"Jožef Stefan" Institute
Energy Efficiency Centre (EEC)

ODYSSEE-MURE

Energy Efficiency trends and policies in Slovenia

National report under ODYSSEE-MURE project

Reported by

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1. ECONOMIC AND ENERGY EFFICIENCY CONTEXT

1.1. ECONOMIC CONTEXT

Slovenian gross domestic product (GDP) increased by 70% in the observed period from 2000 to 2023 (from 28,944 M€$_{2015}$ in 2000 to 49,134 M€$_{2015}$ in 2023), while the growth in total value added (VA) of all economic sectors in the same period was 74% (Table 1, Table 2, Figure 2 and Figure 3). The growth of value added (VA) in industry in this period was 77%.

The average yearly growth of Slovenian gross domestic product (GDP) between 2000-2010 was 2.7%/year. The decrease of GDP in 2009 reached -7.6%. Drop was much larger than the decrease of GDP of EU (-4.3%) (Table 1). Between 2010-2023 average yearly growth of 2.0 %/year was observed, while in EU economic growth of 1.4 %/year has been observed. The average yearly increase of Slovenian GDP in the complete whole observed period 2000-2023 was 69.8% or 2.3%/year, which is higher than in EU-27 (36.0% or 1.4%/year) in the same period (Table 1, Figure 2).

Growth and annual GDP growth for the period 2000-2023 in Slovenia and the EU are shown in Table 1 and Figure 1. Table 2 shows the growth and value of (GDP), value added (VA) and private consumption of households in Slovenia in the period 2000-2023.

Figure 1 shows the trends of macro-economic developments in Slovenia in period 2000-2023 and Figure 2 shows the yearly variation (growth/decrease) of GDP in Slovenia and EU-27 in the period 2000-2023.

Table 1: Growth of Gross domestic product (GDP) in Slovenia and EU

	2000-2023		2000-2010		2010-2023		2023/2022
	%	%/year	%	%/year	%	%/year	%
Slovenia	69.8%	2.3%	30.4%	2.7%	30.2%	2.0%	2.1%
EU	36.0%	1.4%	14.3%	1.3%	19.5%	1.4%	0.4%

Source: Odyssee Mure database 2024

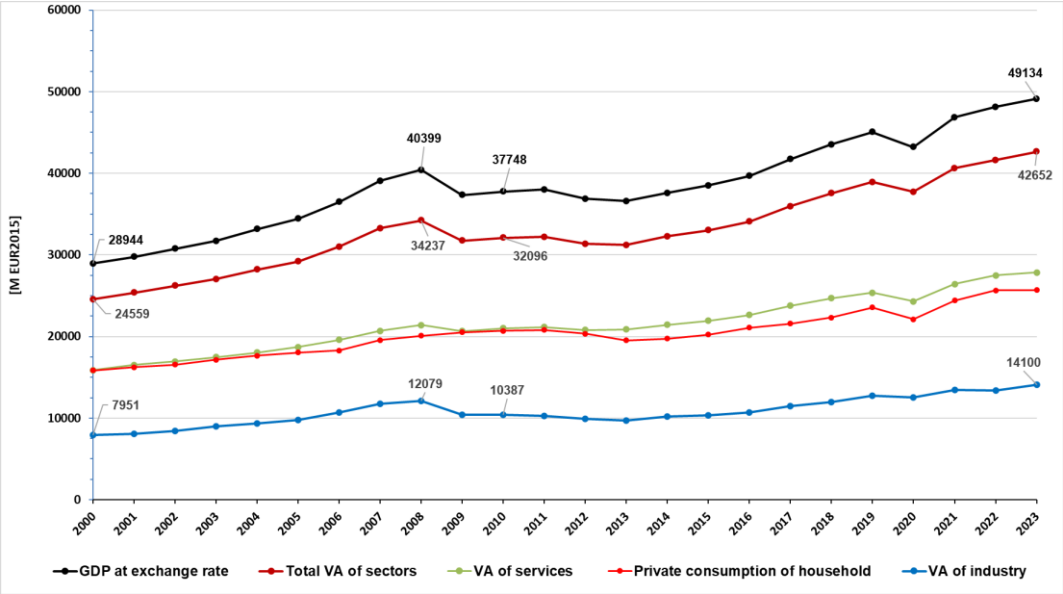


Figure 1: Trends of macro-economic developments in Slovenia in period 2000-2023

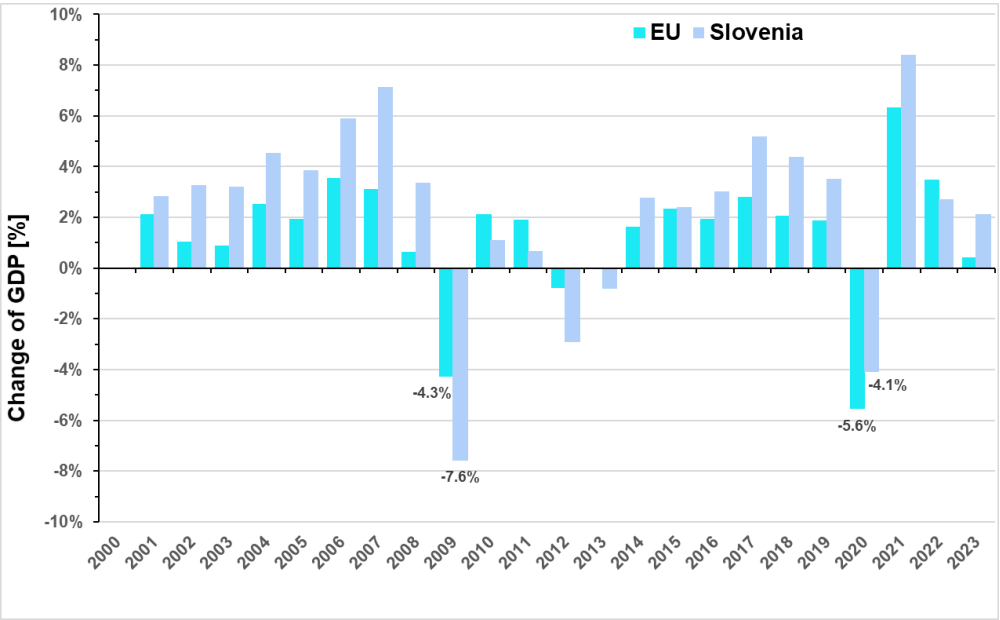


Figure 2: Yearly growth of GDP in Slovenia and EU-27-for the period 2000-2022

Table 2: Gross domestic product (GDP), value added (VA) and private consumption of households in Slovenia

a) GDP, VA and private consumption of households

	2000	2010	2022	2023
	$MEUR_{2015}$			
GDP	**28944**	**37748**	**48117**	**49134**
VA Industry	7951	10387	13385	14100
VA Services	15893	21010	27497	27860
VA Total	24559	32096	41602	42652
Private consumption of households	15835	20697	25637	25678

b) Growth of GDP, VA and private consumption of households

	2000-2023		2000-2010		2010-2023		2023/2022
	%	%/year	%	%/year	%	%/year	%
GDP	**70%**	**2.3%**	**30%**	**2.7%**	**30%**	**2.0%**	**2.1%**
VA Industry	77%	2.5%	31%	2.7%	36%	2.4%	5.3%
VA Services	75%	2.5%	32%	3.6%	33%	2.2%	1.3%
VA Total	**74%**	**2.4%**	**31%**	**2.7%**	**33%**	**2.2%**	**2.5%**
Private consumption of households	**62%**	2.2%	**31%**	2.7%	**24%**	1.7%	0.2%

Source: Odyssee Mure database 2024

The total value added (VA) of all sectors and VA of industry increased for 74% and 77% in the period 2000-2023, 31% and 31% in the period 2000-2010 and 33% and 36% in the period 2010-2023 as is shown in Table 2 and Figure 3.

The private consumption in households has increased for 62% in the whole period (2000-2023) and for 31% and 24% in the periods (2000-2010) and (2010-2023) as is shown in Table 2 and Figure 3.

Figure 3: Trends of macro-economic developments in Slovenia in the period 2000-2023

1.2. TOTAL ENERGY CONSUMPTION AND INTENSITIES

The total energy supply (primary energy) of Slovenia decreased for 5.9% or in average for 0.3%/year in the period 2000-2023 (from 6526 ktoe in 2000 to 6137 ktoe in 2023), as is shown in Table 3 and Table 4.

Table 3: Primary and final energy consumption and energy intensity in Slovenia

	Unit	**2000**	**2010**	**2023**
Total energy supply	[ktoe]	6525	7344	6137
Final energy consumption	[ktoe]	4521	5038	4430
Primary Energy intensity	[koe/€$_{2015}$]	0.225	0.195	0.125
Final energy intensity	[koe/€$_{2015}$]	0.156	0.133	0.090

The growth of total energy supply achieved 12.5% or 1.2%/year in the period between 2000-2010 with increase of 2.4%/year. Due to economic crisis in 2008 and implementation of energy efficiency policy consumption decreased for 16.4% or 1.4%/year in the period 2010-2023. Similar situation was in the final energy consumption. Between 2000-2010 final energy consumption increased by 11.4% or 1.1%/year followed by decline (12.1% or in average 1.0%/year between 2010-2023).

Final energy consumption decreased by 2.0% or 0.1%/year in the 2000-2023 period.

The intensity of primary energy decreased by 44.6% or on average for 2.5%/year in the period 2000-2023 (from 0.225 koe/€2015 in 2000 to 0.125 koe/€2015 in 2023), as is shown in Table 3 and Table 4.

Table 4: Trends of energy consumption and energy intensity in Slovenia

	2000-2010		**2010-2023**		**2000-2023**	
	Total	Per year	Total	Per year	Total	Per year
	[%]	[%/year]	[%]	[%/year]	**[%]**	**[%/year]**
Total energy supply	12.5%	1.2%	-16.4%	-1.4%	**-5.9%**	**-0.3%**
Final energy consumption	11.4%	1.1%	-12.1%	-1.0%	**-2.0%**	**-0.1%**
Primary Energy intensity	-13.7%	-1.5%	-35.8%	-3.4%	**-44.6%**	**-2.5%**
Final energy intensity	-14.6%	-1.6%	-32.4%	-3.0%	**-42.3%**	**-2.4%**

The development of total energy supply, final energy consumption and energy intensity in Slovenia in the period 2000-2023 is shown in Figure 4.

