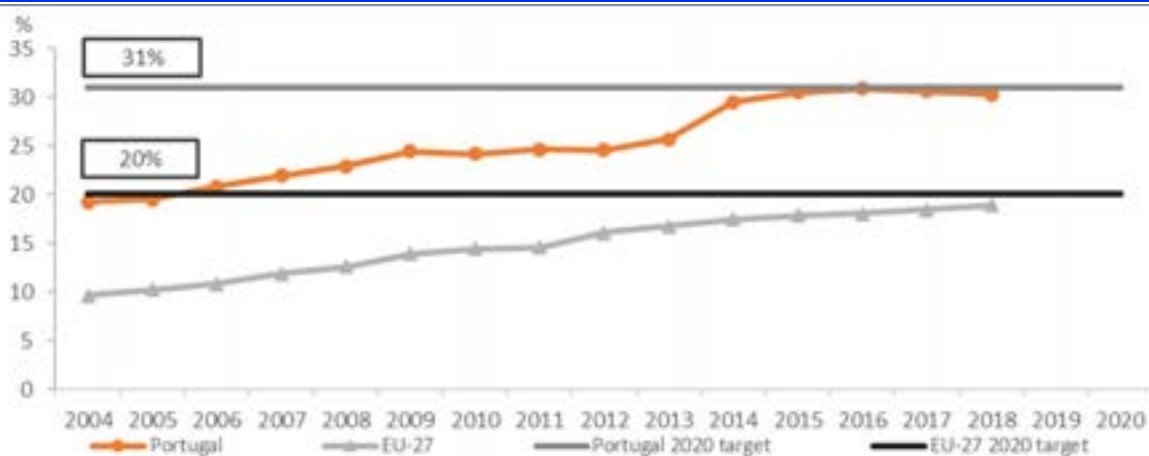
The following targets were set for Portugal regarding the share of energy from renewable energy sources in gross final energy consumption:

- a 20% share of gross final energy consumption by 2020,
- a 31% national target for share of energy from renewable sources in gross final consumption of energy in 2020.

The share of energy from renewable energy sources in Portugal was below EU wide and country specific targets in 2018.

Item 295: Share of energy from renewable energy sources in gross final energy consumption in Portugal

Share of energy from renewable energy sources in gross final energy consumption in Portugal in 2005-2018 and targets for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Share of energy from renewable sources [nrg_ind_ren]

13.8.3 Energy efficiency

The energy efficiency target set for Portugal were respectively:

- Primary Energy Consumption in 2020: 22.5 Mtoe
- Final energy consumption in 2020: 17.4 Mtoe

Following the information provided in Item 296 the results for 2018 were above the targets +4.8% of primary energy consumption but below target -2.8% of final energy consumption. This does not exclude Portugal to achieve the targets in 2020.

Item 296: Energy efficiency target data for Portugal

Primary energy consumption and final energy consumption in Portugal in 2005-2018 and targets for 2020

Ratio of primary energy consumption to target for 2020 and final energy consumption to target for 2020 in Portugal, EU-11, EU-14 and EU-27 in 2018



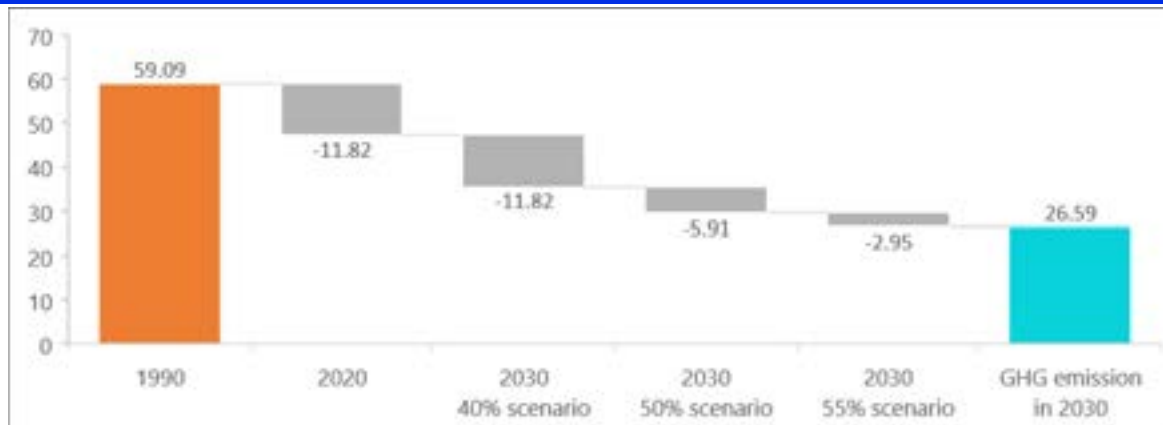
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Primary energy consumption - Primary energy consumption (Europe 2020-2030)(PEC2020-2030), final energy consumption - Final energy consumption (Europe 2020-2030) (FEC2020-2030). EU-11 and EU-14 data estimated based on Eurostat data

13.9 Review of potential impact of Green Deal propositions

At the current stage of discussions regarding the European Green Deal only partial information are available regarding the future targets. EU is proposing to increase the greenhouse gas emission reduction to 50% or 55% for 2030. This is a proposition included in the draft proposal of "Climate Law". Assuming the Portugal greenhouse gas emissions in 1990, an estimation of EU 2030 target emissions can be drafted. The 2020 target of 20% reduction resulted in 11.82 Mt CO₂ emission drop. Further increase of the target to 40% in 2030 require additional 11.82 Mt CO₂ reduction. If the 50% target proposed under European Green Deal is applied then additional 5.91 Mt CO₂ emission decrease is needed, or 8.86 Mt CO₂ decrease, if 55% target is adopted.

Item 297: Estimation regarding greenhouse gas emissions in Portugal under different scenarios (Mt CO₂)

Estimation regarding greenhouse gas emissions in Portugal under different scenarios (Mt CO₂)



Source: Eurostat data for 2018, extracted in 2020. Estimations delivered by the Author

Nevertheless, it is worth to highlight that, if the current structure of greenhouse gas emissions target is maintain, then the 50% target for 2030 is an EU wide target. It is not a binding element for specific countries. Country specific targets could be expected as per ESD and ESR but there is no way to anticipate the potential targets.

At the same time, the review of key EU regulations around climate and energy as:

- Emissions Trading System Directive;
- Effort Sharing Regulation;
- Land use, land use change and forestry Regulation;
- Energy Efficiency Directive;
- Renewable Energy Directive;
- CO₂ emissions performance standards for cars and vans
- Energy Taxation Directive

can bring some additional targets in area of share of energy from renewable energy sources and energy efficiency. For the moment, any estimation of potential targets is not available nor possible to estimate.



14 Spain

14.1 General information

Spain is the second biggest country within EU-14 group in terms of total country area and represents 16.4% of the area. At the same time, it is the 2nd country in EU-27 with 12.0% of the area. It represents 13.6% of EU-14 population and 10.5% of EU-27 population, but 10.0% of its total nominal GDP of EU-14 and 8.9% of EU-27. Despite the robust economic growth in 1995-2018 period, in 2018 Spanish GDP per capita amounted to 91% of the whole EU average (92% in 1995).

Item 298: Spain - key data



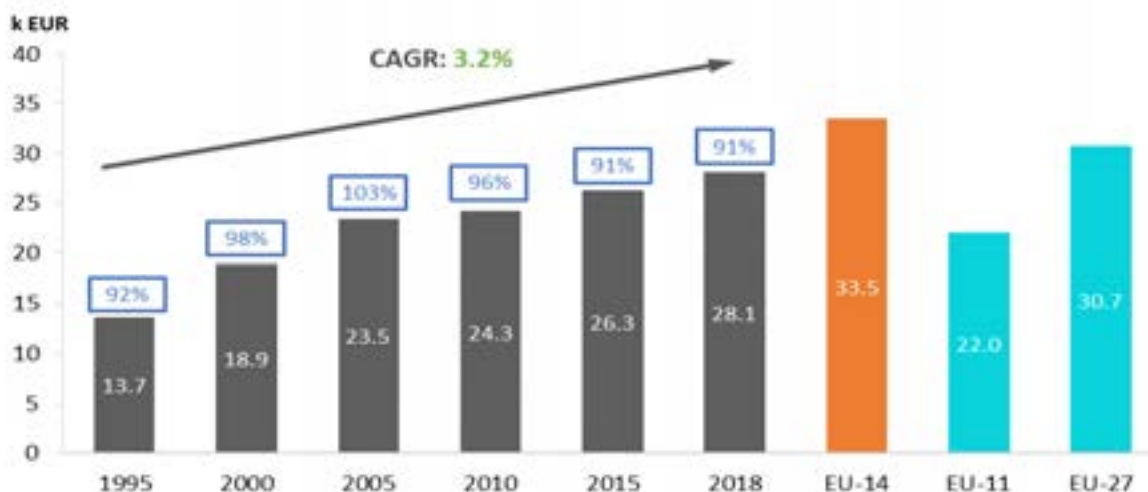
Key data

| | |
|------------------------------------------------------|--------|
| Population (M) | 46.7 |
| GDP per capita (EUR, nominal) | 25,730 |
| GDP per capita (EUR, PPS) | 28,110 |
| GDP as share of EU-14 | 10.0% |
| GDP as share of EU-27 | 8.9% |
| Energy intensity of the economy (kgoe per 1,000 EUR) | 106.6 |
| Greenhouse gas emissions (Mg per capita) | 7.3 |

Source: Eurostat data for 2018, extracted in 2020

With the compounded annual growth rate amounting to 3.2% Spanish economy considerably grew in the period of 1995-2018 (see Item 299). Its GDP per capita was below EU-14 and EU-27 averages (equal to 84% and 91% of the respective averages). Its GDP per capita was also 128% of the average GDP per capita for EU-11 countries.

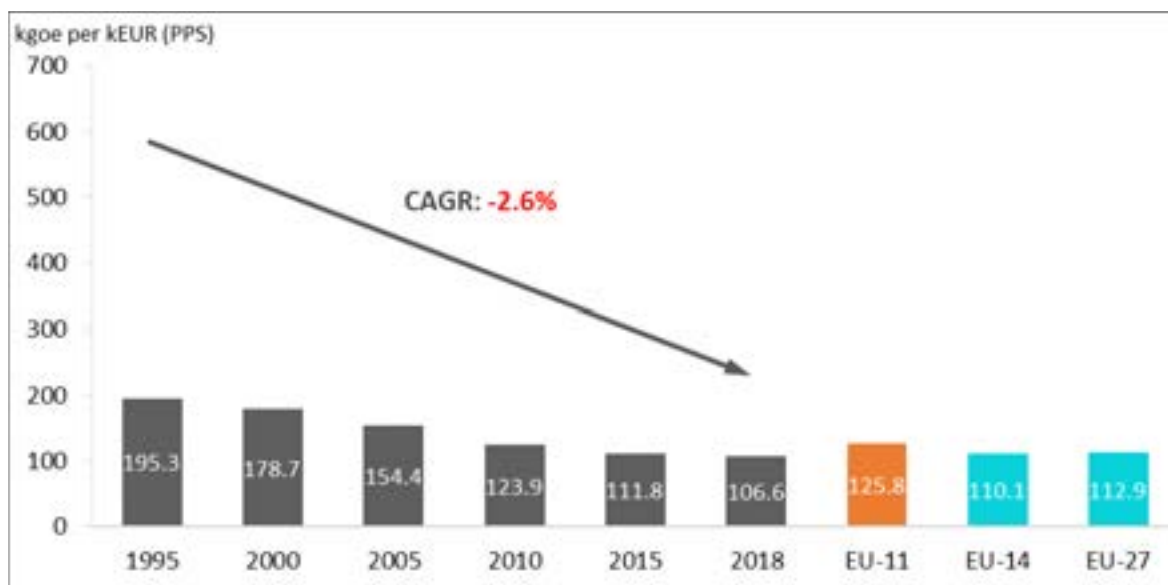
Item 299: GDP per capita in Spain for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in 2018 (kEUR, PPS) and share of Spain GDP per capita in relation to EU-27 average



Source: Eurostat data for 2018, extracted in 2020. Detail references: GDP per capita - Gross domestic product at market prices (B1GQ), Current prices, purchasing power standard per capita (CP_PPS_HAB)

The Spanish economy energy intensity was about 106.6 kgoe per 1,000 EUR PPS in 2018, thanks to a decrease of the energy intensity indicator during the years 1995-2018. It dropped by 88.7 kgoe per 1,000 EUR PPS, i.e. it was reduced by about 45%. The energy intensity of Spain in 2018 represented 85% and 94% of EU-14 and EU-27 averages. At the same time, it represented 97% of EU-11 average.

Item 300: Energy intensity of the economy in Spain in 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)



Source: Eurostat data for 2018, extracted in 2020. Values for EU-11 and EU-14 were recalculated based on energy intensity and GDP data from Eurostat. Detail references: Energy intensity of GDP in purchasing power standards (PPS) - EI_GDP_PPS

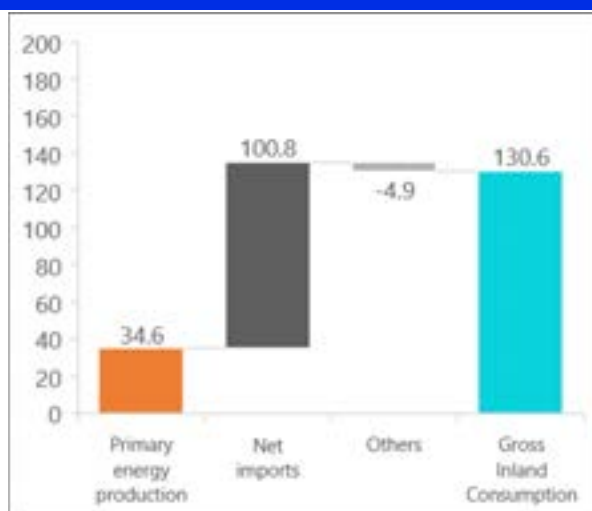
14.2 Energy balance of Spain

The energy balance of Spain in 2018 is presented in 308. The primary energy production was equal to 34.6 Mtoe in 2018. Net imports added 100.8 Mtoe to the balance. The total gross inland consumption accounted for 130.6 Mtoe. The level of import of energy to Spain grew slowly until 2008 and then it dropped to the level of 2018. At the same time the level of net import reported to the energy needs followed similar pattern and it was about 50% in 2018.

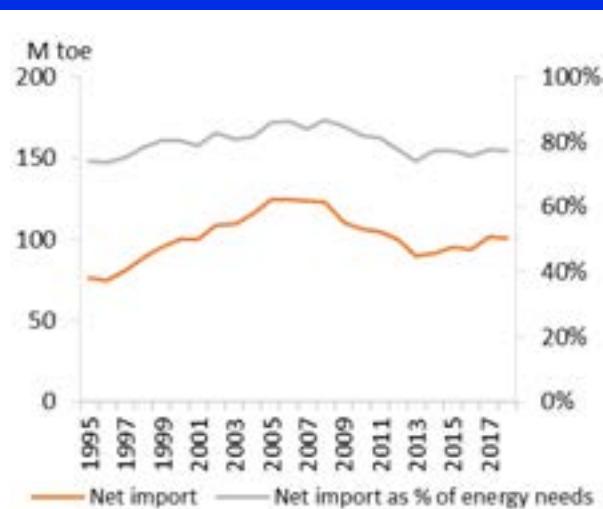
The primary energy production increased over past 23 years, as well as gross energy consumption. National production was meeting only 27% of the country gross consumption and this factor decreased over last 23 years from 31%.

Item 301: Energy balance in Spain

Energy balance in Spain in 2018 (Mtoe)



Net import of energy in Spain in 1995-2018 (Mtoe and as percentage of GIC)



Gross inland consumption, primary energy production (Mtoe) and ratio of primary energy production to gross inland consumption in 1995-2018 in Spain (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Gross inland consumption - GIC. Net imports = Import (IMP) - Export (EXP), Other = Change in stock (STK-CHG) - International maritime bunkers (INTMARB)

The primary energy production in Spain was dominated by nuclear (42%) and renewable energy sources (54%). The mix was completed by 3% share of solid fuels and 1% of other energy sources in the mix. Usage of oil and gas were negligible.

When compared to the European averages, Spain was characterized by very high share of renewable energy sources in the energy mix - 54% versus 38% EU-14 average and 34% EU-27 average. The share of nuclear energy in the Spanish fuel mix was higher in EU-14 and EU-27 (42% versus 36% in EU-14 and 31% in EU-27). At the same time, the share of solid fuels was lower in Spain than the averages for EU-14 and EU-27 (3% versus 10% and 19%). In opposite to EU averages Spain use of oil and gas in primary energy production was negligible.