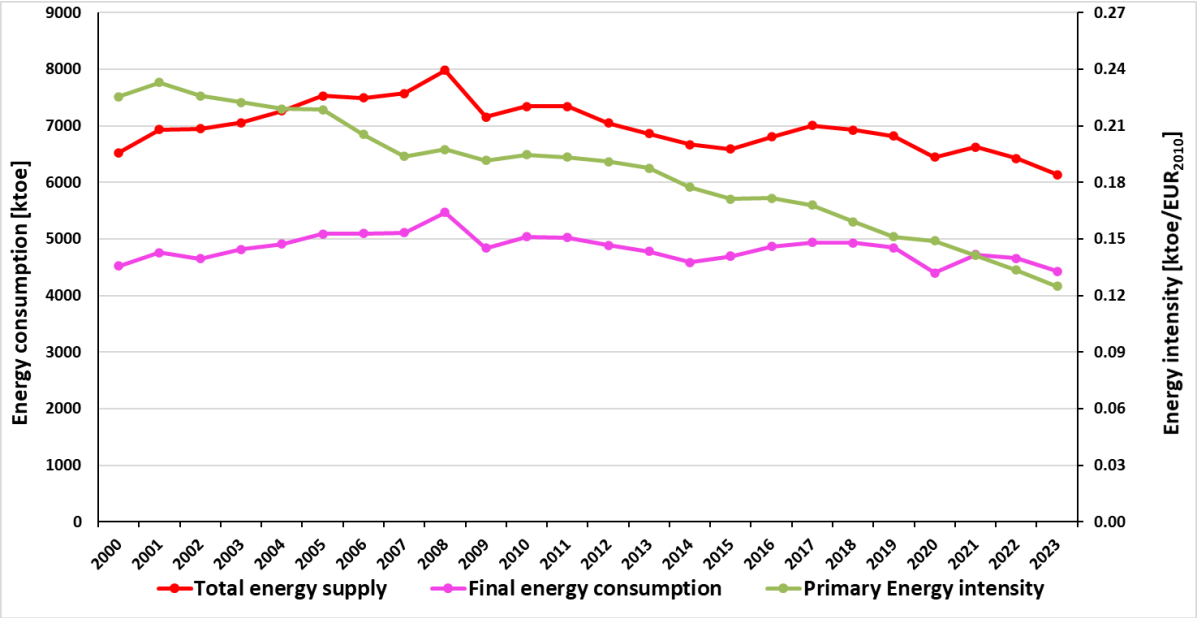


Figure 4: Total energy supply, final energy consumption and energy intensity of Slovenia in the period 2000-2023.

Final energy consumption decreased in all economic sectors except transport between 2000 and 2023. The consumption has decreased by 24.8% (or 1.2%/year) in industry, 20.6% (or 1.0%/year) in households and 16.5% (or 0.8%/year) in services. The final energy consumption has increased for 51.4% (or 1.8%/year) in transport in the same period as is shown in Table 5 and Figure 5.

Table 5: Final energy consumption in Slovenia by economic sectors

	2000-2010		2010-2023		2000-2023		2023/2022
	%/year	%	%/year	%	%/year	%	%
Industry	-1.1%	-10.7%	-1.3%	-15.8%	-1.2%	-24.8%	-9.2%
Transport	3.9%	46.7%	0.2%	3.3%	1.8%	51.4%	-6.2%
Households	0.9%	9.5%	-2.4%	-27.5%	-1.0%	-20.6%	-1.8%
services	-0.2%	-2.3%	-1.2%	-14.6%	-0.8%	-16.5%	2.8%
All sectors	**1.1%**	**11.4%**	**-1.0%**	**-12.1%**	**-0.1%**	**-2.0%**	**-5.0%**

Structure of final energy consumption by economic sectors has changed significantly between 2000-2023. In 2000 the largest share of energy consumption fell on industry with 31.6%, followed by households with 27.4%, transport 26.8% and services 14.3%. Large increase of energy consumption

of transport contributed to increase in share in final energy consumption to 41.4% in 2023. Share of final energy consumption of industry until 2023 decreased to 24.2%, share of households decreased to 22.2% and share of services and other decreased to 12.2% of total final energy consumption (Figure 5).

Figure 5 shows the structure of final energy by economic sectors in whole the observed period 2000-2023.

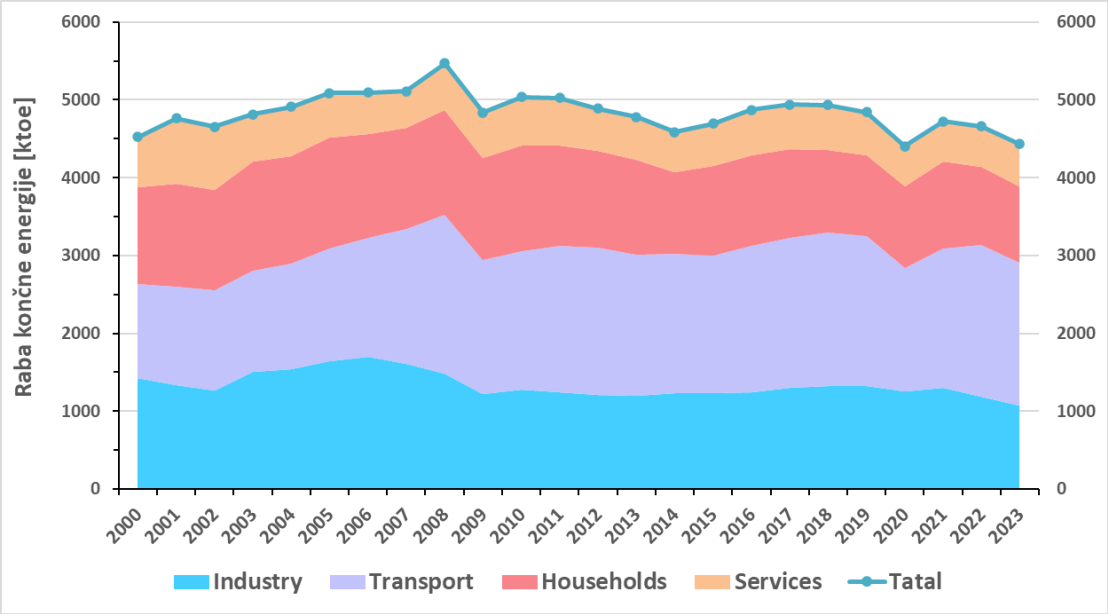


Figure 5: Final energy consumption of Slovenia in the period 2000-2023 by sectors

1.3. ENERGY EFFICIENCY INDEX ODEX

Trend of energy efficiency measured by the energy efficiency indicator ODEX[1] for all sectors and by sectors (industry, transport, households and services) is shown in Figure 6 and Table 6.

The overall energy efficiency index ODEX in all final consumers improved by 30% between 2000 and 2023, which is a mean annual improvement of 1.6%/year.

Largest efficiency improvements were achieved in services with 54% or 3.3%/year following by households by 41% or 2.3%/year within the period from 2000 to 2023. The ODEX indicator for industry shows an overall progress of 38% or 2.1%/year in the period under review. Efficiency in the transport sector (excluding international air transport) improved poorly 0.2%/year or 4% over the whole period (Table 6).

1 Energy efficiency indicators ODEX used to provide an energy efficiency trends by sector.

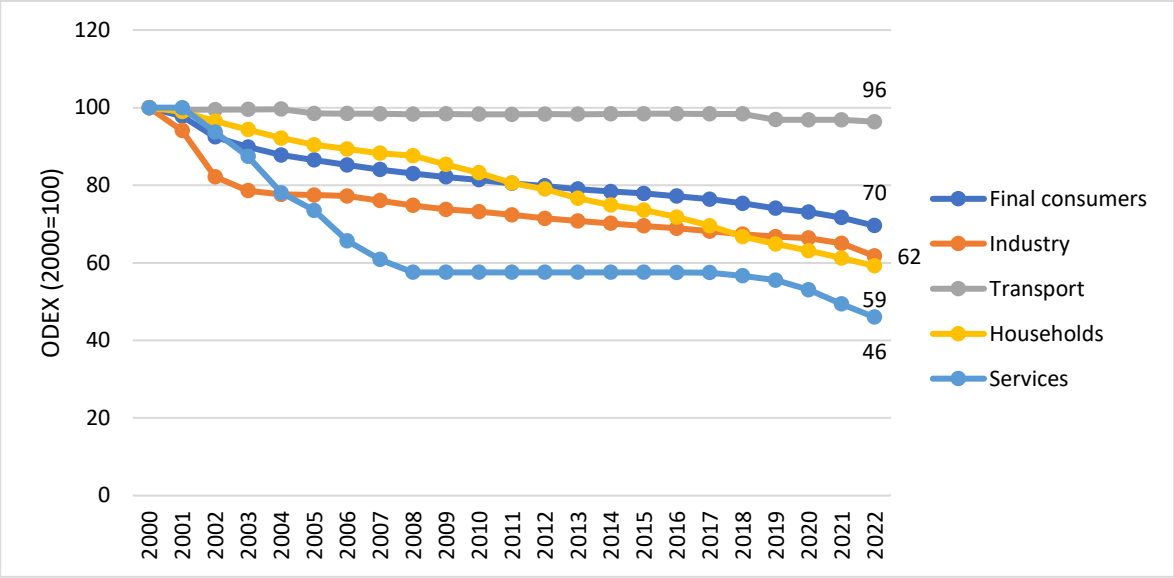


Figure 6: Development of the energy efficiency index ODEX by sectors and average in Slovenia for the period 2000-2022

Table 6 shows the total and annual improvement of overall energy efficiency index ODEX in Slovenia and by sectors.

Table 6: Energy efficiency improvement by sectors in the period 2000-2023

		[%]	[%/year]
Final consumers	**2000=100**	**30.4**	**1.6**
Industry	2000=100	38.2	2.1
Transport	2000=100	3.6	0.2
Households	2000=100	40.8	2.3
Services	2000=100	54.0	3.3

1.4. ENERGY SAVINGS

The cumulative energy savings since 2000 is calculated from ODYSSEE database from the indicator ODEX that measures the energy efficiency progress by sector.

Energy savings include policy related savings and saving from autonomous progress. Energy savings represent the effect of a reduction in unit consumption at the level of up to 30 sub-sectors or end-uses. They correspond to "technical energy savings".

Total energy savings in the end-use sectors were 1842 ktoe in 2023. Cumulative energy savings in 2023 were 145 ktoe more than in 2022.

The largest energy savings were achieved in industry (750 ktoe or 41% of all savings), followed by households (674 ktoe or 37%). The lowest energy savings were achieved in transport (83 ktoe or 4%), while energy savings of 335 ktoe or 18% were achieved in the services. Figure 7 shows cumulative energy savings in Slovenia in the period from 2000 to 2023 by sectors.

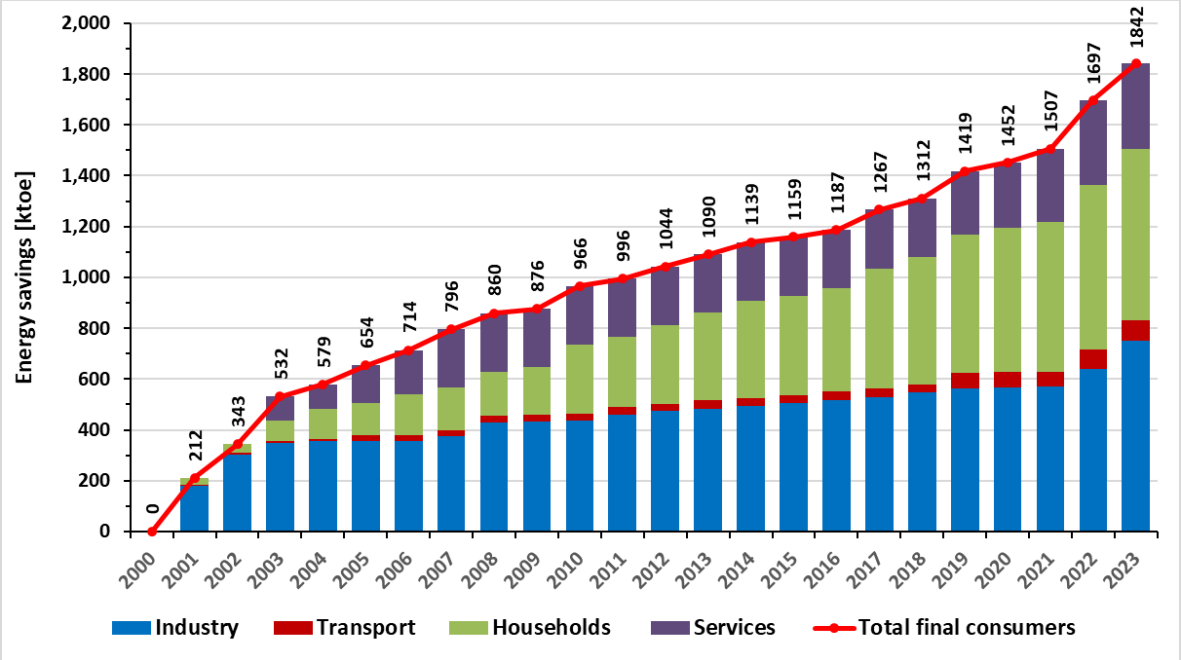


Figure 7: Energy savings by sectors in the period 2000-2023

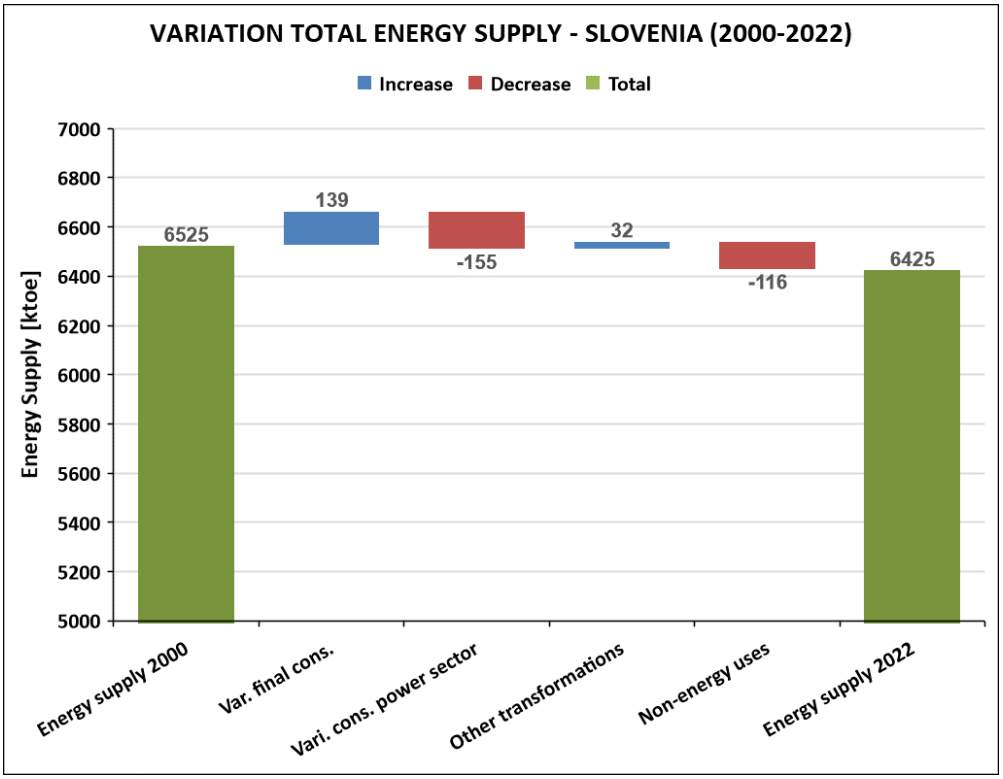
1.5. DECOMPOSITION OF THE VARIATION OF THE PRIMARY AND FINAL ENERGY CONSUMPTION

The decomposition of energy consumption variation aims at identifying the role of different factors.

DECOMPOSITION OF TOTAL ENERGY SUPPLY (PRIMARY ENERGY)

The variation of total energy supply in the period 2000-2022 in Slovenia amounted to 100 ktoe (from 6525 in 2000 to 6425 ktoe in 2022) as shown in Figure 9.

The variation of final energy consumption and other transformations contributed to a total increase in primary energy of 171 ktoe. This was compensated by the variations of consumption of power sector and non-energy uses (-271 ktoe)-.



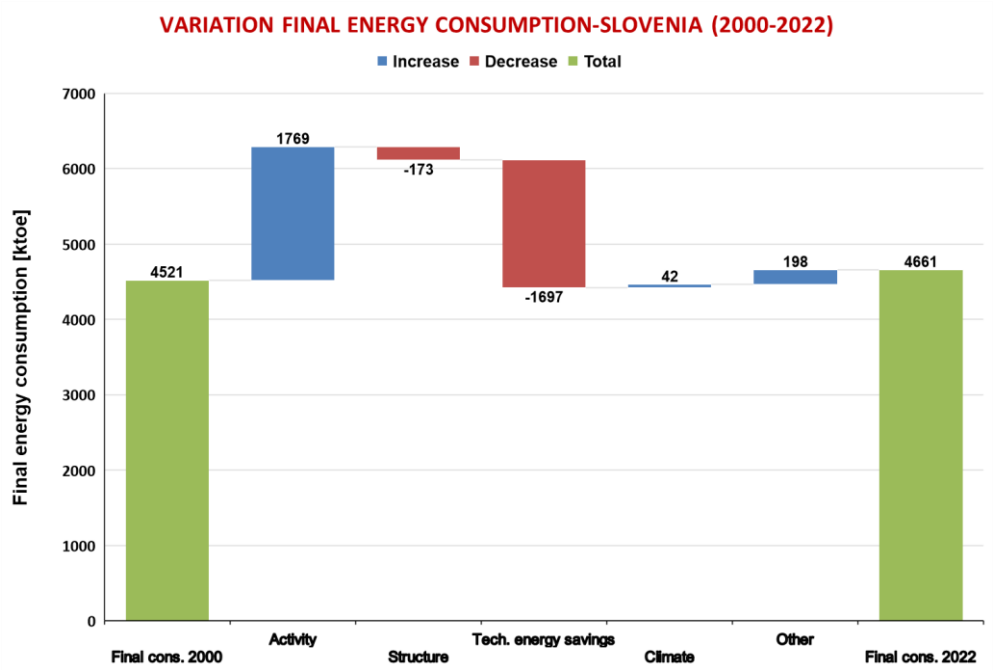
Source : Eurostat; ambient heat excluded.

Figure 8: Decomposition of energy supply in Slovenia for the period 2000-2022

DECOMPOSITION OF THE VARIATION OF THE FINAL ENERGY CONSUMPTION

Decomposition of total final energy consumption (excluding consumption of international air transport) is shown in Figure 9. During the period 2000-2022 total final energy consumption in Slovenia increased for 139 ktoe from 4522 to 4661 ktoe as is shown in Figure 9.

The activity, climate and other effects contributed to a total increase in final energy consumption by 2009 ktoe, with the activity effect being the main driver with a share of 88% or (1769 ktoe). These factors were compensated by the energy savings achieving 1697 ktoe through a considerable improvement in energy efficiency as measured by the ODEX and, to a lesser extent, some structural changes that also caused decreasing energy consumption over the period 2000-2022.



Source: ODYSSEE (based on Eurostat and national data; ambient heat excluded)

Figure 9: Decomposition of total final energy consumption in Slovenia for the period 2000-2022

1.6. ENERGY EFFICIENCY POLICY BACKGROUND

Energy efficiency falls under responsibility of Ministry of the environment, climate and energy but requires cooperation of other ministries to.

Overall development direction of Slovenia is determent in Slovenian Development Strategy 2030. Strategy builds on sustainable growth of which an important part is efficient use of energy and resources.