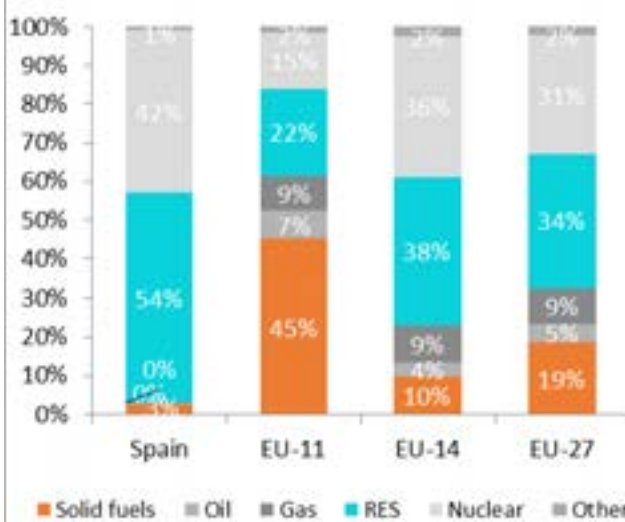
The comparison of Spain to EU-11 averages was mainly characterized by much higher share of RES (54% versus 22%) and higher share of nuclear energy (42% versus 15%). The share of solid fuels was lower in Spain than in EU-11 countries (3% versus 45%). Shares of gas and oil were significantly lower as Spain use of these fuels was negligible.

Item 302: Primary energy structure in Spain

Primary energy structure in Spain in 2018 (%)



Primary energy production structure in Spain in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

Gross inland consumption of energy in Italy was dominated by oil (44%), gas (21%) and renewable energy sources (14%). The mix was completed by 11% of nuclear energy, 9% of solid fuels and 1% of other energy sources.

Comparing to European averages gross inland consumption of energy in Spain was marked by low share of solid fuels (9% versus 11% in EU-14 and 14% in EU-27). The share of oil was higher in Spain (44%) than in EU-14 (35%) and EU-27 (34%) whereas the share of gas was almost the same (21% versus 22-23%). Spain was characterized by lower share of renewable energy sources in the mix - 14% versus 16% and 15% in EU-14 and EU-27 respectively, as well as lower share of nuclear energy in the mix (11% versus 14% in EU-14 and 13% in EU-27).

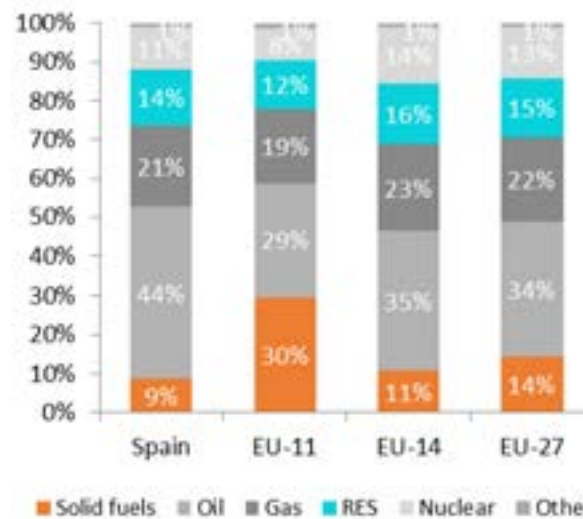
When compared to EU-11 the main difference was around much lower share of solid fuels consumption in Spain (9% versus 30% in EU-11) and higher share of renewable energy sources (14% versus 12%). The share of oil and gas use in Spain were also higher than in EU-11 countries (44% versus 29% and 21% versus 19% respectively). EU-11 average gross final consumption included nuclear energy at 8%. In Spain it was 11%.

Item 303: Gross inland consumption structure in Spain

Gross inland consumption structure in Spain in 2018 (%)



Gross inland consumption structure in Spain in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gross inland consumption - GIC, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

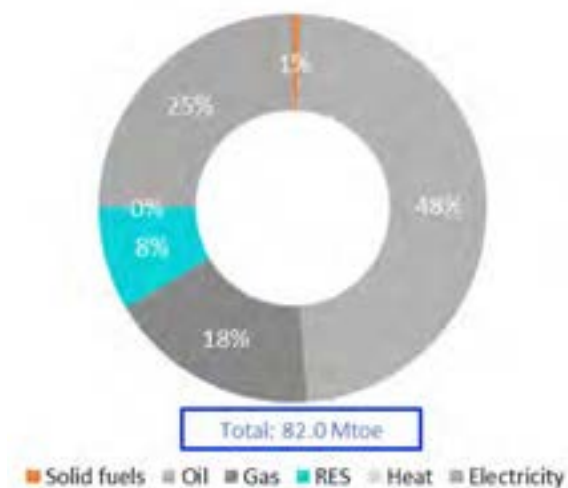
The final energy consumption in Spain was dominated by oil (48%), followed by electricity (25%), gas (18%) and renewable energy sources (8%). The mix was completed by solid fuels (1%).

The sectoral final energy consumption in Spain was characterized by lower share of industrial and but higher of transport sectors than in EU-14 and EU-27 (25% and 40% versus 26% and 31% in EU-14 and EU-27). The share of commercial and public services in final energy consumption in Spain (14%) was close to the one in EU-14 (15%) and EU-27 (14%).

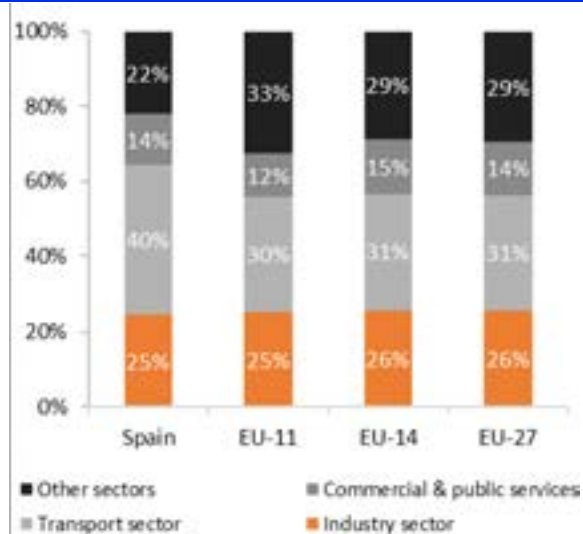
When compared to EU-11 Spain similar conclusions as related to EU-14 and EU-27 can be drawn.

Item 304: Final energy consumption structure in Spain

Final energy consumption structure in Spain in 2018 (%)



Final energy consumption structure in Spain in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Heat (H8000), Electricity (E7000), Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial & public services - FC_OTH_CP_E, Other - FC_OTH_E-FC_OTH_CP_E. Errors in summation to 100% are due to rounding

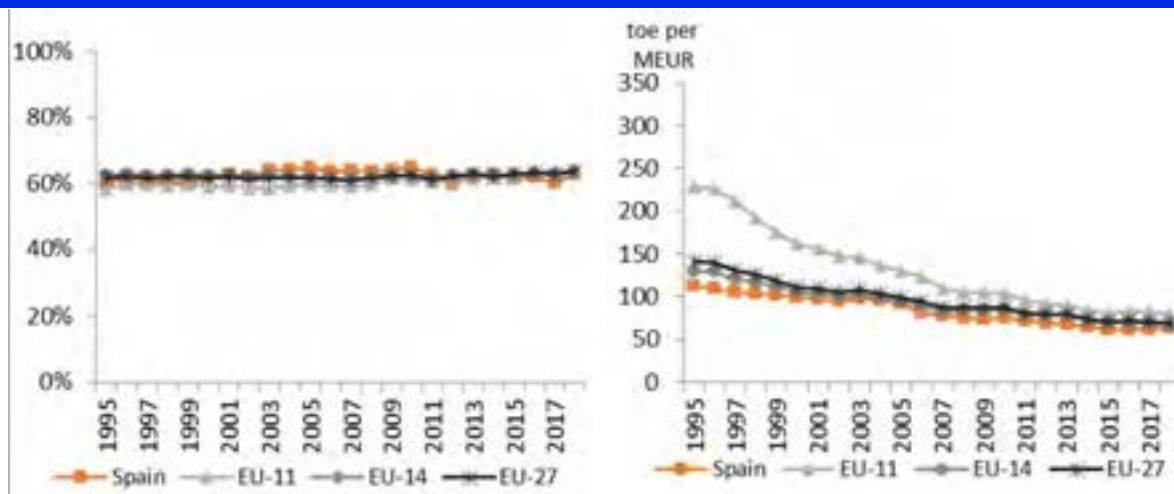
Spanish final energy consumption to gross inland consumption ratio which measure energy efficiency was higher than the averages for EU-11, EU-14 and EU-27. The situation remained stable for last 23 years.

Simultaneously, a decrease of energy volume associated with generating gross domestic product was noticed in line with the averages for EU-14 and EU-27 averages.

Item 305: Final energy consumption in Spain in relation to selected indicators

Final energy consumption to gross inland consumption ratio in Spain in 1995-2018 (%)

Final energy consumption to gross domestic product ratio in Spain in 1995-2018 in comparison with EU-11, EU-14, and EU-27 averages (toe per M EUR)



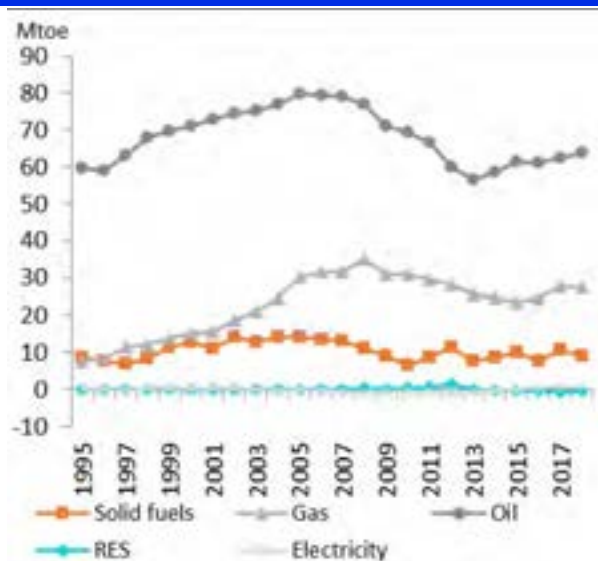
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final energy consumption - FEC, Gross inland consumption - GIC, Gross Domestic Product - Gross domestic product at market prices B1GQ, Current prices - CP-MEUR

Net import of energy to Spain by fuels was characterized by an increase of oil import up to 2007 and then a decrease. The level of import in 2018 of oil was similar as in 1995. The level of oil import increased up to 2009 and then decrease a little to the current value. Solid fuels import was fluctuating over past 23 years.

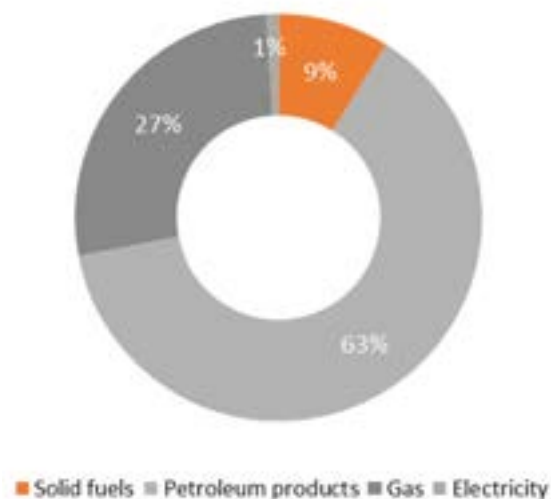
The import structure of energy to Spain was dominated by oil (63%) and gas (27%). The imports were completed by 9% of solid fuels and 1% of electricity.

Item 306: Net import of energy in Spain

Net import of energy by fuel in 1995-2018 (Mtoe)



Net import structure in 2018 (% only fuels for which import is greater than export)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Electricity (E7000). Errors in summation to 100% are due to rounding

Solid fuels were imported to Spain mainly from Indonesia (28%), Russia (23%), Colombia (21%) and several other countries.

Main oil importers to Spain were Nigeria (12%), Mexico (11%), Saudi Arabia (10%) and Libya (8%). The remaining 59% were imported from various locations.

Spain was importing gas mainly from Algeria (39%), Nigeria (16%) and Qatar (13%). The remaining 32% were supplied from different locations.

Electricity was mainly imported from France (64%) and Portugal (35%). Smaller amounts were imported from Morocco (about 1% of the total).

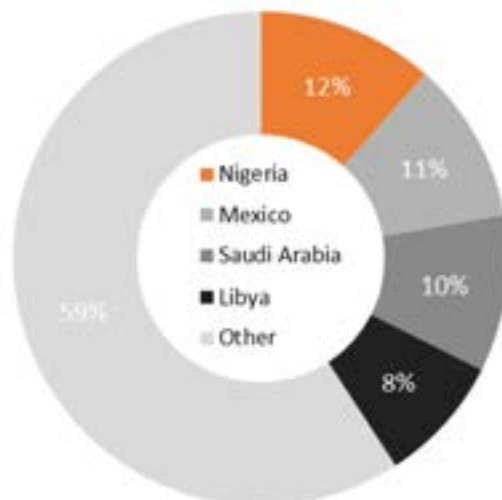
Item 307: Foreign fuel suppliers

Foreign suppliers of solid fuels in Spain in 2018 (%)



Total: 9.3 Mtoe

Foreign suppliers of crude oil in Spain in 2018(%)



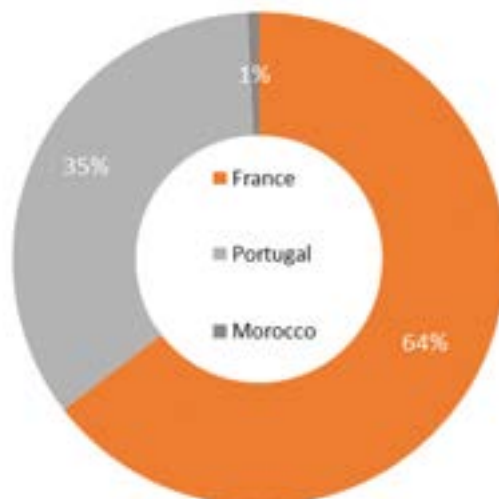
Total: 89.2 Mtoe

Foreign suppliers of gas in Spain in 2018 (%)



Total: 30.3 Mtoe

Foreign suppliers of electricity in Spain in 2018 (%)



Total: 2.1 Mtoe

Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fossil fuels - C000X0350-0370, Gas - Natural gas (G3000), Oil - Oil and petroleum products (excluding biofuel portion) (O4000XBIO), Electricity - E7000. Errors in summation to 100% are due to rounding

14.3 Greenhouse gas emissions

Between 1995-2017 greenhouse gases emissions in Spain were increased - from over 288.5 Mt CO₂ in 1995 to 340.2 Mt CO₂ in 2017, but average emissions per capita decreased to 7.3 Mg CO₂ per capita in 2017 (from 8.3 Mg CO₂ per capita in 1995), which was lower comparing to EU-14 and EU-27 averages (8.5 Mg CO₂ per capita and 8.6 Mg CO₂ per capita, respectively), and also lower than in EU-11 (9.0 Mg CO₂ per capita)

There were some noteworthy changes in the Spanish structure of greenhouse gas emissions over the period considered. The significance of manufacturing and construction and industrial processes sectors emissions dropped by 27% and 11%, as well as emissions from energy industries 7%. On other hand, transport emissions, agriculture and waste management sectors emissions gained in importance increasing by 27%, 10% and 25% respectively.

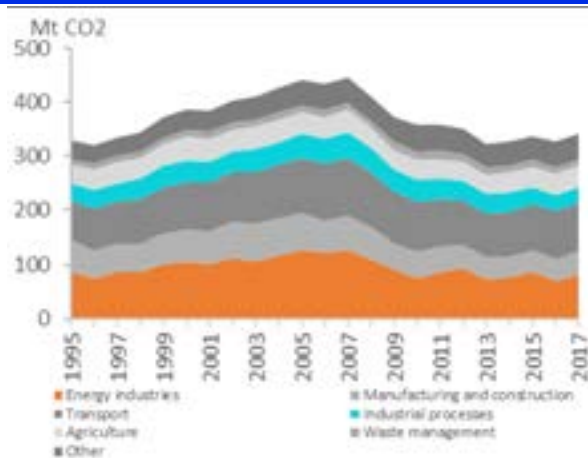
Comparing to EU-11, EU-14 and EU-27 countries, Spain was characterized by higher share of emissions from transport (26% versus 17%, 23% and 21%). The share of energy industries emissions was lower in Spain, as well as emissions from industrial processes. Agriculture and waste management's share were a little higher in Spain than the European averages.

Item 308: Greenhouse gas emissions in Spain

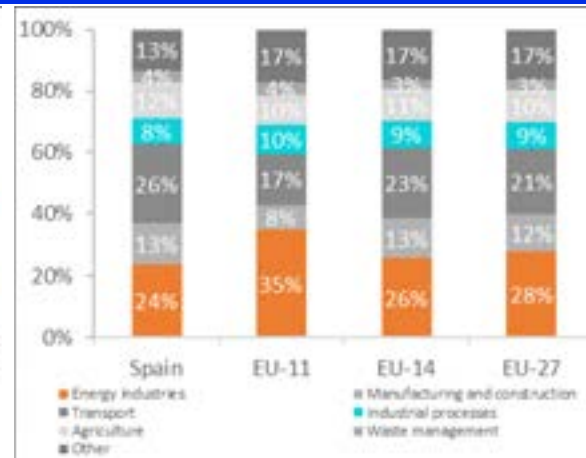
Greenhouse gas emissions per capita in Spain in 1995-2017 in comparison with EU-11, EU-14 and EU-27 averages in 2017 (Mg per capita)



Greenhouse gas emissions in Spain by sectors in 1995-2017 (Mt CO₂)



Greenhouse gas emissions in Spain by sectors in 2017 in comparison with EU-11, EU-14 and EU-27 averages (%)



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - * values for EU-11, EU-14 and EU-27 recalculated by the Author; Energy industry - Fuel combustion in energy industries (CRF1A1), Manufacturing and construction - Fuel combustion in manufacturing industries

and construction (CRF1A2), Transport - Fuel combustion in transport (CRF1A3), Industrial processes - Industrial processes and product use (CRF2), Agriculture - Agriculture (CRF3), Waste management - Waste management (CRF5), Other = Other fuel combustion sectors (CRF1A4)+ Other fuel combustion sectors n.e.c. (CRF1A5) + Fuels - fugitive emissions (CRF1B)+Other sectors (CRF6); Total GHG emissions equal to All sectors (excluding LULUCF and memo items) (CRF1-6X4_MEMO) i.e. emission from all sectors excluding Land use, land use change, and forestry (LULUCF), Transport and storage of CO₂ (memo item), International aviation (memo item), International navigation (memo item), Multilateral operations (memo item), Biomass - CO₂ emissions (memo item). Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. Errors in summation to 100% are due to rounding

14.4 Overview of electricity sector

Item 309 presents electricity production and the current fuel mix of Spain. Over last 23 years net electricity production increased from 149.0 TWh in 1995 to 227.2 TWh in 2018 (CAGR 1.9%). As visible, net electricity production represented 10.6% of EU-14 total electricity production, which was higher compared to Spanish GDP share of 10.0%.

The Spanish fuel mix was dominated by renewable energy sources and gas with shares of 38.9% and 21.7% respectively. The mix was completed by 20.4% of production from nuclear energy, 13.6% from solid fuels and small shares of oil (5.3%). Compared to EU-14 and EU-27 countries, Spain had a much bigger share of renewable energy sources and gas in its energy mix. Spain was also more relying on oil - 5.3% share versus 1.9% in EU-14. On other hand, the country produced relatively less electricity from solid fuels and nuclear energy, respectively 13.6% and 20.4%.

When compared to EU-11 average fuel mix one can notice much higher share of renewable energy sources and gas used in Spain than in EU-11 (38.9% and 21.7% versus 21.3% and 10.6%) and significantly lower use of solid fuels (13.6% versus 45.8%). The share of oil was higher (5.3% versus 2.7%). Spain was more relying on nuclear energy than EU-11 countries with a share of 20.4% versus 19.5% in EU-11.

Item 309: Net electricity production and gross electricity production fuel mix in Spain

Net electricity production in Spain in 1995-2018
(Mtoe)

Gross electricity production fuel mix in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Electricity Production - NEP, Gross Electricity Production - GEP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

In Item 310 the evolution of final per capita consumption of electricity and its breakdown by economic sector is presented. In recent years final consumption of electricity in Spain increased (CAGR in the period of 1995-2019 was around 1.6%) and its level was lower compared to EU-14 and EU-27 countries. Spanish final energy consumption per capita represented 82.8% of EU-14 level and 90.8% of EU-27 level.

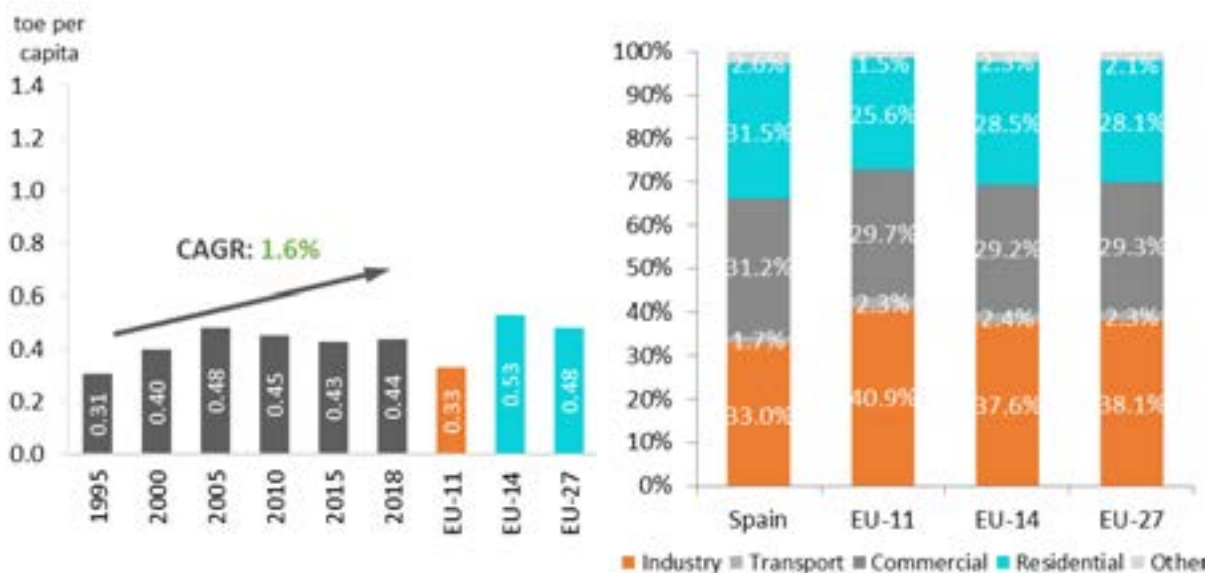
The structure of final electricity consumption in Spain was dominated by commercial and residential sectors (31.2% and 31.5% versus 29.2% and 28.5% in EU-14 countries). Relatively less energy was used in transport (1.7% versus 2.4%) and less in industry (33.0% versus 37.6%).

Spain was consuming relatively more electricity in commercial and residential sectors than EU-11 countries (31.2% and 31.5% versus 29.7% and 25.6%). At the same time, it used relatively less electricity in transport and industry (1.7% and 33.0% versus 2.3% and 40.9%).

Item 310: Final consumption of electricity in Spain

Final consumption of electricity per capita in Spain (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Final consumption of electricity in Spain by sectors in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Electricity E7000. Errors in summation to 100% are due to rounding

14.5 Overview of heat sector

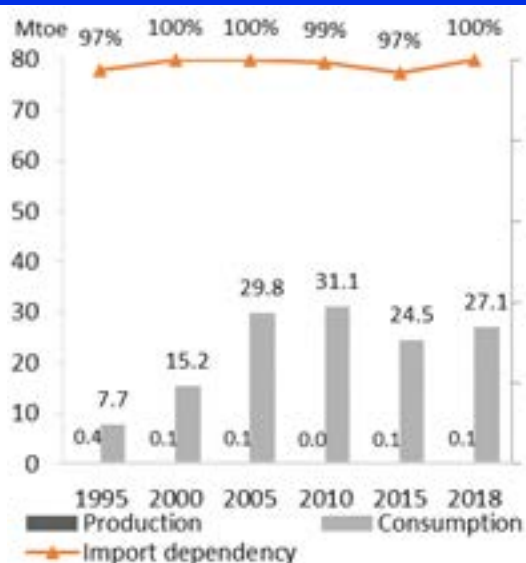
The official Eurostat statistic does not provide any information about Spanish heat production, nor consumption. Therefore, there was no heat sector in Spain.

14.6 Overview of gas sector

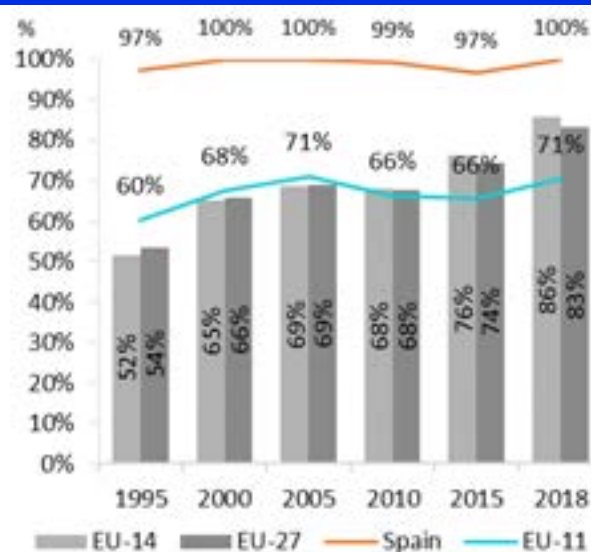
Spain consumed 27.1 Mtoe of gas in 2018. It increased from 7.7 Mtoe in 1995 to 31.1 Mtoe in 2010 and then decreased. National production accounted for 0.1 Mtoe and it decreased over past 23 years from 0.4 Mtoe to the current value. The remaining part of gas was imported. The country dependency on import was fluctuating from 97% to 100% over past 23 years. In 2018 the country was more dependent on import than EU-11, EU-14 and EU-27 average values.

Item 311: Gas sector in Spain

Gas production, gross consumption and import dependence in Spain in 1995-2018 (Mtoe)



Gas Import dependence in Spain and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gas production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Natural Gas G3000

The final consumption of gas per capita in Spain increased from 0.16 toe per capita to 0.31 toe per capita over past 23 years. This value was lower than the average values for EU-14, EU-11 and EU-27 countries.

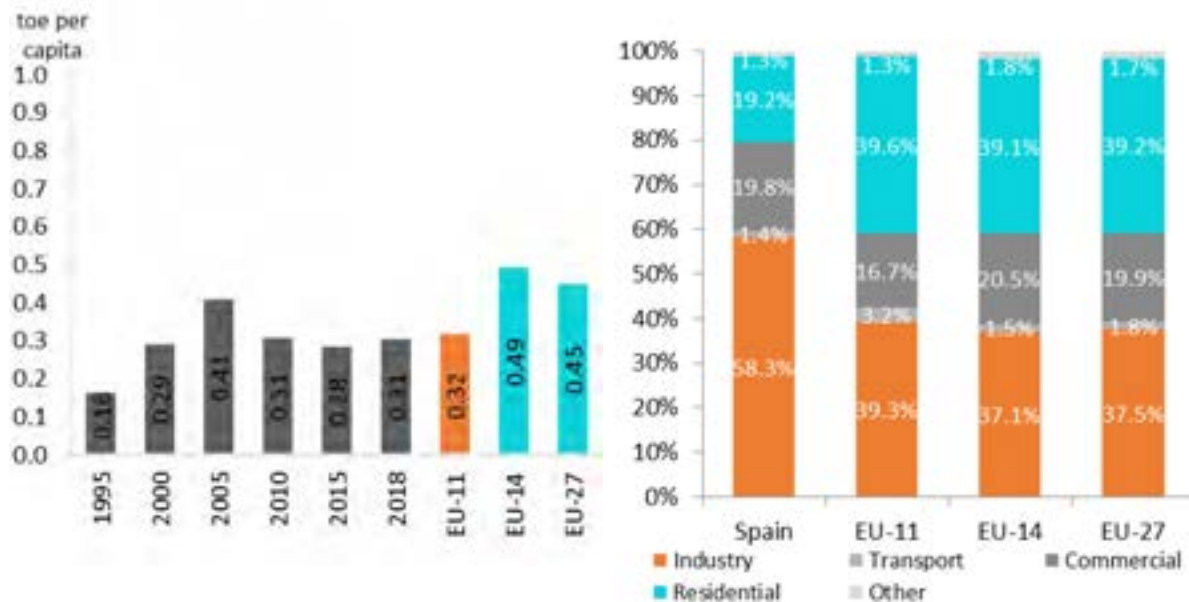
The structure of final gas consumption in Spain in 2018 was characterized by high share of industry - 58.3% versus 37.1% in EU-14. The share of use of gas in transport, commercial and residential applications were lower than the averages for EU-14 countries.

When compared to EU-11 countries, Spain was using relatively more gas industry than EU-11 countries - 58.3% versus 39.3%. The country was using less gas in transport and residential sectors - 1.4% versus 3.2% and 19.2% versus 39.6% respectively. On other hand, the share of gas used in commercial sector was higher than in EU-11 countries, 19.8% versus 16.7%.

Item 312: Final consumption of gas per capita in Spain in 1995-2018 and gas final consumption by sectors in Spain and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of gas per capita in Spain (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Gas final consumption by sectors in Spain and EU-11, EU-14 and EU-27 countries in 2018



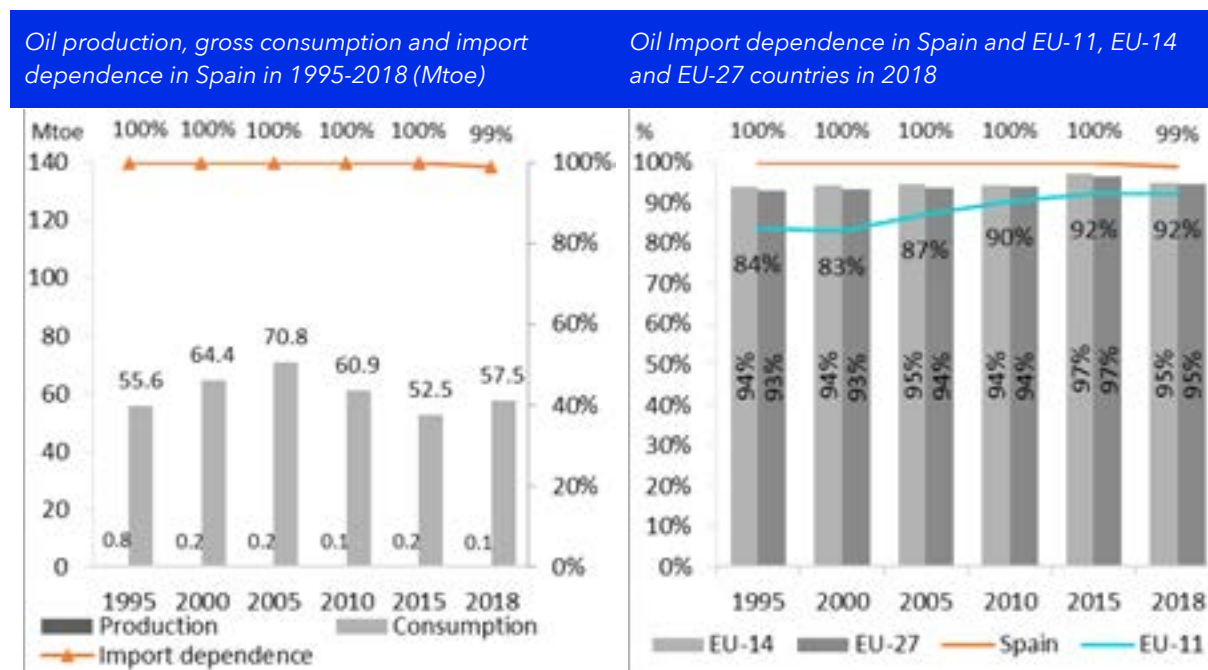
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Natural Gas G3000. Errors in summation to 100% are due to rounding

14.7 Overview of oil sector

The oil consumption of Spain grew from 55.6 Mtoe in 1995 to 57.5 Mtoe in 2018. At the same time the national production dropped from 0.8 Mtoe to 0.1 Mtoe. Therefore, the level of import dependency was high - between 99% and 100%.

When compared to EU-14 and EU-27 average import dependency, the country had a higher import dependency of 99% versus 95% in EU-14 and EU-27 countries. At the same time, the import dependency of the country was higher than EU-11 average - 99% versus 92%.

Item 313: Oil sector in Spain



Source: Eurostat data for 2018, extracted in 2020. Detail references: Oil production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Import dependence above 100% has been rounded to 100%

The final consumption of oil per capita in Spain increased from 0.95 toe per capita in 1995 to 1.17 toe per capita in 2005 and then dropped to 0.85 toe per capita in 2018. The level of final consumption per capita remained higher than the one for EU-11, EU-14 and EU-27.

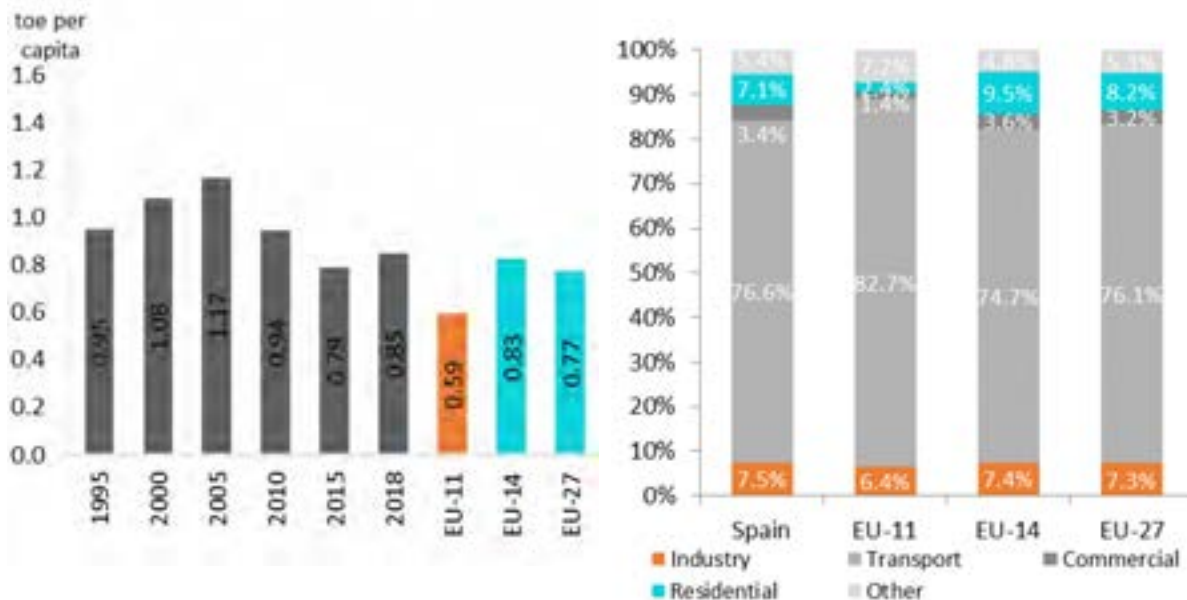
Oil consumption was dominated by transport sector - 76.6% versus 74.7% in EU-14 countries. Relatively more oil was used in industry - 7.5% versus 7.4% but less in commercial sector - 3.4% versus 3.6%. The residential use of oil was also lower than EU-14 average - 7.1% versus 9.5%.