The first National Energy and Climate Action plan (NECP) has been adopted in February 2020 and the second was adopted by the government on December 2024. It contains national targets and different measures that will contribute to achieving those targets in five dimensions of energy union, amongst which is also energy efficiency. Long term climate strategy has been adopted in 2021, where an important corner stone of reaching net zero emissions is improvement of energy efficiency contributing to reduction of energy consumption.

The Slovenian parliament adopted the Act on Energy Efficiency (ZURE) on October 2020. The Act on Energy Efficiency (ZURE) regulates areas previously covered in the Energy Act (EZ-1) and brings the country in line with the new European Union rules. ZURE contains measures for energy efficiency improvement for all sectors. The Act on Energy Efficiency (ZURE) includes energy services and essential measures for improving energy efficiency to achieve energy savings targets.

Energy efficiency measures contribute to higher competitiveness of the economy, have positive effect on economic growth and employment and reduce impacts on the environment.

They contribute to achievement of other targets under climate and energy package, i.e. renewable and GHG target.

ENERGY EFFICIENCY TARGETS

The Slovenian policy objective in the NECP 2024 is to improve energy efficiency by 2030 at least in line with the indicative target from the latest amendment to the Energy Efficiency Directive (EED). The new target value for final energy consumption in 2030 should not exceed 50.2 TWh (4320 ktoe), which is 4.7 TWh (404 ktoe) lower than the previous target in the NECP 2020. Converted to primary energy levels, consumption in 2030 would not exceed 69.5 TWh (5980 ktoe).
Projections show that Slovenia is capable of achieving a reduction in final and primary energy consumption by 2030 compared to the PRIMES 2020 reference scenario.

The key objectives of energy efficiency policy/dimension as defined in NECP 2024 are:

- accelerating energy efficiency and material efficiency improvements in all sectors (including energy supply) as a key enabler of a successful exit from the energy crisis and the effective implementation of the green transition (and thus reducing the consumption of energy and other natural resources) based on the energy efficiency first principle, which is a prerequisite for a successful and competitive transition to a climate-neutral society,
- improve energy efficiency and the amount of annual savings under the mandatory savings scheme by 2030, at least in line with the indicative target set in the new Energy Efficiency Directive (EED);
- ensure the systematic implementation of adopted policies and measures to ensure that final energy consumption does not exceed 50.2 TWh (4320 ktoe),
- reduce final energy use in buildings by 15 % by 2030 compared to 2020,
- final energy consumption in the public sector will be reduced by 1.9 % annually by 2030 compared to the base year;
- renovate 3 % of the total floor area of public sector buildings annually;
- ensure accessibility to energy efficiency for all – including financially weaker users;
- active and accelerated support for industry to increase efficiency and competitiveness, the introduction of new efficient green technologies and the circular economy;
- accelerate the implementation of information, awareness-raising and training programmes for different target groups on the benefits and practical aspects of the development and use of RES and RES technologies and understanding the concept of adequacy and motivation for less material well-being

In the NECP 2024 Slovenia sets its renewable target to achieving at last 33% share of renewable sources in final energy consumption in 2030.

2. ENERGY EFFICIENCY IN BUILDINGS

2.1. ENERGY EFFICIENCY TRENDS

The share of energy consumption of buildings accounted for 32 % of final energy consumption in 2022, being 3 percentage point lower compared to 2015. 68 % is consumed in households and 32 % in the service sector (public and private).

The final energy consumption in households in 2022 was 16 % lower than in 2000 and taking into account climate correction 17 % lower (Figure 10). Actual consumption is in the period 2000-2010 more often above consumption with climatic correction, while in the period 2011-2022 actual consumption is more often below. This means that winters in the second period are more often milder compared to 2000-2020 average, compared to the 2000-2010 period. In general consumption in households with climatic correction was increasing between 2000 and 2008, and after 2008 it is decreasing. The decrease is due to implementation of energy efficiency measures that are successfully implemented with subsidies from Eco fund. In 2020 and 2021 consumption was increasing due to measures during COVID pandemic. In 2022, decrease in energy consumption continued. Actual consumption decreased by 10 %, while consumption with climatic corrections by 4 %. Further decrease was observed in 2023 due to milder winter and also energy efficiency improvement. In 2023 rise in electricity consumption was quite significant with 8 %.

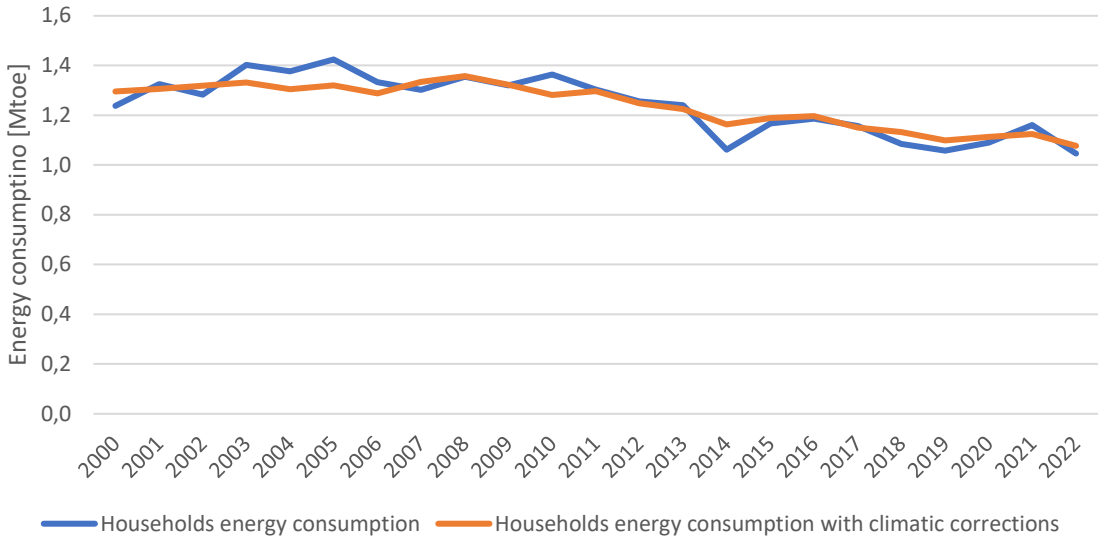


Figure 10: Final energy consumption in households (2000-2022) (Source: Odyssee database)

The final energy consumption of tertiary sector is calculated as a residual in energy statistics between 2000-2021, contributing to large deviations in energy consumption in this sector (Figure 11) and especially large deviations at the level of individual fuels. Along that use of RES is not estimated for this sector meaning that final energy consumption is underestimated. But use of RES is not as important as in households. From 2022 onward data is gathered through survey meaning that energy consumption trend will better reflect actual situation, and RES consumption will also be included with exception of heat pumps that were included in 2023.

Final energy use in tertiary sector in 2000 amounted to 0.6 Mtoe and in 2022 0.5 Mtoe, therefore decreasing by 15 %. Maximum level of consumption has been reached in 2001 with 0.8 Mtoe and minimum in 2007 with 0.4 Mtoe. In 2022 consumption in tertiary increased by 9,5 % probably due to change in methodology and also due to returning back to normal after COVID situation.

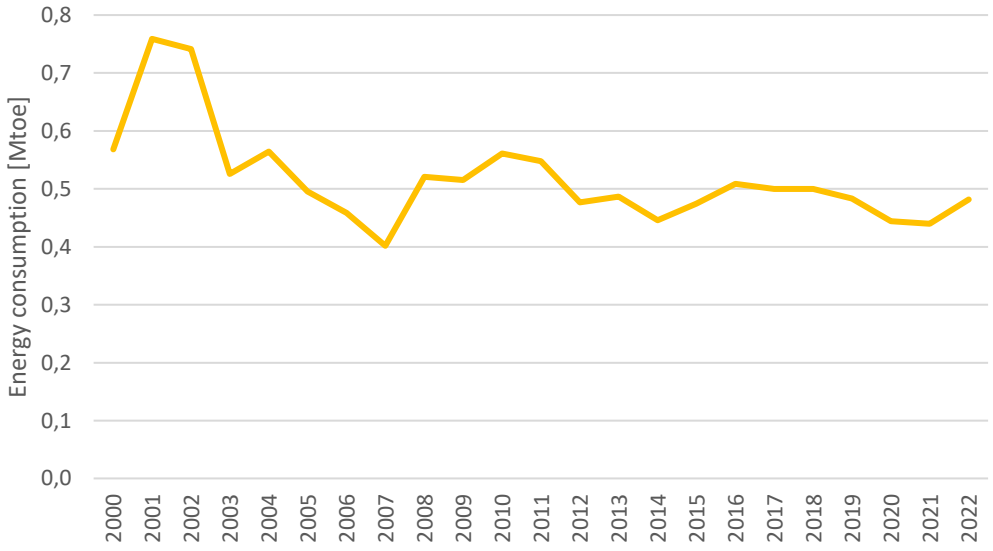


Figure 11: Final energy consumption in tertiary sector (2000-2022) (Source: Odyssee database)

The largest share of energy consumption in households falls on heating with 63 % in 2022, followed by hot water and specific electricity uses including large appliances and lighting both with 16 % and cooling 1 % (Figure 12). Comparison of consumption per purposes in 2000, 2010 and 2022 shows that the decrease was observed only in heating, while energy consumption in other uses increased. Reduction in heating is a consequence of improved performance of buildings and more efficient production of heat. Use of electricity in large appliances and for lighting decreased due to more efficient devices. Important part of electricity consumption cannot be attributed to known uses. This consumption is increasing contributing to increase in specific electricity.