The relative consumption of oil in Spain compared to EU-11 was lower in 2018 - 76.6% versus 82.7%. The use in industry was relatively lower higher - 7.5% versus 6.4%. At the same time commercial and residential sector were consuming relatively more oil in the country than EU-11 averages - 3.4% and 7.1% versus 1.4% and 2.4%.

Item 314: Final consumption of oil per capita in Spain in 1995-2018 and oil final consumption by sectors in Spain and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of oil per capita in Spain (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Oil final consumption by sectors in Spain and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Errors in summation to 100% are due to rounding

14.8 EU climate policy and its targets for Spain

Spain is subject to EU energy and climate regulations and therefore, specific targets were set and verified regarding greenhouse gas emission, share of energy from renewable energy sources and energy efficiency improvements (see Item 315).

Item 315: Energy and climate targets for Spain for 2020 and 2030

| | Spain 2020 targets | Spain 2030 targets |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | EU wide target of 20% reduction from 1990 levels (14% from 2005 level) | EU wide target of 40% reduction from 1990 levels |
| Greenhouse gas emissions in ETS | EU wide target of 21% reduction from 2005 | EU wide target of 43% reduction from 2005 |
| National emission reduction targets in non-ETS - Effort Sharing Decision (ESD) | -10% in relation to their 2005 levels | - |
| National emission reduction targets in non-ETS - Effort Sharing Regulations (ESR) | - | -26% in relation to their 2005 levels |
| Share of energy from renewable energy sources | EU wide target of 20% energy from renewables | EU wide target of minimum 32% share for renewable energy |
| EU wide target of share of energy from renewable energy sources | EU wide target of 20% share of gross final energy consumption | EU wide target of 32% share of gross final energy consumption |
| National target of share of energy from renewable energy sources | 20% of gross final consumption | Not yet available |
| Improvement in energy efficiency | EU wide target of 20% improvement in energy efficiency | EU wide target of at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |
| Primary energy consumption | EU wide target < 1,483 Mtoe National target < 119.8 Mtoe | EU wide target of 1,273 Mtoe (< 1,128 Mtoe EU-27) National targets not available yet |
| Final energy consumption | EU wide target < 1,086 Mtoe National target < 80.1 Mtoe | EU wide target < 956 Mtoe (< 846 Mtoe EU-27) National targets not available yet |

Source: EU website

In following chapter, the overview of Spain targets and performance are summarized.

14.8.1 Greenhouse gas emissions

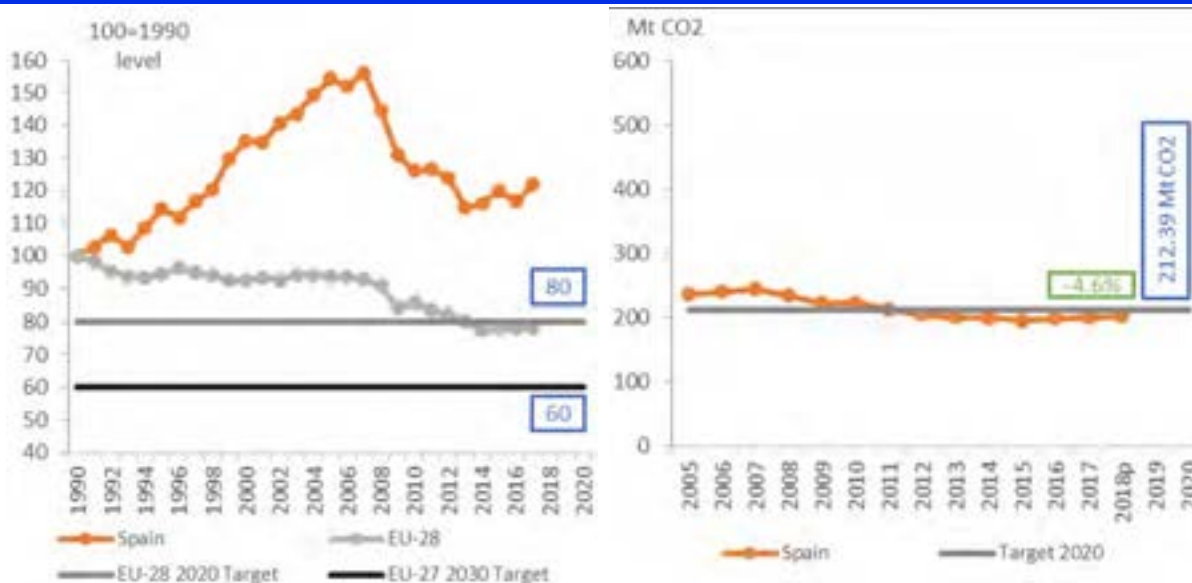
EU set a target for CO₂ reduction by 20% compared to 1990 level at EU level. Regardless the fact that the target was not binding for specific country, the level of CO₂ emission in Spain was below EU wide target.

The non-ETS greenhouse gas emissions the binding national targets for Spain was 212.39 Mt of CO₂ equivalent emissions. Comparing to 2018 provisional results the level of emissions overachieved the target by 4.6%.

Item 316: Energy efficiency target data for Spain

Greenhouse gas emissions level in Spain and EU-28, base year 1990, and EU 2020 target

Greenhouse gas emissions in Effort Sharing Decision (ESD) sectors



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Greenhouse gas emissions, base year 1990 [T2020_30], Greenhouse gas emissions in ESD sectors [T2020_35]

14.8.2 Renewable energy sources

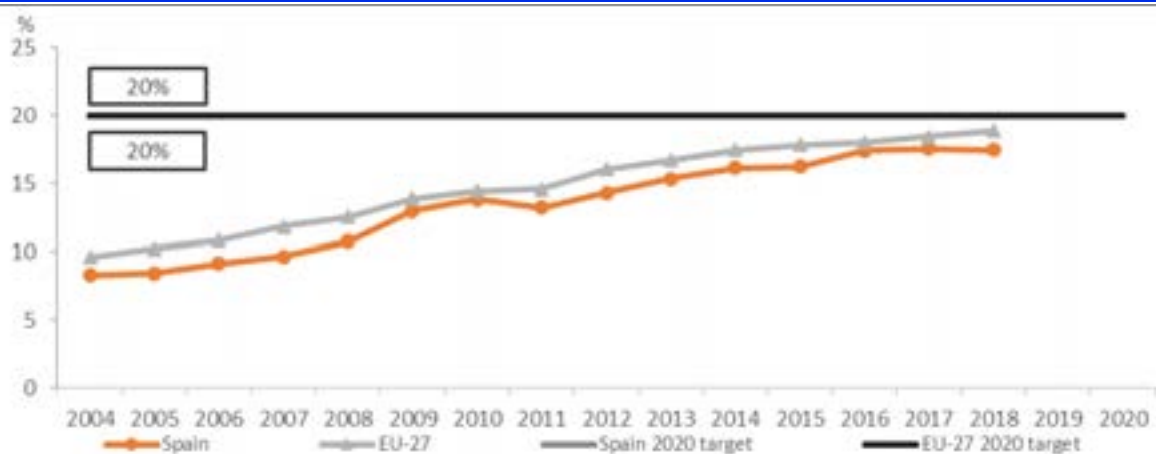
The following targets were set for Spain regarding the share of energy from renewable energy sources in gross final energy consumption:

- a 20% share of gross final energy consumption by 2020,
- a 20% national target for share of energy from renewable sources in gross final consumption of energy in 2020.

The share of energy from renewable energy sources in Spain was below EU wide and country specific targets in 2018.

Item 317: Share of energy from renewable energy sources in gross final energy consumption in Spain

Share of energy from renewable energy sources in gross final energy consumption in Spain in 2005-2018 and targets for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Share of energy from renewable sources [nrg_ind_ren]

14.8.3 Energy efficiency

The energy efficiency target set for Spain were respectively:

- Primary Energy Consumption in 2020: 119.8 Mtoe
- Final energy consumption in 2020: 80.1 Mtoe

Following the information provided in Item 318 the results for 2018 were above the targets in both criteria, respectively +4.0% of primary energy consumption and 8.5% of final energy consumption. This does not exclude Spain to achieve the targets in 2020.

Item 318: Energy efficiency target data for Spain

Primary energy consumption and final energy consumption in Spain in 2005-2018 and targets for 2020

Ratio of primary energy consumption to target for 2020 and final energy consumption to target for 2020 in Spain, EU-11, EU-14 and EU-27 in 2018



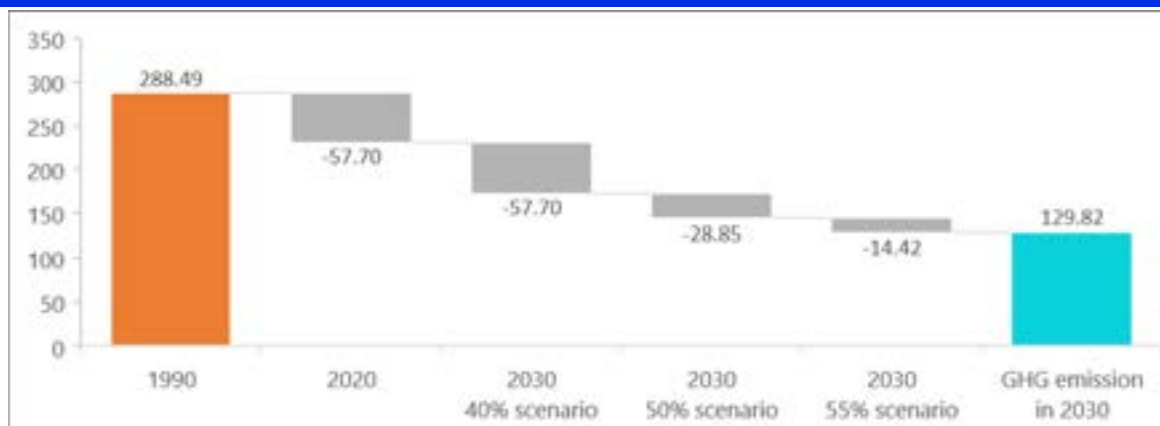
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Primary energy consumption - Primary energy consumption (Europe 2020-2030) (PEC2020-2030), final energy consumption - Final energy consumption (Europe 2020-2030) (FEC2020-2030). EU-11 and EU-14 data estimated based on Eurostat data

14.9 Review of potential impact of Green Deal propositions

At the current stage of discussions regarding the European Green Deal only partial information are available regarding the future targets. EU is proposing to increase the greenhouse gas emission reduction to 50% or 55% for 2030. This is a proposition included in the draft proposal of "Climate Law". Assuming the Spain greenhouse gas emissions in 1990, an estimation of EU 2030 target emissions can be drafted. The 2020 target of 20% reduction resulted in 57.70 Mt CO₂ emission drop. Further increase of the target to 40% in 2030 require additional 57.70 Mt CO₂ reduction. If the 50% target proposed under European Green Deal is applied then additional 28.85 Mt CO₂ emission decrease is needed, or 43.27 Mt CO₂ decrease, if 55% target is adopted.

Item 319: Estimation regarding greenhouse gas emissions in Spain under different scenarios (Mt CO₂)

Estimation regarding greenhouse gas emissions in Spain under different scenarios (Mt CO₂)



Source: Eurostat data for 2018, extracted in 2020. Estimations delivered by the Author

Nevertheless, it is worth to highlight that, if the current structure of greenhouse gas emissions target is maintain, then the 50% target for 2030 is an EU wide target. It is not a binding element for specific countries. Country specific targets could be expected as per ESD and ESR but there is no way to anticipate the potential targets.

At the same time, the review of key EU regulations around climate and energy as:

- Emissions Trading System Directive;
- Effort Sharing Regulation;
- Land use, land use change and forestry Regulation;
- Energy Efficiency Directive;
- Renewable Energy Directive;
- CO₂ emissions performance standards for cars and vans
- Energy Taxation Directive

can bring some additional targets in area of share of energy from renewable energy sources and energy efficiency. For the moment, any estimation of potential targets is not available nor possible to estimate.



15 Sweden

15.1 General information

Sweden is the third biggest country within EU-14 group in terms of total country area and represents 14.5% of the area. At the same time, it is the third country in EU-27 with 10.6% of the area. It represents 3.0% of EU-14 population and 2.3% of EU-27 population, but 3.9% of its total nominal GDP of EU-14 and 3.5% of EU-27. Despite the economic growth in 1995-2018 period, in 2018 Swedish GDP per capita amounted to 121% of the whole EU average (129% in 1995).

Item 320: Sweden - key data



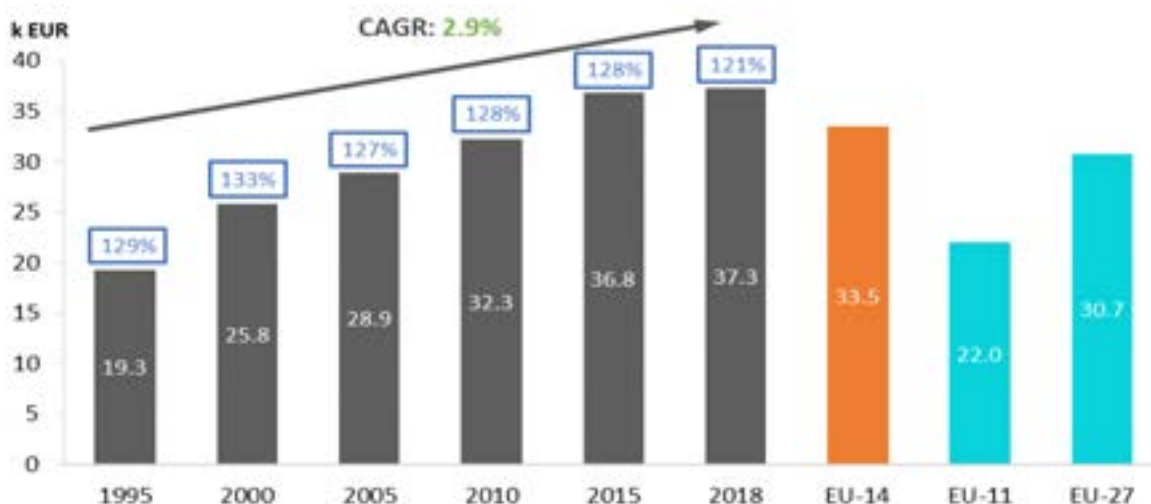
Key data

| | |
|------------------------------------------------------|--------|
| Population (M) | 10.1 |
| GDP per capita (EUR, nominal) | 46,310 |
| GDP per capita (EUR, PPS) | 37,310 |
| GDP as share of EU-14 | 3.9% |
| GDP as share of EU-27 | 3.5% |
| Energy intensity of the economy (kgoe per 1,000 EUR) | 139.7 |
| Greenhouse gas emissions (Mg per capita) | 5.2 |

Source: Eurostat data for 2018, extracted in 2020

With the compounded annual growth rate amounting to 2.9% Swedish economy considerably grew in the period of 1995-2018 (see Item 321). Its GDP per capita was above EU-14 and EU-27 averages (equal to 111% and 121% of the respective averages). Its GDP per capita was also 170% of the average GDP per capita for EU-11 countries.

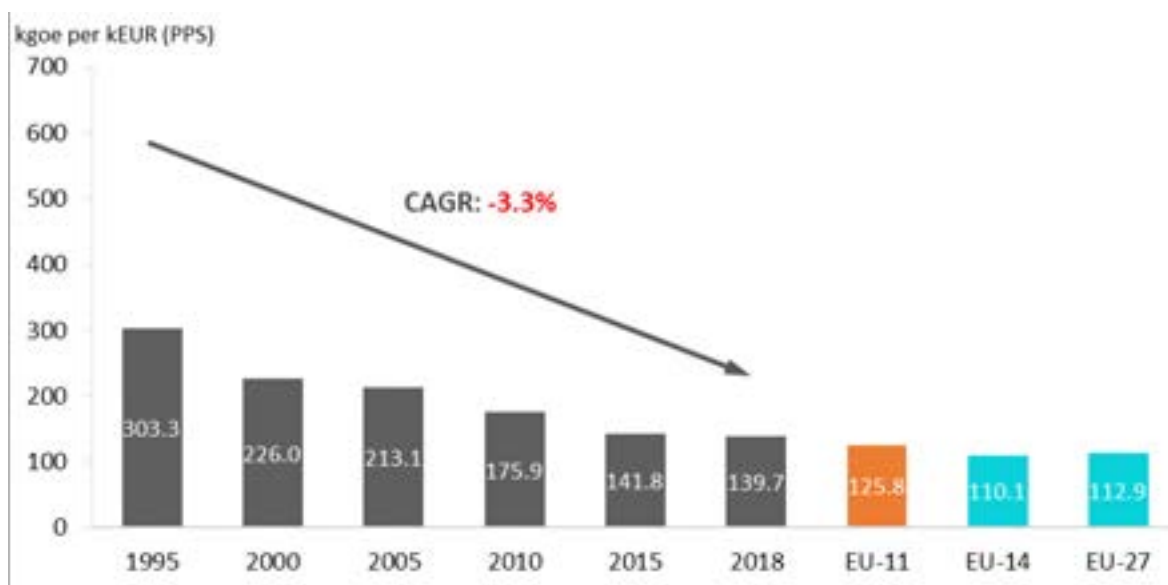
Item 321: GDP per capita in Sweden for 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages in 2018 (kEUR, PPS) and share of Sweden GDP per capita in relation to EU-27 average



Source: Eurostat data for 2018, extracted in 2020. Detail references: GDP per capita - Gross domestic product at market prices (B1GQ), Current prices, purchasing power standard per capita (CP_PPS_HAB)

The Swedish economy energy intensity was about 139.7 kgoe per 1,000 EUR PPS, thanks to a decrease of the energy intensity indicator during the years 1995-2018. It dropped by 163.7 kgoe per 1,000 EUR PPS, i.e. it was reduced by about 54%. The energy intensity of Sweden in 2018 represented 111% and 124% of EU-14 and EU-27 averages. At the same time, it represented 127% of EU-11 average.

Item 322: Energy intensity of the economy in Sweden in 1995-2018 in comparison with EU-11, EU-14 and EU-27 averages, 2018 (kgoe per 1,000 EUR PPS)



Source: Eurostat data for 2018, extracted in 2020. Values for EU-11 and EU-14 were recalculated based on energy intensity and GDP data from Eurostat. Detail references: Energy intensity of GDP in purchasing power standards (PPS) - EI_GDP_PPS

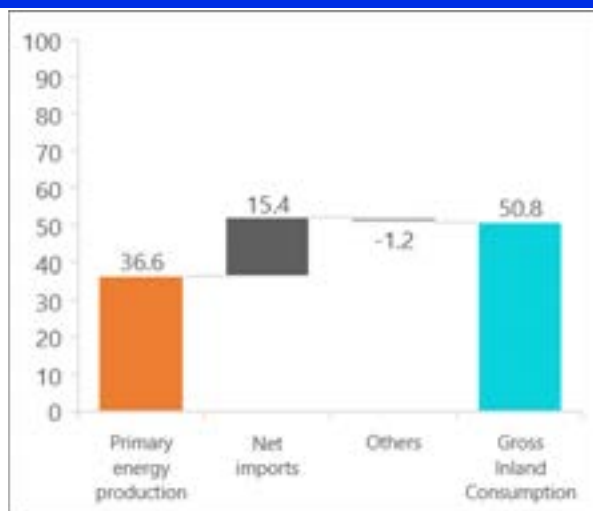
15.2 Energy balance of Sweden

The energy balance of Sweden in 2018 is presented in 331. The primary energy production was equal to 36.6 Mtoe in 2018. Net imports added 15.4 Mtoe to the balance. The total gross inland consumption accounted for 50.8 Mtoe. The level of import of energy to Sweden decreased slowly during last 23 years from about 20 Mtoe to about 15 Mtoe. At the same time the level of net import reported to the energy needs followed the same pattern and reached level of 30%.

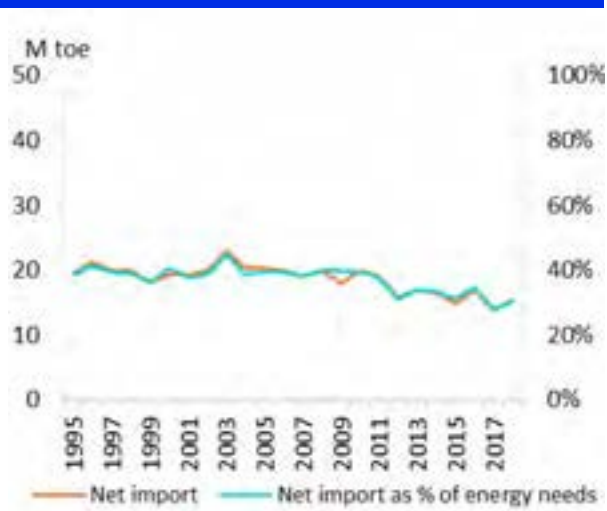
The primary energy production increased over past 23 years whereas gross energy consumption remained stable. National production was meeting 72% of the country gross consumption and this factor increased over last 23 years from 62%.

Item 323: Energy balance in Sweden

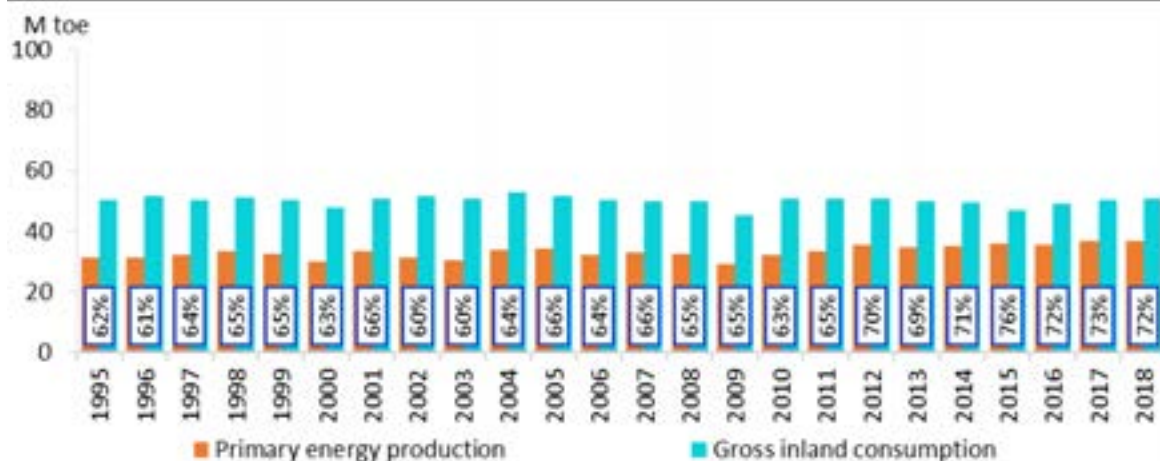
Energy balance in Sweden in 2018 (Mtoe)



Net import of energy in Sweden in 1995-2018 (Mtoe and as percentage of GIC)



Gross inland consumption, primary energy production (Mtoe) and ratio of primary energy production to gross inland consumption in 1995-2018 in Sweden (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy - Primary Production (PPRD), Gross inland consumption - GIC. Net imports = Import (IMP) - Export (EXP), Other = Change in stock (STK-CHG) - International maritime bunkers (INTMARB)

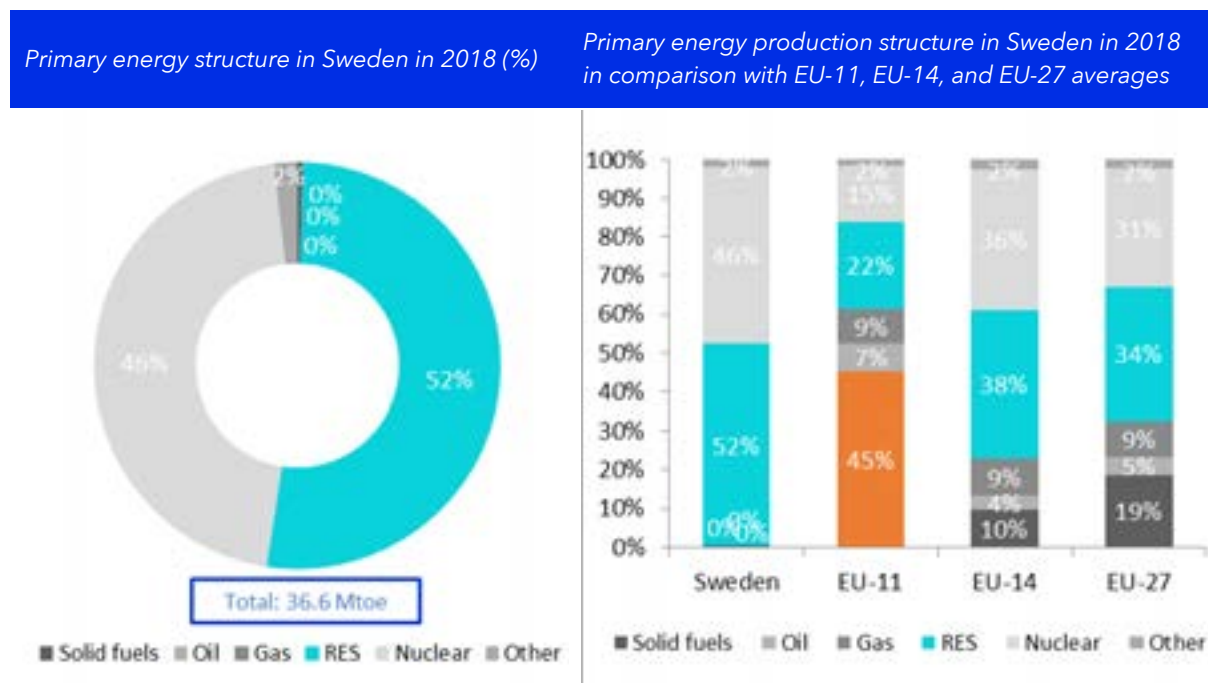
The primary energy production in Sweden was dominated by renewable energy sources (52%) and nuclear energy (46%). The mix was completed by 2% of other sources. Usage of oil and gas in primary energy production was null and the use of solid fuels was negligible.

When compared to the European averages, Sweden was characterized by very high share of renewable energy sources in the energy mix - 52% versus 38% EU-14 average and 34% EU-27 average and a higher share of nuclear energy - 46% versus 36% and 31% in EU-11 and EU-27 respectively. The shares of gas and oil were obviously lower as Sweden was not using these fuels for primary energy production. The share of solid fuels was much lower as its use was negligible in this country.

The comparison of Sweden to EU-11 averages was mainly characterized by much higher share of RES (52% versus 22%) and nuclear energy (46% versus 15%). In opposite to EU-11

Sweden was not using oil and gas for primary energy production and the use of solid fuels was negligible.

Item 324: Primary energy structure in Sweden



Source: Eurostat data for 2018, extracted in 2020. Detail references: Primary energy – Primary Production (PPRD), Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H) , Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

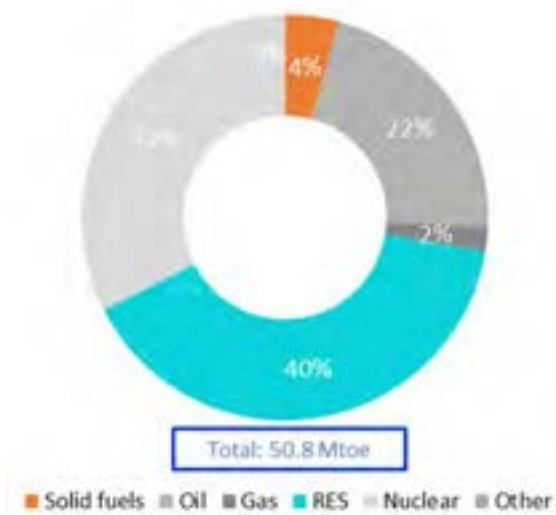
Gross inland consumption of energy in Sweden was dominated by renewable energy sources (40%), nuclear energy (32%) and oil (22%). The mix was completed by 4% of solid fuels and 2% of gas.

Comparing to European averages gross inland consumption of energy in Sweden was marked by low share of solid fuels (4% versus 11% in EU-14 and 14% in EU-27). The share of oil was lower in Sweden (22%) than in EU-14 (35%) and EU-27 (34%) as well as the share of (2% versus 23% and 22% in EU-14 and EU-27). Sweden was characterized by much higher share of renewable energy sources in the mix - 40 % versus 16% and 15% in EU-14 and EU-27 respectively, as well as higher share of nuclear energy (32% versus 14% in EU-14 and 13% in EU-27).

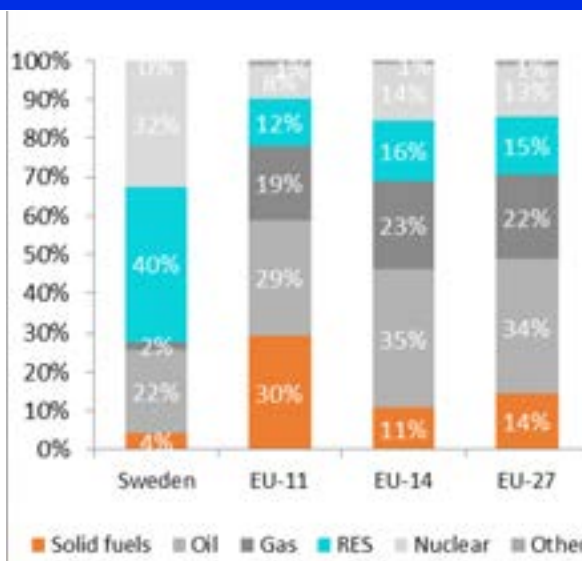
When compared to EU-11 the main difference was around much lower share of solid fuels consumption in Sweden (4% versus 30% in EU-11) and higher share of renewable energy sources (40% versus 12%). The share of oil and gas use in Sweden were lower than in EU-11 countries (22% versus 29% and 2% versus 19% respectively). EU-11 average gross final consumption included nuclear energy at 8%. In Sweden it represents 32%.

Item 325: Gross inland consumption structure in Sweden

Gross inland consumption structure in Sweden in 2018 (%)



Gross inland consumption structure in Sweden in 2018 in comparison with EU-11, EU-14, and EU-27 averages



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gross inland consumption - GIC, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear - Nuclear Heat (N900H), Other = Heat (H8000) + Electricity (E7000) + Non-renewables waste (W6100-6220). Errors in summation to 100% are due to rounding

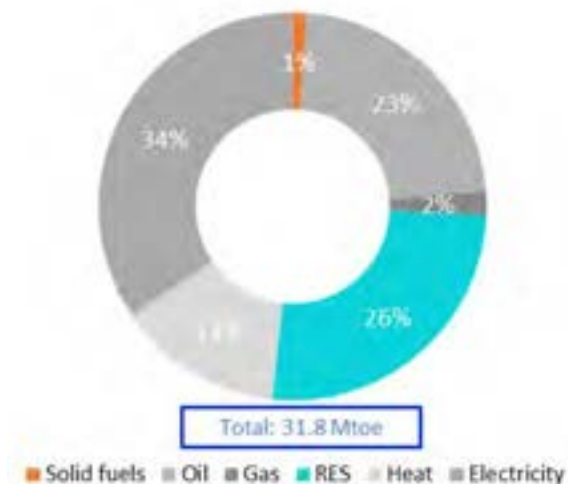
The final energy consumption in Sweden was dominated by electricity (34%), followed by renewable energy sources (26%), oil (23%) and heat (14%). The mix was completed by gas (2%) and solid fuels (1%).

The sectoral final energy consumption in Sweden was characterized by higher share of industrial but lower of transport sectors than in EU-14 and EU-27 (35% and 22% versus 26% and 31% in EU-14 and EU-27). The share of commercial and public services in final energy consumption in Sweden (13%) was lower than the one in EU-14 (15%) and EU-27 (14%).

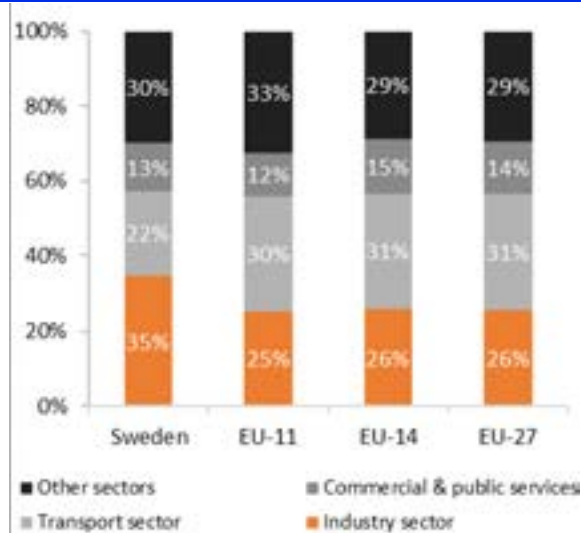
When compared to EU-11 Sweden similar conclusions as related to EU-14 and EU-27 can be drawn.