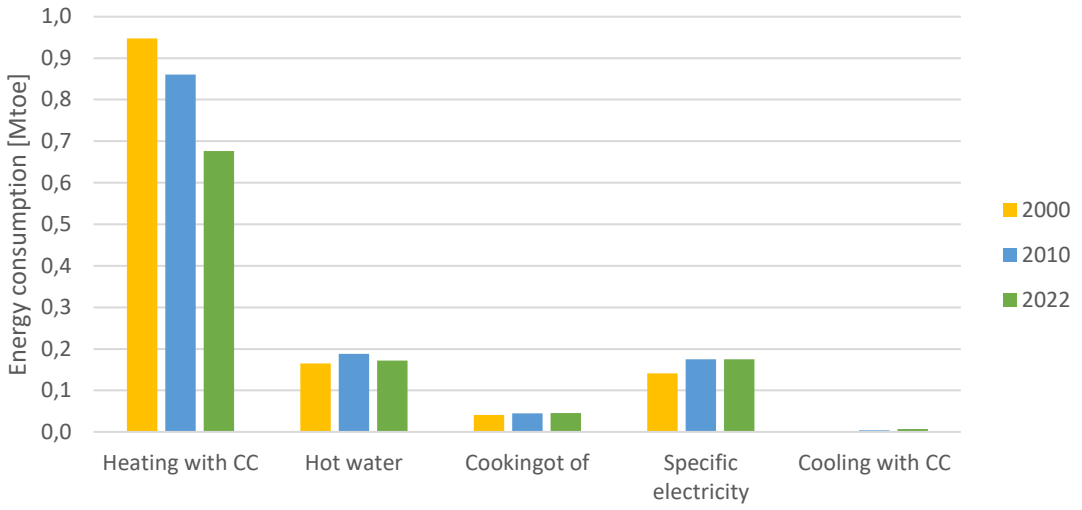


Figure 12: The structure of energy consumption of households by purposes in 2000, 2010 and 2022 (Source: Odyssee database)

Energy use for heating per square meter in households between 2000 and 2022 mainly decreased due to renovation of buildings, renovation of heating systems, building of new efficient buildings and change in behaviour (Figure 13). Two increases can be observed. First in 2007, when large drop in use of heating oil occurred compared to 2006, which was in the model compensated by an increase in the use of wood in old boilers resulting in decrease of efficiency in buildings. Increase in 2011 is a consequence of normalisation to average winter, since in Slovenia different factors in methodology for normalization to average winter are in use than in ODYSSEE database. Specific consumption in 2022 is 43 % lower than in 2000.

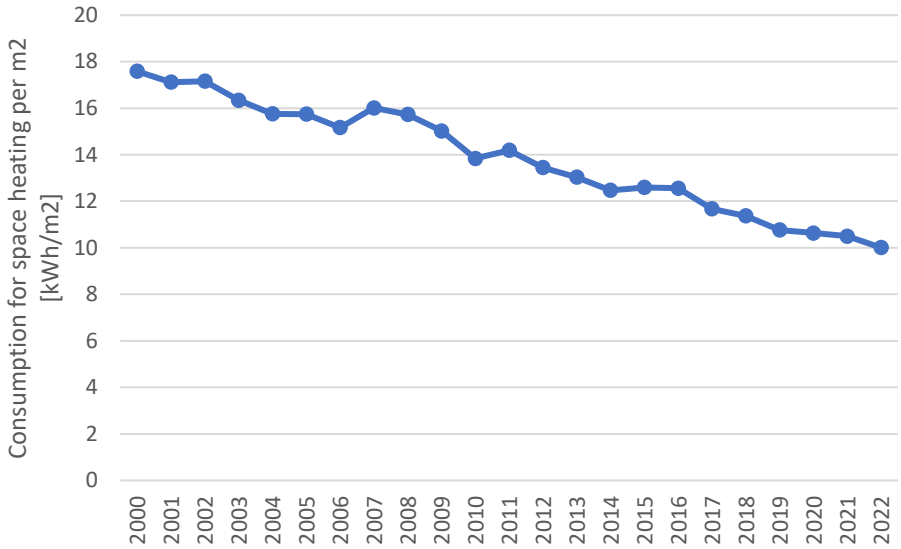


Figure 13: Energy consumption for heating in households per surface area (Source: Odyssee database)

The structure of energy use in households changed considerably in the period 2000-2022 (Figure 14, Figure 15). Consumption of heating oil fell sharply. Consumption in 2022 was less than 30 % of the consumption in 2000. Decrease can also be observed in district heat consumption due to implementation of a pay according to use principle in multifamily houses and renovation of buildings. In the last year prices were an important factor. Consumption decreased by 26 %. Large decrease has also been observed in LPG use, due to higher penetration of electric cooking and changes of fuel to natural gas. Despite higher share of households using wood for heating decrease in consumption of wood has been observed due to higher share of efficient wood boilers being used. In recent years heat pumps are also substituting wood biomass. Use of other RES has on the other hand increased, so total RES consumption decreased by 9 % mainly due to improvement in efficiency of buildings. On the other hand, increase has been observed in consumption of natural gas, especially between 2000 and 2008, in recent years consumption is decreasing, and electricity consumption which has been increasing through the whole period.

Wood biomass is the most important fuel in Slovenian households with 34 % share in households final consumption in 2019, followed by electricity (31 %), natural gas (10 %), heating oil (9 %), district heat with 7 % and LPG with 3 %. Other RES (mainly ambient heat) had 7 %.

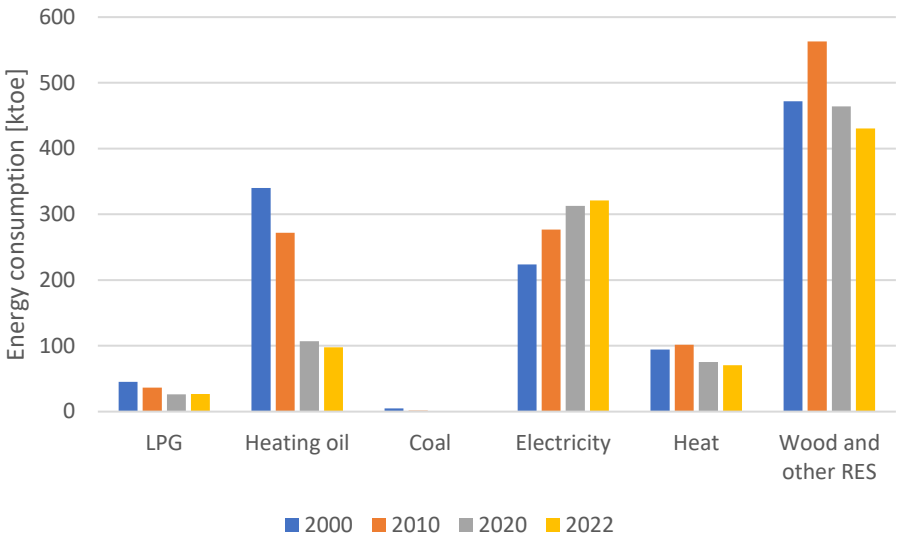


Figure 14: Fuel structure of energy consumption in households in 2000, 2010, 2020 and 2022 (Source: Odyssee database)

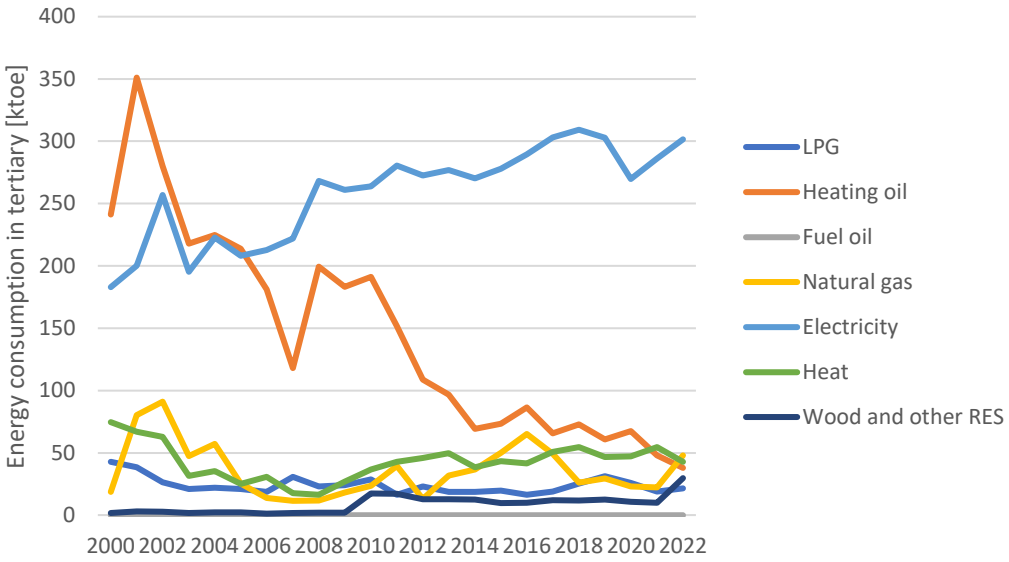


Figure 15: Fuel structure of energy consumption in tertiary sector between 2000 and 2022 (Source: Odyssee database)

In the service sector electricity is the most important fuel with 63 % of sectors final consumption in 2022. Second fuel is natural gas with 10 %, followed by district heat with 9 % and heating oil with 8 %. LPG represented 4 %. RES (biogas, geothermal and wood) represented 6 %. Sharp decline of heating oil can be observed in the period 2000-2022 (decrease by 203 ktoe), which has not been compensated by growth in other fuels. Use of district heating and LPG also declined by 32 ktoe and 21 ktoe respectively, natural gas being the only fuel, used mainly for heating and hot water preparation purposes, with increase (28 ktoe). As mentioned from 2022 onward energy consumption data for tertiary is collected with survey enabling also capture of use of wood biomass and rough estimate for ambient heat, increasing use of RES considerably (almost by a factor of 3). Growth of electricity use (by 119 ktoe) can partially be attributed to higher penetration of heat pumps in the service sector, important drivers also being higher share of air-conditioned buildings and higher use of IT devices, while on the other hand higher efficiency in lighting contributed to energy savings. Large growth of service sector in Slovenia is also strongly contributing to growth of use of electricity.

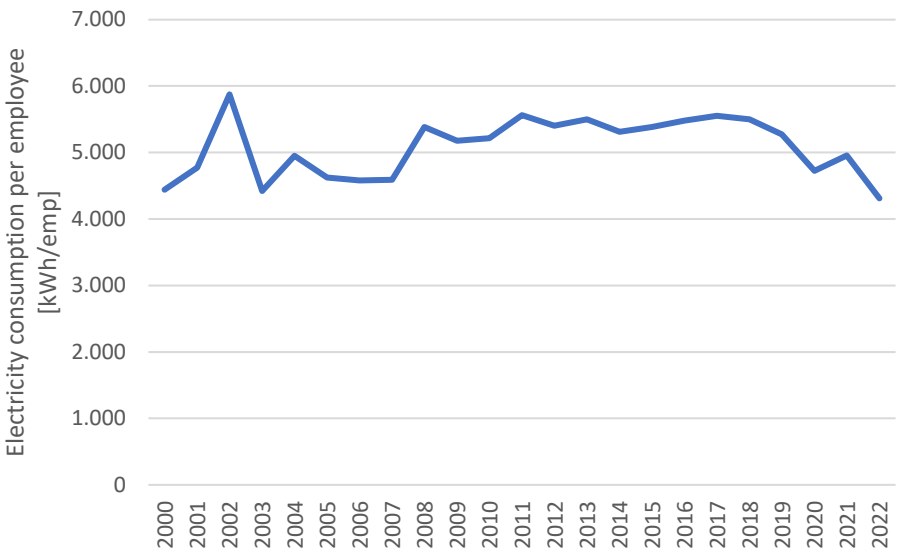


Figure 16: Electricity consumption in service sector per employee in the period 2000-2022 (Source: Odyssee database)

Electricity use growth in the period 2000-2017 was higher than the growth of employees in the service sector which resulted in increase in unit consumption by 25 %. Majority of the increase happened before 2008, while in 2008-2017 period slight increase has been observed. After 2017 the indicator decreased quickly to the lowest value in 2022, being 3 % below 2000 value.

Improvement in energy efficiency is measured by energy efficiency index so called ODEX (Figure 17), which has been developed in the project ODYSSEE-MURE. Along energy efficiency index, which can also increase (have negative savings) due to changes in behaviour, also technical index has been developed which assumes that negative savings are not possible thus eliminating negative impact of behavioural changes on energy efficiency improvement. This is done by restricting increase of indices per different uses in year t compared to previous year. In the report, technical indices are shown.

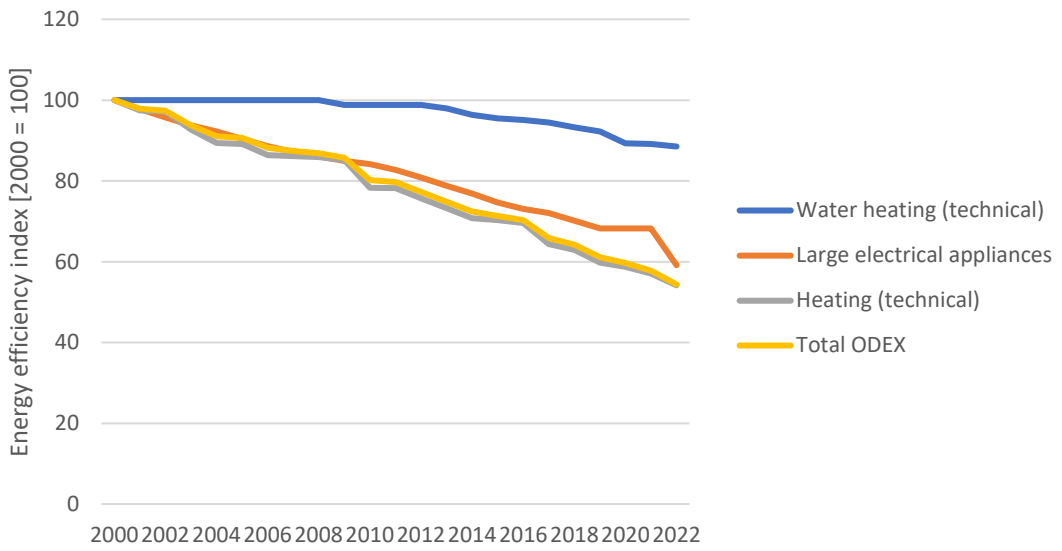


Figure 17: Energy efficiency improvement of households in the period 2000-2022 (Source: Odyssee database)

Energy efficiency in households improved by 46 % between 2000 and 2022 (Figure 17). Efficiency of heating, hot water preparation and large household appliances improved constantly through the whole period reaching 46 %, 11 % and 41 % efficiency improvement in 2022 respectively. Heating has by far the largest effect on total ODEX.

Due to energy efficiency improvement in 2000-2022 period energy savings in the households amounted to 719 ktoe in 2022, which is 67 % of the climate corrected consumption in 2022. If these savings would not be realized energy use in the 2000-2022 would increase by 39 % while in reality it decreased by 17 % (Figure 18)

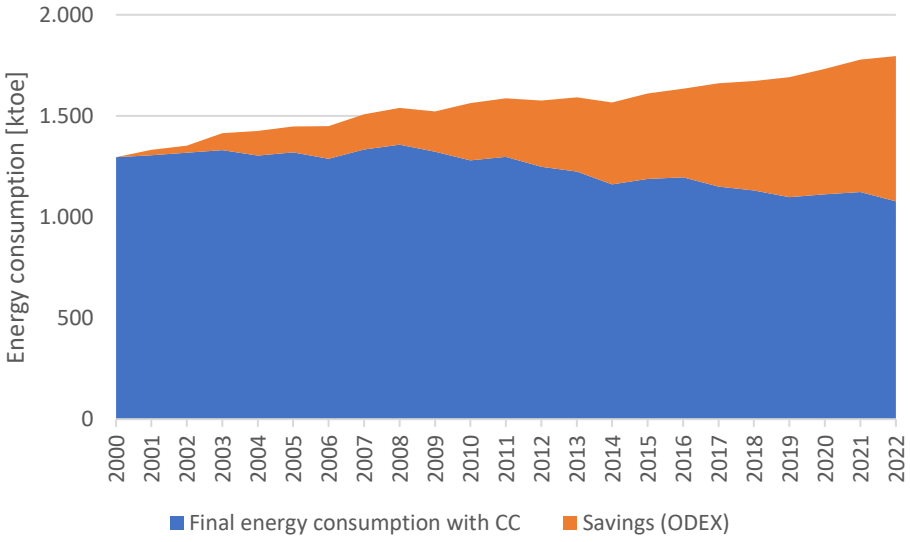


Figure 18: Savings due to energy efficiency measures in households compared to climate corrected final energy consumption (Source: Odyssee database)

Decrease of the households energy consumption between 2000 and 2022 by 0,19 Mtoe can be decomposed to:

- Change in number of occupied dwellings ("more dwellings") – increase of energy consumption by 0,17 Mtoe– negative effect;
- Change in floor area of a dwelling for space heating ("larger homes") - increase by 0,14 Mtoe– negative effect;
- Change in number of large appliances per dwelling (“More appliances”) – increase by 0,15 Mtoe – negative effect
- Climatic difference ("climate effect") – small increase in consumption (0,03 Mtoe) = small negative effect;
- Energy savings, as measured by (technical) ODEX – large decrease of consumption (by 0,75 Mtoe) – positive effect;
- Other effects (mainly change in heating behaviours) increase of consumption by 0,06 Mtoe – negative effect;

Variation of energy consumption of households in Slovenia is presented in the figure below (Figure 19).

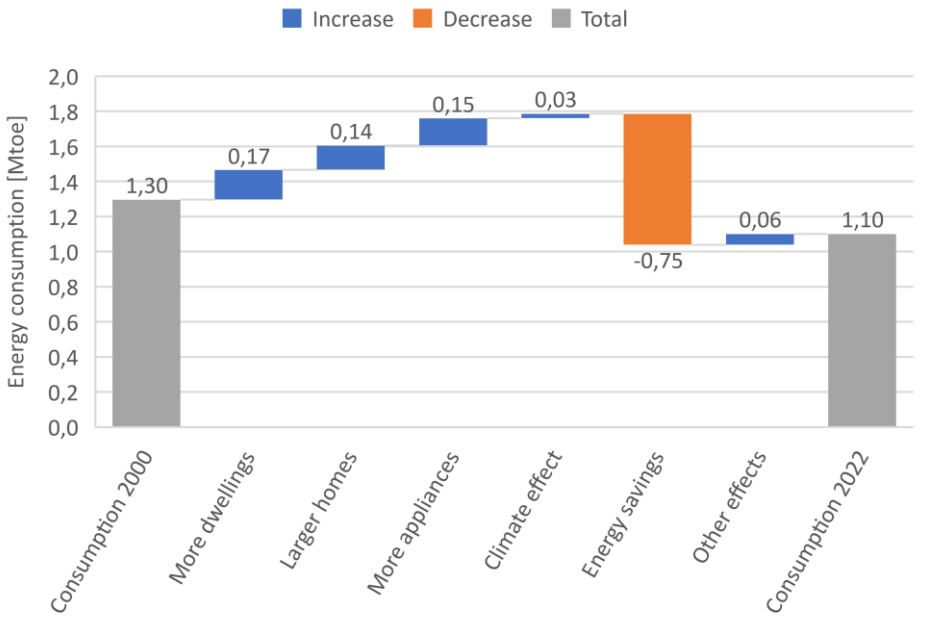


Figure 19: Variation of energy consumption of households for the period 2000-2022 (Source: Odyssee database)

2.2. ENERGY EFFICIENCY POLICIES

Improvement of energy efficiency is among the main objectives of all Slovenian strategic documents adopted in the previous years. Implementation of policies and measures in household sector in the past has been done according to Slovenian national energy efficiency plans, National Action plans for renewables and Operational programmes for GHG emissions reduction. In 2015 Long term strategy for mobilising investments in the energy renovation of buildings was prepared and accepted by the Government. Strategy has been updated in 2018. For the period until 2030 policies and measures are laid down in National Energy and Climate Plan (NECP). In 2024 updated NECP has been adopted which has even more focus on energy efficiency policies, since it is implementing energy efficiency first rule.