Item 326: Final energy consumption structure in Sweden

Final energy consumption structure in Sweden in 2018 (%)



Final energy consumption structure in Sweden in 2018 in comparison with EU-11, EU-14, and EU-27 averages



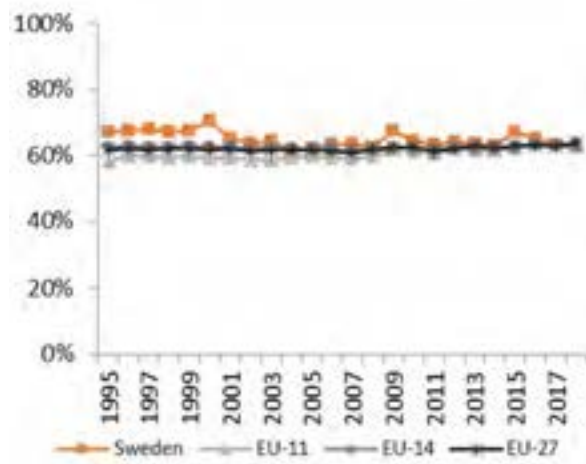
Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Heat (H8000), Electricity (E7000), Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial & public services - FC_OTH_CP_E, Other - FC_OTH_E-FC_OTH_CP_E. Errors in summation to 100% are due to rounding

Swedish final energy consumption to gross inland consumption ratio which measure energy efficiency was close to the averages for EU-11, EU-14 and EU-27. It used to be higher in the past.

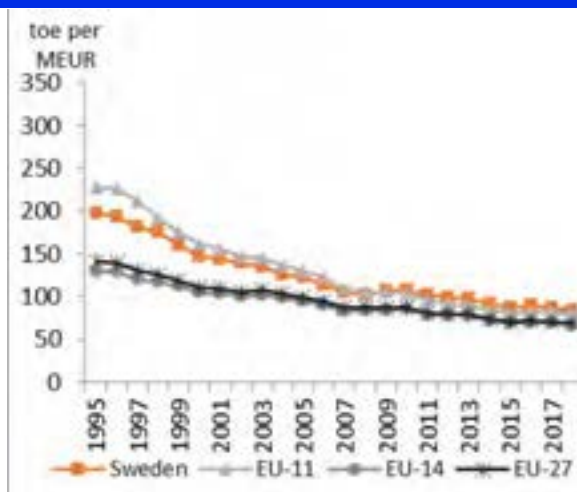
Simultaneously, a decrease of energy volume associated with generating gross domestic product was noticed. The current values were a little higher than the averages for EU-14 and EU-27 averages.

Item 327: Final energy consumption in Sweden in relation to selected indicators

Final energy consumption to gross inland consumption ratio in Sweden in 1995-2018 (%)



Final energy consumption to gross domestic product ratio in Sweden in 1995-2018 in comparison with EU-11, EU-14, and EU-27 averages (toe per M EUR)



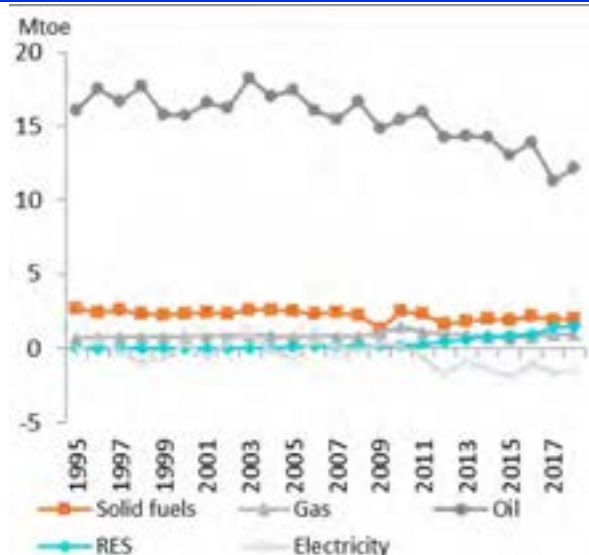
Source: Eurostat data for 2018, extracted in 2020. Detail references: Final energy consumption - FEC, Gross inland consumption - GIC, Gross Domestic Product - Gross domestic product at market prices B1GQ, Current prices - CP-MEUR

Net import of energy to Sweden by fuels was characterized by a decrease of oil imports and stable level of import of solid fuels and gas. Sweden was a growing electricity exporter and the import of RES was increasing in last 10 years.

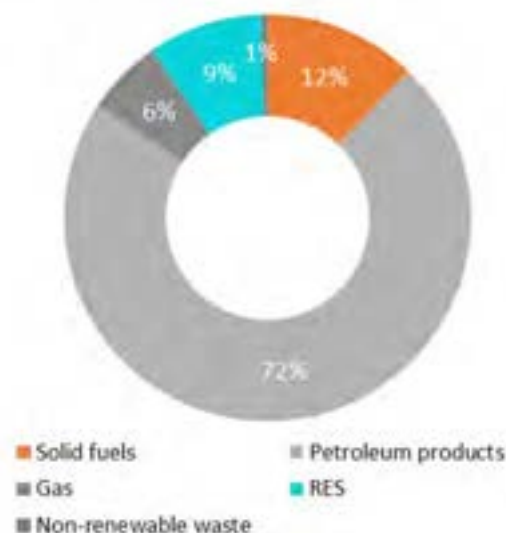
The import structure of energy to Sweden was dominated by oil (72%) and solid fuels (12%). The imports were completed by 6% of gas, 9% of renewable energy sources and 1% of non-renewable waste.

Item 328: Net import of energy in Sweden

Net import of energy by fuel in 1995-2018 (Mtoe)



Net import structure in 2018 (% , only fuels for which import is greater than export)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Electricity (E7000). Errors in summation to 100% are due to rounding

Solid fuels were imported to Sweden mainly from Australia (36%), Russia (21%), USA (14%) and several other countries.

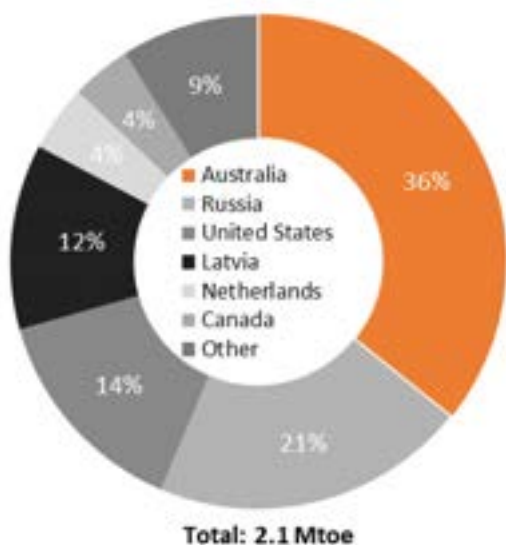
Main oil importers to Sweden were Russia (31%), Norway (27%), Nigeria (13%) and Denmark (11%). The remaining 18% were imported from various locations.

Sweden was importing gas mainly from Denmark (53%), Norway (20%) and Netherland (13%). The remaining part was imported from Belgium (11%), Finland (2%) and South Africa (1%).

Electricity was mainly imported from Norway (67%) and Denmark (23%). Smaller amounts were imported from Germany, Poland, Lithuania, and Finland.

Item 329: Foreign fuel suppliers

Foreign suppliers of solid fuels in Sweden in 2018 (%)



Foreign suppliers of crude oil in Sweden in 2018(%)



Foreign suppliers of gas in Sweden in 2018 (%)



Foreign suppliers of electricity in Sweden in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Solid fossil fuels - C000X0350-0370, Gas - Natural gas (G3000), Oil - Oil and petroleum products (excluding biofuel portion) (O4000XBIO), Electricity - E7000. Errors in summation to 100% are due to rounding

15.3 Greenhouse gas emissions

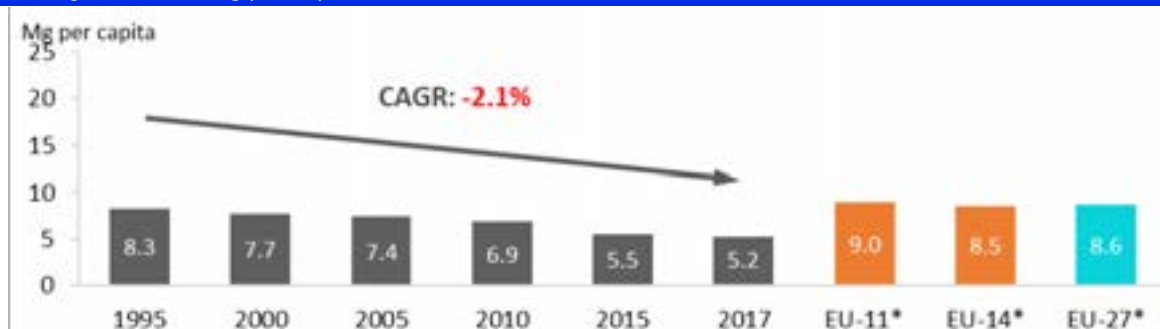
Between 1995-2017 greenhouse gases emissions in Sweden were decreased - from over 71.3 Mt CO₂ in 1995 to 52.7 Mt CO₂ in 2017. Consequently average emissions per capita decreased to 5.2 Mg CO₂ per capita in 2017 (from 8.3 Mg CO₂ per capita in 1995), which was lower comparing to EU-14 and EU-27 averages (8.5 Mg CO₂ per capita and 8.6 Mg CO₂ per capita, respectively), and also lower than in EU-11 (9.0 Mg CO₂ per capita)

There were some noteworthy changes in the Swedish structure of greenhouse gas emissions over the period considered. The significance of waste management and manufacturing and construction sectors emissions dropped swiftly by 43% and 65%, as well as emissions from energy industries 19%. Emissions also dropped from all other sectors in last 23 years.

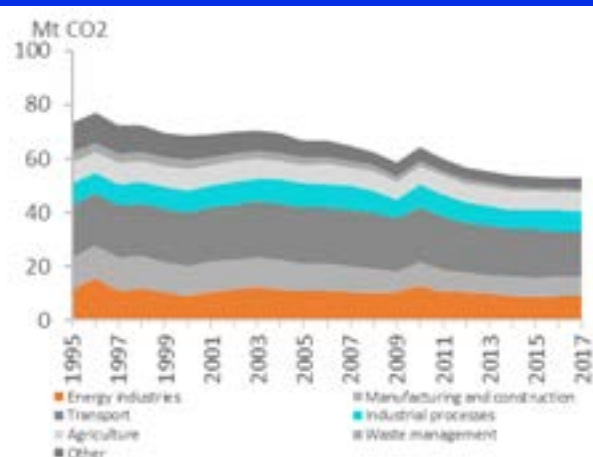
Comparing to EU-11, EU-14 and EU-27 countries, Sweden was characterized by higher share of emissions from transport (31% versus 17%, 23% and 21%). Share of emissions from energy industries was lower than European averages but shares of emissions from industrial processes and agriculture were higher.

Item 330: Greenhouse gas emissions in Sweden

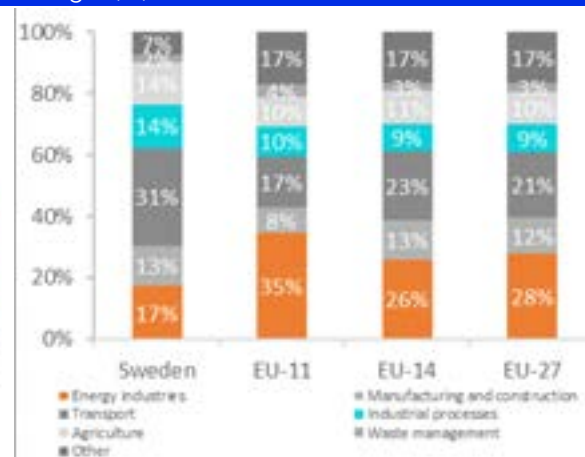
Greenhouse gas emissions per capita in Sweden in 1995-2017 in comparison with EU-11, EU-14 and EU-27 averages in 2017 (Mg per capita)



Greenhouse gas emissions in Sweden by sectors in 1995-2017 (Mt CO₂)



Greenhouse gas emissions in Sweden by sectors in 2017 in comparison with EU-11, EU-14 and EU-27 averages (%)



Source: Eurostat data for 2018, extracted in 2020; Detail references: Greenhouse gas emissions per capita source: EEA - * values for EU-11, EU-14 and EU-27 recalculated by the Author; Energy industry - Fuel combustion in energy industries (CRF1A1), Manufacturing and construction - Fuel combustion in manufacturing industries and construction (CRF1A2), Transport - Fuel combustion in transport (CRF1A3), Industrial processes - Industrial processes and product use (CRF2), Agriculture - Agriculture (CRF3), Waste management - Waste management

(CRF5), Other = Other fuel combustion sectors (CRF1A4)+ Other fuel combustion sectors n.e.c. (CRF1A5) + Fuels - fugitive emissions (CRF1B)+Other sectors (CRF6); Total GHG emissions equal to All sectors (excluding LULUCF and memo items) (CRF1-6X4_MEMO) i.e. emission from all sectors excluding Land use, land use change, and forestry (LULUCF), Transport and storage of CO₂ (memo item), International aviation (memo item), International navigation (memo item), Multilateral operations (memo item), Biomass - CO₂ emissions (memo item). Greenhouse gases (CO₂, N₂O in CO₂ equivalent, CH₄ in CO₂ equivalent, HFC in CO₂ equivalent, PFC in CO₂ equivalent, SF₆ in CO₂ equivalent, NF₃ in CO₂ equivalent) - GHG. Errors in summation to 100% are due to rounding

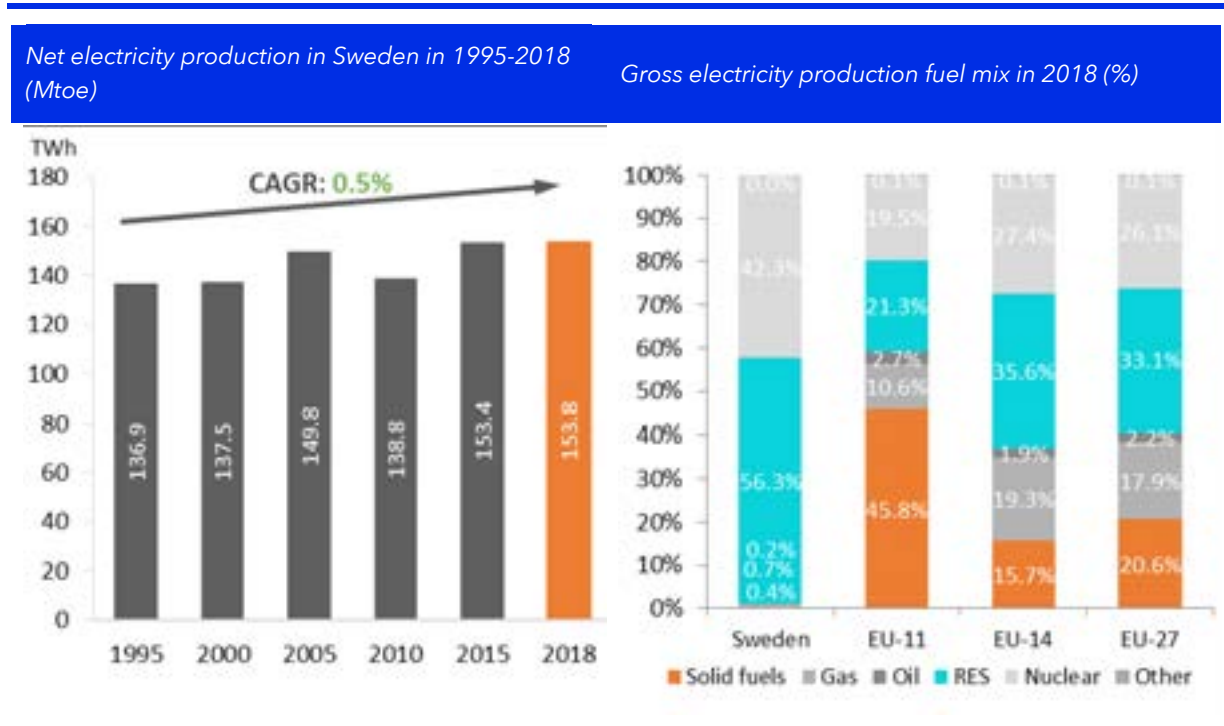
15.4 Overview of electricity sector

Item 331 presents electricity production and the current fuel mix of Sweden. Over last 23 years net electricity production increased from 50.5 TWh in 1995 to 57.4 TWh in 2018 (CAGR 0.6%). As visible, net electricity production represented 7.1% of EU-14 total electricity production, which was higher compared to Swedish GDP share of 3.9%.

The Swedish fuel mix was dominated by nuclear energy and renewable energy sources with shares of 42.3% and 56.3% respectively. The mix was completed by small shares of solid fuels (0.4%), gas (0.7%) and oil (0.2%). Compared to EU-14 and EU-27 countries, Sweden had a much bigger share of nuclear energy and renewable energy sources in its energy mix. On other hand, the country produced relatively less electricity from solid fuels, gas, and oil, respectively 0.4%, 0.7% and 0.2%.

When compared to EU-11 average fuel mix one can notice much higher share of nuclear energy and renewable energy sources used in Sweden than in EU-11 (42.3% and 56.3% versus 19.5% and 21.3%) and significantly lower use of solid fuels (0.4% versus 45.8%). The share of oil was lower (0.2% versus 2.7%) as well as the share of gas - 0.7% versus 10.6%.