Measures in the buildings sector

The following existing measures are being implemented in the buildings:

- Regulations on the energy efficiency and renewable energy use in buildings
- Support scheme for the renovation of the built cultural heritage
- Energy performance contracting
- Compulsory division and billing of heating costs in multi-apartment buildings according to actual consumption
- Energy advice network for citizens - ENSVET
- Financial incentives for energy efficiency and RES investments in residential buildings
- Energy efficiency aid scheme for low-income households
- Promoting energy efficiency and renewable energy use in households
- Energy management in public sector
- Financial incentives for energy renovation of buildings in public sector
- Quality assurance for energy renovation projects in public sector
- Office of Energy Renovation of Public Buildings

Along existing measures NECP and Long-term renovation strategy defined these additional measures:

- Development of sustainability criteria for buildings
- Limitation of use of fossil fuels for heating in buildings
- Establishing an energy and emission cadastre of buildings
- Preparation of a financial plan for wider renovation of buildings
- Provision of sufficient resources for financial incentives for energy efficiency and use of RES in residential buildings
- Further enhancement of the energy efficiency aid scheme for low-income households
- Setting up supportive environment for mitigating energy poverty
- Additional development of financial incentives for energy efficiency and RES investments in residential buildings
- Additional instruments for financing the renovation of buildings with multiple owners
- Splitting of incentives between owners and tenants in multi-family buildings
- Establishment of a guarantee scheme
- Mandatory Building certificate for multi-family houses

- Project office for the preparation of the energy renovation projects for the multi-family buildings
- Pilot projects for testing new financial instruments and models for renovation of multi-family buildings
- Additional development of financial incentives for energy renovation of buildings in the public sector
- Promoting energy renovation in the central government buildings
- Preparation of solutions and measures for effective energy control in buildings and effective integration of renewable energy sources
- Comprehensive renovation of publicly owned housing which consists of: preparation of comprehensive inventory of publicly owned housing from the perspective of quality of living, earthquake safety, energy efficiency and suitability for (energy) renovation, preparation of strategy for the comprehensive renovation of the publicly owned housing and the implementation of this strategy in the 2027-2035

3. ENERGY EFFIENCY IN TRANSPORT

3.1. ENERGY EFFICIENCY TRENDS

Energy consumption in transport increased heavily in the 2000-2019 period. In 2020 consumption dropped significantly due to measures during COVID pandemics, but increased again in 2021 and 2022. In 2022 consumption with 1 972 ktoe reached almost the same level as was in 2019 (1 927 ktoe) meaning that COVID did not have any substantial long-term effect.
In the past especially high growth has been observed between 2003 and 2008 when it increased for 56 %. This large increase can be attributed to a large extent to accession of Slovenia to the EU, which resulted in large increase of transit transport through Slovenia and also increase of domestic transport. In conjunction with low fuel prices compared to the neighbouring countries increase of transport resulted in even larger increase of fuel consumption. In 2009 economic crisis affected transport through Slovenia and at the same time fuel prices compared to neighbouring countries were not favourable any more. This resulted in a large drop of energy consumption in transport with -16 %. Between 2010 and 2019 fuel consumption in transport in Slovenia was on average increasing slowly, but it never reached levels from peak in 2008. Fluctuations are a consequence of economic situation and prices of transport fuels in Slovenia compared to neighbouring countries.

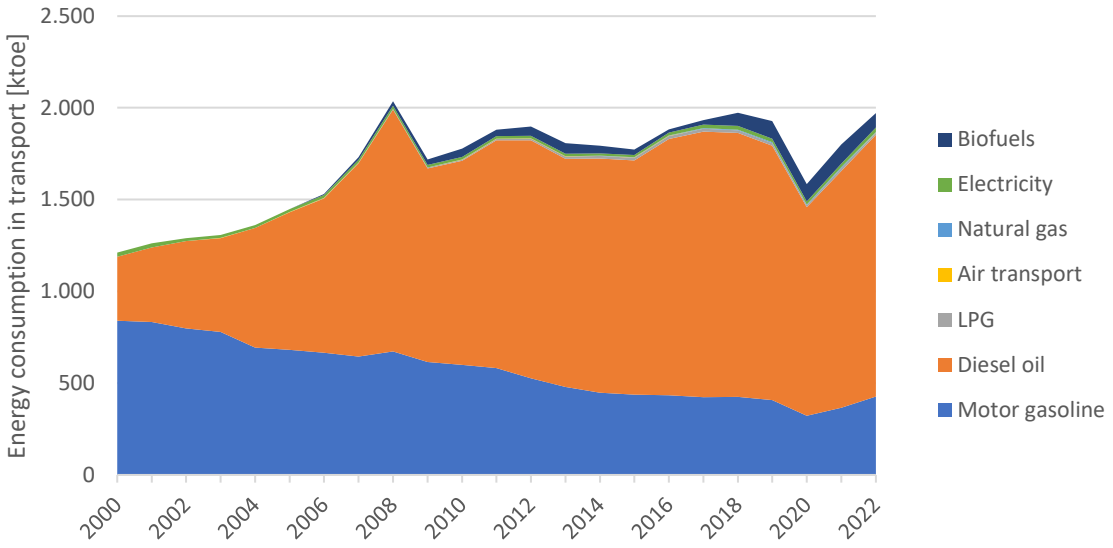


Figure 20: Final energy consumption of transport by type of fuels (source: ODYSSEE)

Structure of energy consumption per fuel has changed considerably in the 2000-2019 period with large increase of share of diesel fuel. Its share increased from 29 % to 72 % while on the other hand share of gasoline decreased from 69 % to 20 %. As can be observed from Figure 20 consumption of gasoline slowly decreased over the whole period with slowdown in the last two years. Dieselgate and change in price ration between diesel and gasoline contributed to change in trend. The share of gasoline increased and in 2022 gasoline had 22 % and diesel remained at 72 %. In the last years share of biofuels increased to 6 %, while decreasing in 2022 due to Governmental measures to keep fuel

prices low. Shares of other fuels in 2022 are: electricity 1.0 %, LPG 0.5 %, gas 0.2 % and fuel in domestic air transport 0.03 %.

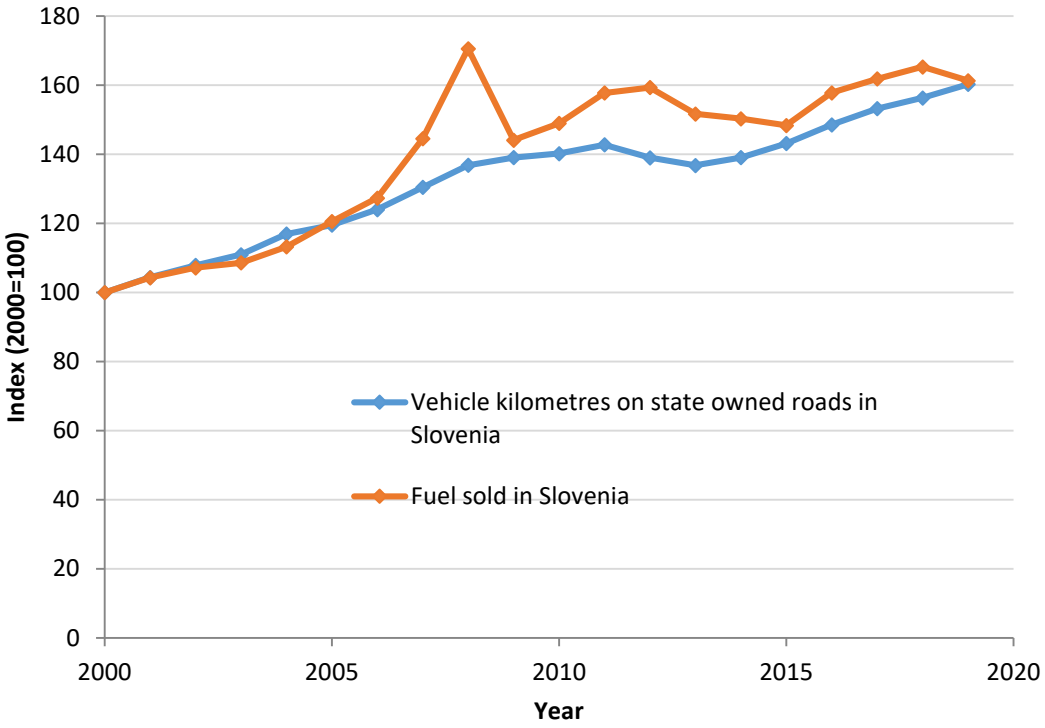


Figure 21: Comparison of trend for vehicle kilometres on state owned roads in Slovenia and fuel sold in Slovenia (source: DRI, SORS)

Road transport dominates in structure of energy consumption per type of transport. Its share was increasing between 2000-2008 from 98 % to 99%, and afterward is was more or less constant round 99 %. Share of rail transport decreased from 2% in 2000 to 1% in 2022, while share of domestic air transport is negligible (Figure 22).

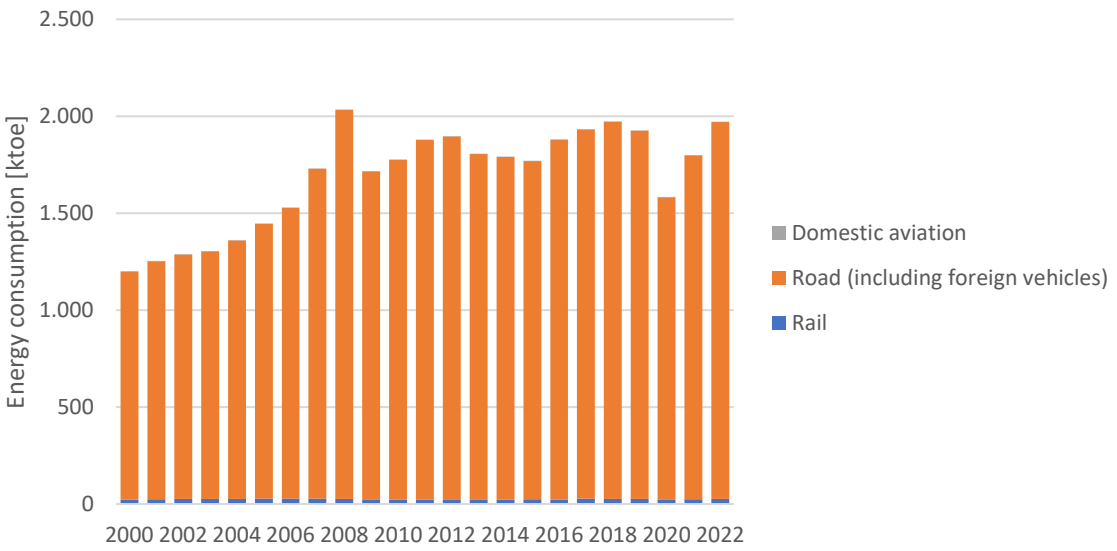


Figure 22: Structure of energy consumption in transport sector per type of transport (source: SORS)

Road transport

In 2000 75% of energy in road transport was consumed by cars, 19% by trucks, 4% by light duty vehicles and 2% by buses. Improved methodology for estimating consumption of foreign vehicles has been used, which showed that 25 % of cars consumption can be attributed to foreign cars in 2000, while consumption of foreign trucks is negligible. After 2003 transport of foreign trucks started to increase and this had an important impact on total energy consumption in road transport. Peak of energy consumption attributed to foreign trucks was observed in 2008, with 8 % share in energy consumption of road transport, while foreign cars represented 15 % of road transport energy consumption. In 2008 peak of energy consumption in road transport with 1983 ktoe was reached. After that, fuel purchase of foreign vehicles decreased sharply due to economic crisis and less favourable fuel prices in Slovenia. Slow increase in purchase has then been observed until 2012, followed by decline towards 2020. In 2021 and 2022 increase has again been observed, followed by decrease in 2023.