Item 331: Net electricity production and gross electricity production fuel mix in Sweden



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Electricity Production - NEP, Gross Electricity Production - GEP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding

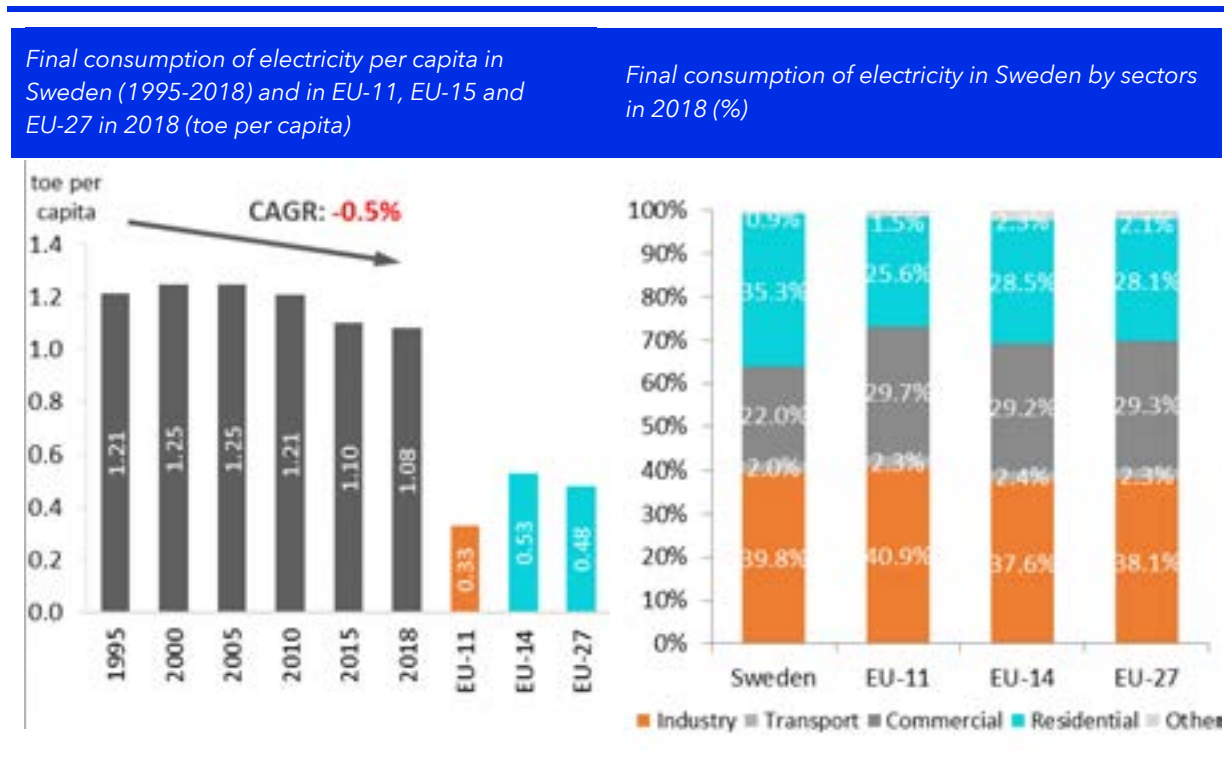
biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

In Item 332 the evolution of final per capita consumption of electricity and its breakdown by economic sector was presented. In recent years final consumption of electricity in Sweden decreased (CAGR in the period of 1995-2019 was around -0.5%) and its level was higher compared to EU-14 and EU-27 countries. Swedish final energy consumption per capita represented 204.3% of EU-14 level and 223.9% of EU-27 level.

The structure of final electricity consumption in Sweden was dominated by residential sector (35.3% versus 28.5%) and industry (39.8% versus 37.6% in EU-14 countries). Relatively less energy was used in transport (2.0% versus 2.4%) and less in commercial sector (22.0% versus 29.2%).

Sweden was consuming relatively more electricity in residential sector than EU-11 countries (35.3% versus 25.6%) but less in transport (2.0% versus 2.3%). At the same time, it used relatively less electricity in commercial sector and industry (22.0% and 39.8% versus 29.7% and 40.9%).

Item 332: Final consumption of electricity in Sweden



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Electricity E7000. Errors in summation to 100% are due to rounding

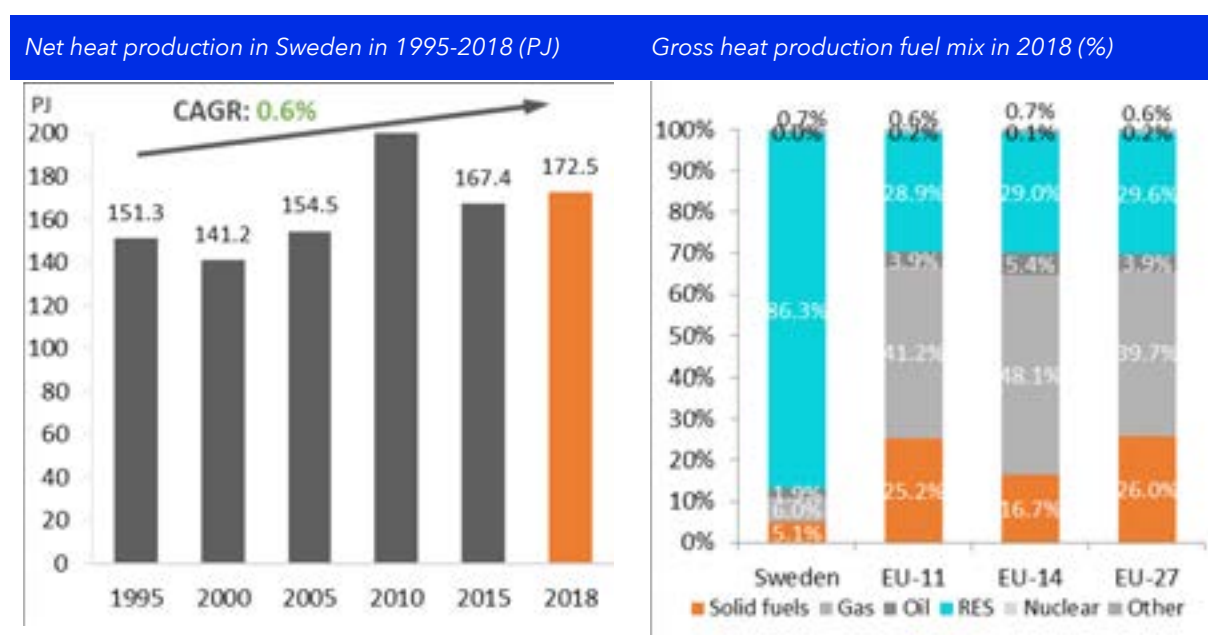
15.5 Overview of heat sector

Item 333 presents heat production and the current fuel mix of Sweden. Over last 23 years net heat production increased from 151.3 PJ in 1995 to 172.5 PJ in 2018 (CAGR 0.6%).

The Swedish fuel mix of heat production was dominated by renewable energy sources with share of 86.3%. The mix was completed by 5.1% of solid fuels, 6.0% of gas and 1.9% of oil. Compared to EU-14 and EU-27 countries, Sweden had a much bigger share of renewable energy sources in its heat production mix. On other hand, the country produced relatively less heat from solid fuels, gas, and oil, respectively 5.1%, 6.0% and 1.9%. Sweden did not use nuclear energy for heat production where some heat was produced in nuclear facilities in EU-14 countries (0.1%).

When compared to EU-11 average fuel mix one can notice much higher share of renewable energy sources used in Sweden than in EU-11 (86.3% versus 28.9%) and significantly lower use of solid fuels (5.1% versus 25.2%). The share of gas was lower in Sweden (6.0% versus 41.2%) as well as the share of oil (1.9% versus 3.9%). Sweden as not using nuclear energy for heat generation in opposite to EU-11 where the share of nuclear was 0.2%.

Item 333: Net heat production and gross electricity production fuel mix in Sweden



Source: Eurostat data for 2018, extracted in 2020. Detail references: Net Heat Production - NHP, Gross Heat Production - GHP, Solid fuels = Solid fossil fuels (C000X0350-0370)+Peat and peat products (P1000), Gas = Manufactured gases (C0350-0370)+Natural gas (G3000), Oil = Oil and petroleum products (excluding biofuel portion) (O4000XBIO)+Oil shale and oil sands (S2000), RES = Renewables and biofuels (RA000), Nuclear = Nuclear heat (N900H), Other = Industrial waste (W6100) + Electricity (E7000). Errors in summation to 100% are due to rounding

Item 334 presents final heat consumption per capita and its breakdown by sectors.

The per capita demand for heat in Sweden increased from 0.40 toe per capita in 1995 to 0.43 toe per capita in 2018. As a result, within the 23 years analyzed, heat consumption per capita increased at CAGR of 0.3%. The heat consumption remained higher than the averages for EU-11, EU-14 and EU-27, respectively 0.13 toe per capita, 0.10 toe per capita and 0.10 toe per capita.

The structure of final consumption of heat in Sweden was characterized by higher share of commercial (29.3% compared to 21.3% in EU-14) and higher residential usage (58.7% compared to 40.1% in EU-14). The share of industry in heat consumption was lower than the averages (11.9% compared to 37.9% in EU-14).

In relation to EU-11 countries, the structure of final heat consumption in Sweden was characterized by lower share of residential sector (58.7% versus 60.5%) and higher share of commercial sector (29.3% versus 19.3%). The industrial use of heat consumed 11.9% of it in Sweden whereas 19.7% in EU-11.

Item 334: Final consumption of heat in Sweden

Final consumption of heat per capita in Sweden (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Final consumption of heat in Sweden by sectors in 2018 (%)



Source: Eurostat data for 2018, extracted in 2020. Detail references: Final consumption per capita - Final consumption energy use FC_E/ Population (INDIC_DE); Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Heat H8000. Errors in summation to 100% are due to rounding

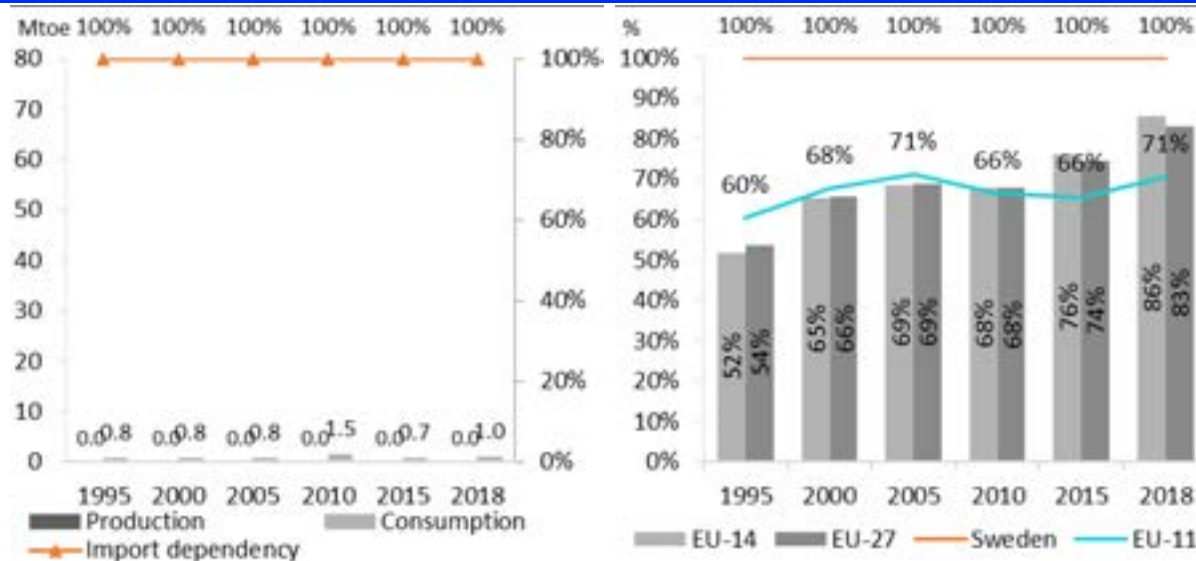
15.6 Overview of gas sector

Sweden consumed 1.0 Mtoe of gas in 2018. It increased from 0.8 Mtoe in 1995 to 1.5 Mtoe in 2010 and then decreased. National production was null. Gas was imported. Therefore, the country dependency on import was 100% over past 23 years. In 2018 the country was more dependent on import than EU-11, EU-14 and EU-27 average values.

Item 335: Gas sector in Sweden

Gas production, gross consumption and import dependence in Sweden in 1995-2018 (Mtoe)

Gas Import dependence in Sweden and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detail references: Gas production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Natural Gas G3000

The final consumption of gas per capita in Sweden increased from 0.04 toe per capita to 0.05 toe per capita over past 23 years. This value was lower than the average values for EU-14, EU-11 and EU-27 countries.

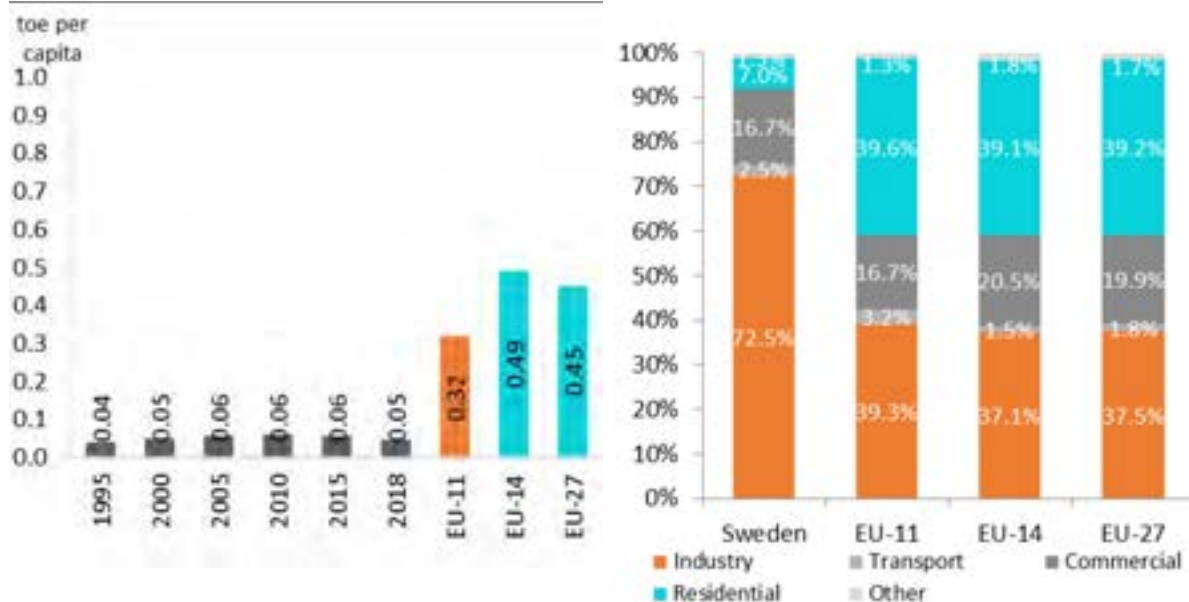
The structure of final gas consumption in Sweden in 2018 was characterized by high share of industry - 72.5% versus 37.1% in EU-14. The share of use of gas in commercial and residential applications were lower than the averages for EU-14 countries but the relative use in transport was higher - 2.5% versus 1.5%.

When compared to EU-11 countries, Sweden was using relatively more gas industry than EU-11 countries - 72.5% versus 39.3%. The country was using more gas in transport - 2.5% versus 3.2%. On other hand, the share of gas used in residential sector was lower than in EU-11 countries - 7.0% versus 39.6% respectively. The share of gas use in commercial application was the same - 16.7%

Item 336: Final consumption of gas per capita in Sweden in 1995-2018 and gas final consumption by sectors in Sweden and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of gas per capita in Sweden (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Gas final consumption by sectors in Sweden and EU-11, EU-14 and EU-27 countries in 2018



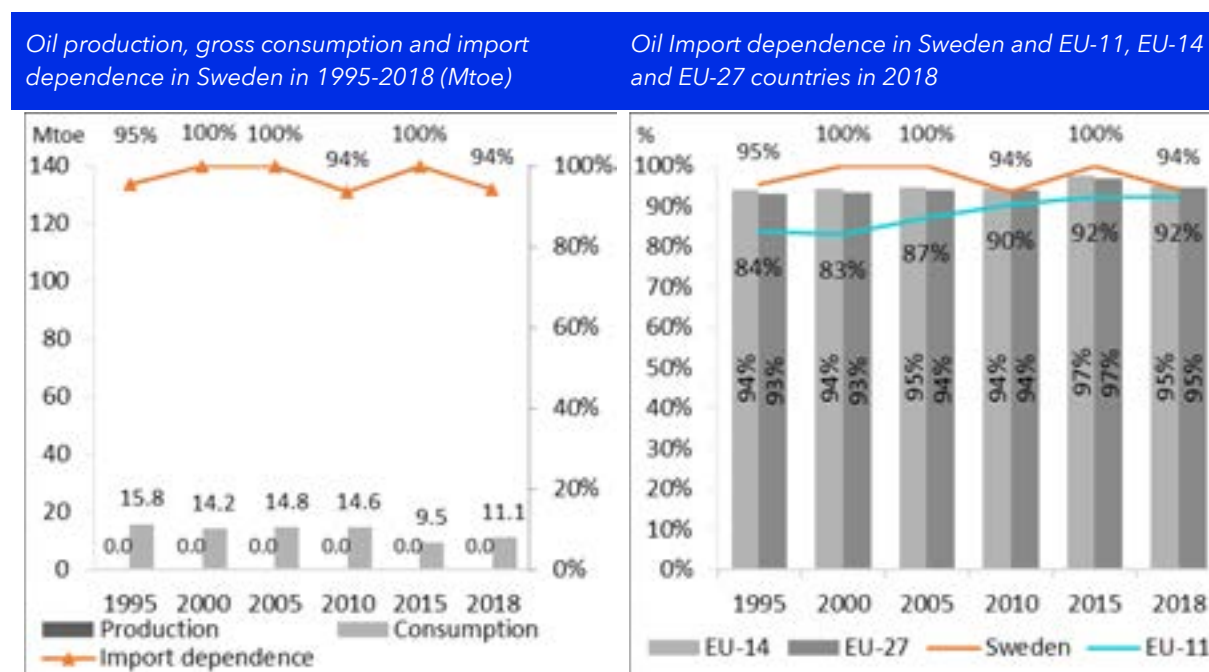
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Natural Gas G3000. Errors in summation to 100% are due to rounding

15.7 Overview of oil sector

The oil consumption of Sweden dropped from 15.8 Mtoe in 1995 to 11.1 Mtoe in 2018. At the same time the national production remained null. Therefore, the level of import dependency was high - between 94% and 100%.

When compared to EU-14 and EU-27 average import dependency, the country had a lower import dependency of 94% versus 95% in EU-14 and EU-27 countries. At the same time, the import dependency of the country was higher than EU-11 average - 94% versus 92%.

Item 337: Oil sector in Sweden



Source: Eurostat data for 2018, extracted in 2020. Detail references: Oil production - PPRD, gross consumption - GIC, import dependence (IMP-EXP)/GAE. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Import dependence above 100% has been rounded to 100%

The final consumption of oil per capita in Sweden increased from 1.51 toe per capita in 1995 to 0.71 toe per capita in 2018. The level of final consumption per capita remained higher than the one for EU-11 but lower than the averages for EU-14 and EU-27.

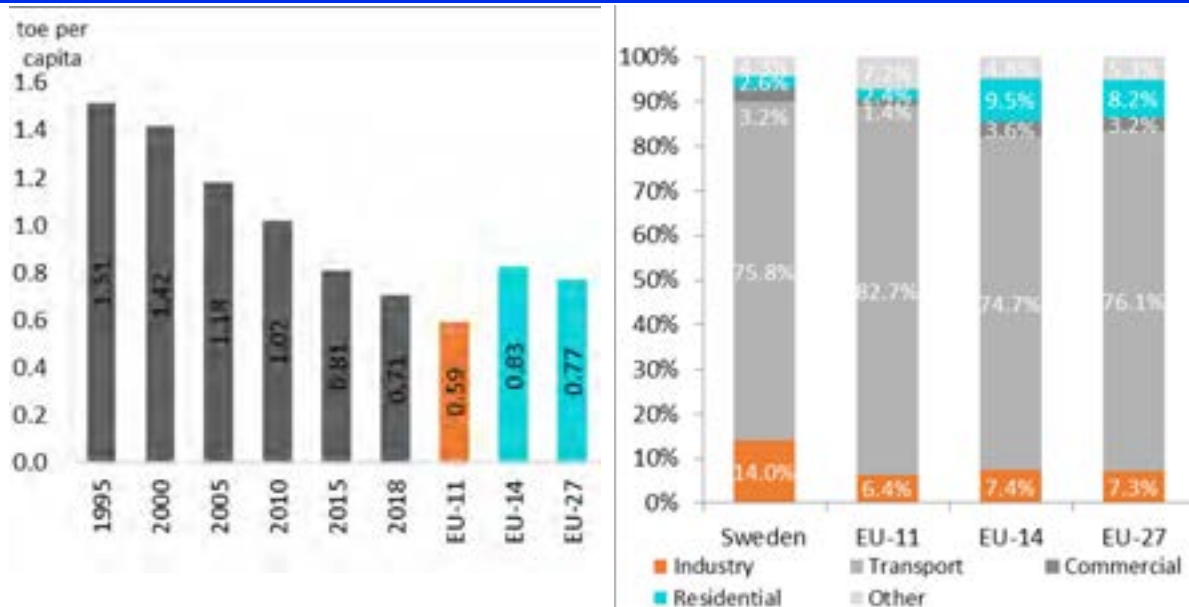
Oil consumption was dominated by transport sector - 75.8% versus 74.7% in EU-14 countries. Relatively more oil was used in industry - 14.0% versus 7.4% but less in commercial sector - 3.2% versus 3.6%. The residential use of oil was also lower than EU-14 average - 2.6% versus 9.5%.

The relative consumption of oil in Sweden compared to EU-11 was lower in 2018 - 75.8% versus 82.7%. The use in industry was relatively higher - 14.0% versus 6.4%. At the same time commercial and residential sector were consuming relatively more oil in the country than EU-11 averages - 3.2% and 2.6% versus 1.4% and 2.4%.

Item 338: Final consumption of oil per capita in Sweden in 1995-2018 and oil final consumption by sectors in Sweden and EU-11, EU-14 and EU-27 countries in 2018

Final consumption of oil per capita in Sweden (1995-2018) and in EU-11, EU-15 and EU-27 in 2018 (toe per capita)

Oil final consumption by sectors in Sweden and EU-11, EU-14 and EU-27 countries in 2018



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Final consumption per capita - FC_E/INDIC_DE; Final consumption - FC_E, Industry - FC_IND_E, Transport - FC_TRA_E, Commercial - FC_OTH_CP_E, Residential - FC_OTH_HH_E, Other - FC_OTH_E-FC_OTH_CP_E-FC_OTH_HH_E. All for Oil and petroleum products (excluding biofuel portion) O4000XBIO. Errors in summation to 100% are due to rounding

15.8 EU climate policy and its targets for Sweden

Sweden is subject to EU energy and climate regulations and therefore, specific targets were set and verified regarding greenhouse gas emission, share of energy from renewable energy sources and energy efficiency improvements (see Item 339).

Item 339: Energy and climate targets for Sweden for 2020 and 2030

| | Sweden 2020 targets | Sweden 2030 targets |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Greenhouse gas emissions | EU wide target of 20% reduction from 1990 levels (14% from 2005 level) | EU wide target of 40% reduction from 1990 levels |
| Greenhouse gas emissions in ETS | EU wide target of 21% reduction from 2005 | EU wide target of 43% reduction from 2005 |
| National emission reduction targets in non-ETS - Effort Sharing Decision (ESD) | -17% in relation to their 2005 levels | - |
| National emission reduction targets in non-ETS - Effort Sharing Regulations (ESR) | - | -40% in relation to their 2005 levels |
| Share of energy from renewable energy sources | EU wide target of 20% energy from renewables | EU wide target of minimum 32% share for renewable energy |
| EU wide target of share of energy from renewable energy sources | EU wide target of 20% share of gross final energy consumption | EU wide target of 32% share of gross final energy consumption |
| National target of share of energy from renewable energy sources | 49% of gross final consumption | Not yet available |
| Improvement in energy efficiency | EU wide target of 20% improvement in energy efficiency | EU wide target of at least 32.5% improvement in energy efficiency (compared with a projected business-as-usual scenario for 2030) |
| Primary energy consumption | EU wide target < 1,483 Mtoe National target < 43.4 Mtoe | EU wide target of 1,273 Mtoe (< 1,128 Mtoe EU-27) National targets not available yet |
| Final energy consumption | EU wide target < 1,086 Mtoe National target < 30.3 Mtoe | EU wide target < 956 Mtoe (< 846 Mtoe EU-27) National targets not available yet |

Source: EU website

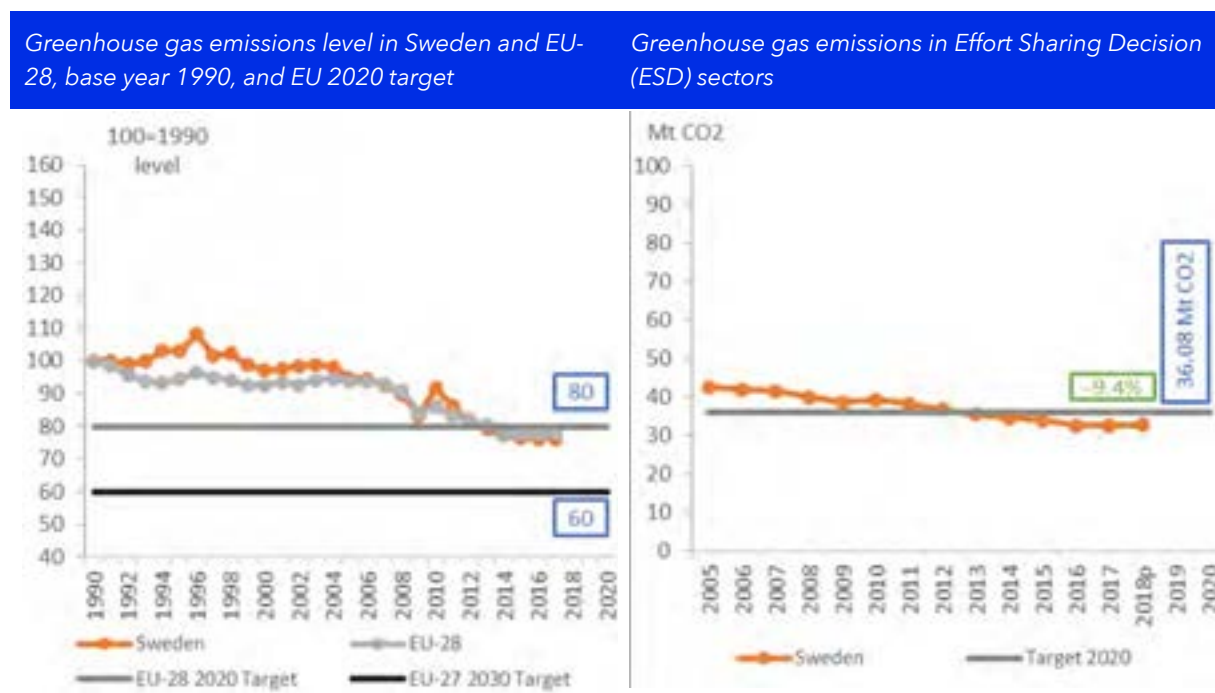
In following chapter, the overview of Sweden targets and performance are summarized.

15.8.1 Greenhouse gas emissions

EU set a target for CO₂ reduction by 20% compared to 1990 level at EU level. Regardless the fact that the target was not binding for specific country, the level of CO₂ emission in Sweden was below EU wide target.

The non-ETS greenhouse gas emissions the binding national targets for Sweden was 36.08 Mt of CO₂ equivalent emissions. Comparing to 2018 provisional results the level of emissions overachieved the target by 9.4%.

Item 340: Energy efficiency target data for Sweden



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Greenhouse gas emissions, base year 1990 [T2020_30], Greenhouse gas emissions in ESD sectors [T2020_35]

15.8.2 Renewable energy sources

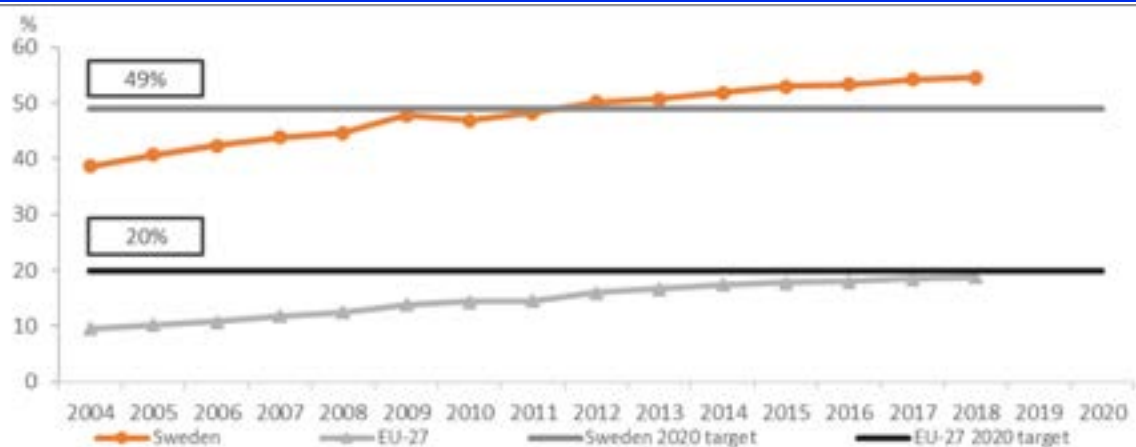
The following targets were set for Sweden regarding the share of energy from renewable energy sources in gross final energy consumption:

- a 20% share of gross final energy consumption by 2020,
- a 49% national target for share of energy from renewable sources in gross final consumption of energy in 2020.

The share of energy from renewable energy sources in Sweden was below EU wide and country specific targets in 2018.

Item 341: Share of energy from renewable energy sources in gross final energy consumption in Sweden

Share of energy from renewable energy sources in gross final energy consumption in Sweden in 2005-2018 and targets for 2020



Source: Eurostat data for 2018, extracted in 2020. Detailed references: Share of energy from renewable sources [nrg_ind_ren]

15.8.3 Energy efficiency

The energy efficiency target set for Sweden were respectively:

- Primary Energy Consumption in 2020: 43.4 Mtoe
- Final energy consumption in 2020: 30.3 Mtoe

Following the information provided in Item 342 the results for 2018 were above the targets in both criteria, respectively +8.2% of primary energy consumption and 5.6% of final energy consumption. This does not exclude Sweden to achieve the targets in 2020.

Item 342: Energy efficiency target data for Sweden

Primary energy consumption and final energy consumption in Sweden in 2005-2018 and targets for 2020

Ratio of primary energy consumption to target for 2020 and final energy consumption to target for 2020 in Sweden, EU-11, EU-14 and EU-27 in 2018



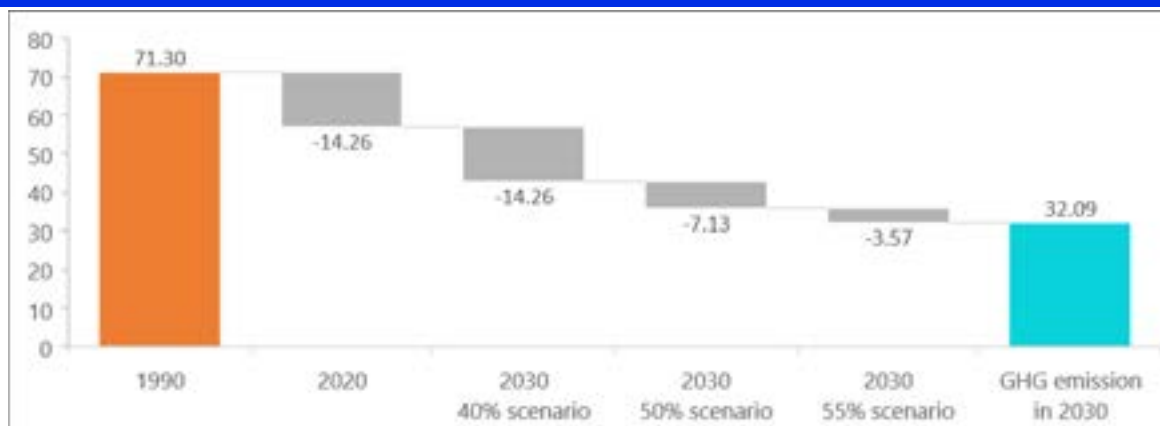
Source: Eurostat data for 2018, extracted in 2020. Detailed references: Primary energy consumption - Primary energy consumption (Europe 2020-2030)(PEC2020-2030), final energy consumption - Final energy consumption (Europe 2020-2030) (FEC2020-2030). EU-11 and EU-14 data estimated based on Eurostat data

15.9 Review of potential impact of Green Deal propositions

At the current stage of discussions regarding the European Green Deal only partial information are available regarding the future targets. EU is proposing to increase the greenhouse gas emission reduction to 50% or 55% for 2030. This is a proposition included in the draft proposal of "Climate Law". Assuming the Sweden greenhouse gas emissions in 1990, an estimation of EU 2030 target emissions can be drafted. The 2020 target of 20% reduction resulted in 14.26 Mt CO₂ emission drop. Further increase of the target to 40% in 2030 require additional 14.26 Mt CO₂ reduction. If the 50% target proposed under European Green Deal is applied then additional 7.13 Mt CO₂ emission decrease is needed, or 10.70 Mt CO₂ decrease, if 55% target is adopted.

Item 343: Estimation regarding greenhouse gas emissions in Sweden under different scenarios (Mt CO₂)

Estimation regarding greenhouse gas emissions in Sweden under different scenarios (Mt CO₂)



Source: Eurostat data for 2018, extracted in 2020. Estimations delivered by the Author

Nevertheless, it is worth to highlight that, if the current structure of greenhouse gas emissions target is maintain, then the 50% target for 2030 is an EU wide target. It is not a binding element for specific countries. Country specific targets could be expected as per ESD and ESR but there is no way to anticipate the potential targets.

At the same time, the review of key EU regulations around climate and energy as:

- Emissions Trading System Directive;
- Effort Sharing Regulation;
- Land use, land use change and forestry Regulation;
- Energy Efficiency Directive;
- Renewable Energy Directive;
- CO₂ emissions performance standards for cars and vans
- Energy Taxation Directive

can bring some additional targets in area of share of energy from renewable energy sources and energy efficiency. For the moment, any estimation of potential targets is not available nor possible to estimate.



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