In 2022 domestic cars consumed 53 % of energy in road transport, domestic trucks 23 %, light duty vehicles 8%, buses 2 %, motorcycles and mopeds 0,4 %, foreign cars 13 % and foreign trucks 2 % (Figure 23). The model estimates fuel consumption of domestic vehicles based on number of domestic vehicles and their driven kilometres. Since no data is available for domestic cars on where they purchase fuel, it is assumed that they do it in Slovenia although this is not always the case. Results for foreign cars can, based on that, be interpreted as net purchase of foreign cars. For trucks certain data is available on which we can estimate the amount of fuel purchased in Slovenia by domestic and foreign vehicles so for trucks data represent more realistic estimate of actual purchase.

As Slovenia is export oriented country with international port increase in freight transport is heavily linked with GDP growth in Slovenia. Correlation between GDP and fuel consumption in freight transport of domestic trucks is very high with correlation factor being 0.90. Since foreign trucks mainly go through Slovenia other factors than Slovenia's GDP are more important for trend in their

fuel consumption. Correlation between GDP and fuel consumption of cars is also very strong with factor 0.83.

The largest growth of energy consumption in absolute terms in the 2000-2022 period was observed in domestic cars (320 ktoe), followed by domestic trucks (220 ktoe) and light duty vehicles (102 ktoe). Purchase of foreign truck increased by 39 ktoe while purchase of foreign cars increased by 12 ktoe.

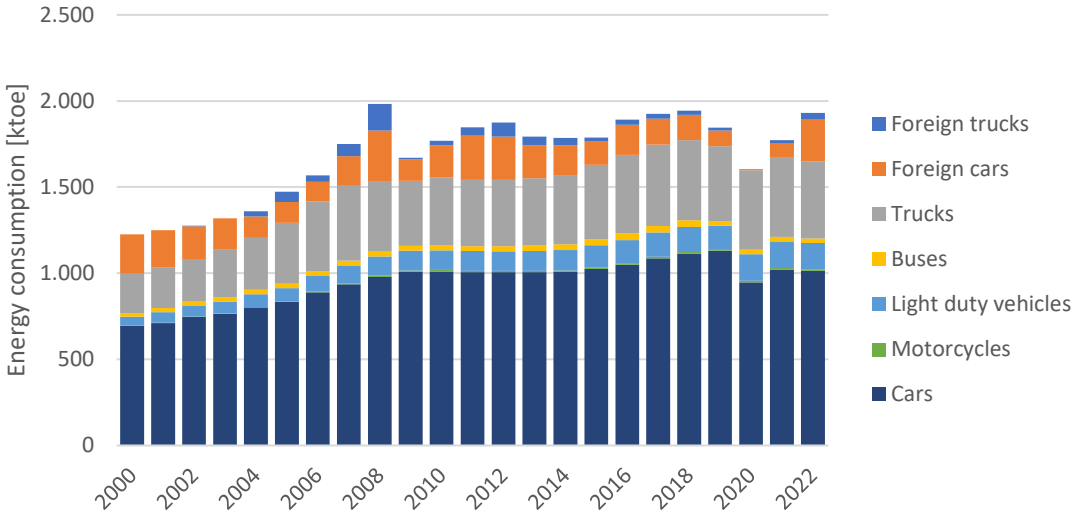


Figure 23 : Structure of energy consumption in road transport per type of vehicles (source: EARS, JSI-EEC)

Increase in energy consumption of cars can to a large extent be attributed to increase in car ownership which is a result of transport policy in Slovenia. Number of cars increased by 49% between 2000-2022, while energy use in domestic cars increased by 46%. The structure of cars has changed also. Share of diesel cars has increased and share of gasoline cars has declined as can be seen from Figure 24. Diesel cars are bigger and more powerful than gasoline cars and make on average more kilometres per year. Trend towards heavier cars is also very strong in last years. Gains in weight and power offset efficiency improvements, resulting in only 8 % decrease of specific energy consumption of cars per driven kilometre in the period 2000-2022. Specific energy consumption per pkm on the other hand increased by 7 % due to decrease in load factor for cars. Electric vehicles (PHEV and BEV) represented 0.4 % of all cars in 2022.

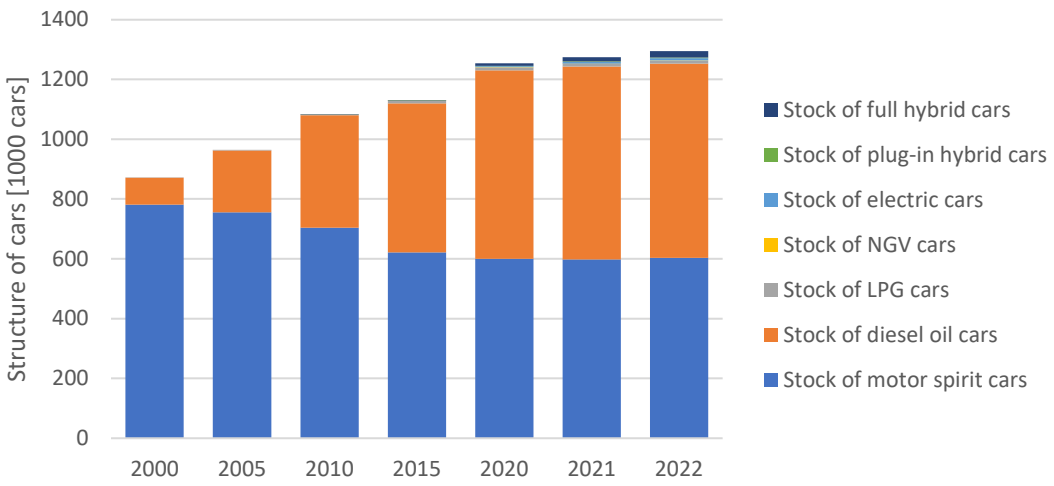


Figure 24 : Number of cars and structure per engine size (source: JSI-EEC)

ODEX indicator

Energy efficiency in transport sector has not improved in 2000-2022 period based on actual ODEX. Analysis have been made excluding transit transport and air transport. Actual ODEX has been used because large fluctuations occur in indices per different modes of transport that are hidden in technical ODEX. Throughout the whole period ODEX index increased meaning that energy efficiency worsened, only in last few years index decreased, but that was not enough to fall below 2000 level. The main factor that influences total ODEX index is index for cars which is increasing from 2000-2021 and only in 2022 it decreases. Worsening of energy efficiency of cars can be attributed to negative trends in use of cars (reduction of load factor) and weight and power gains of cars that outweighed efficiency gains. Decrease in 2022 is a consequence of large increase of passenger kilometres based on DG MOVE data, which is probably unrealistic. Energy efficiency in trucks improved and was in 2022 9 % better than in 2000. Improvement is due to better logistics. Largest efficiency gains have been observed for rail with 38 %, but in the last two years decrease in energy efficiency occurred. This decrease can be attributed to activity data that are taken from DG MOVE statistics which are different than national statistics.

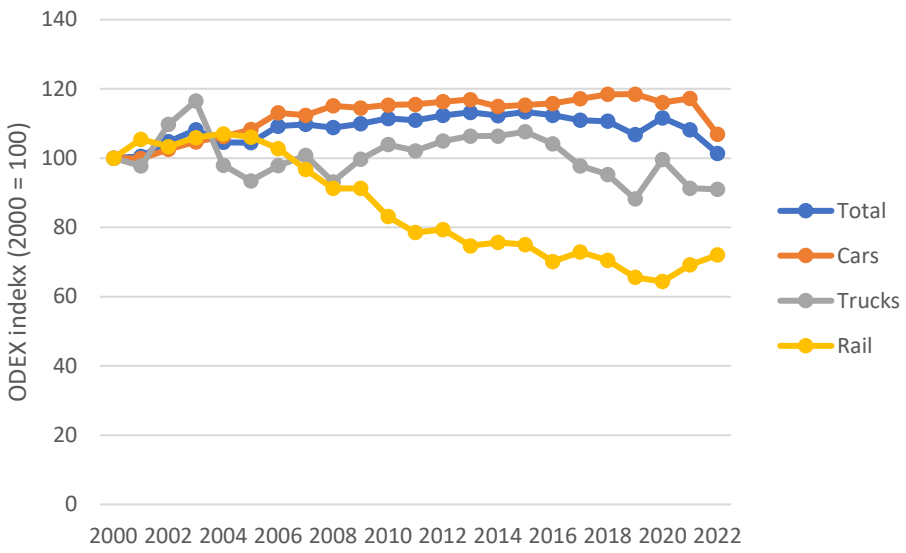


Figure 25: ODEX indicators for transport (source: ODYSSEE)

Decomposition

Decomposition of total transport energy consumption excluding air transport (Figure 26) shows that growth of energy consumption between 2000 and 2022 is due to one main factor – increase in passenger and tonne kilometres – activity effect. Energy consumption increased also due to shift to transport modes that use more energy like cars in passenger transport and heavy trucks in freight transport– modal shift and other effects (behavioural changes and decrease in fuel purchase by foreign vehicles). On the other hand energy consumption decreased due to efficiency improvement in vehicles and also improvement of logistics – gross savings, but its effect was far from being enough to outweigh other effects that contribute to increased energy consumption.

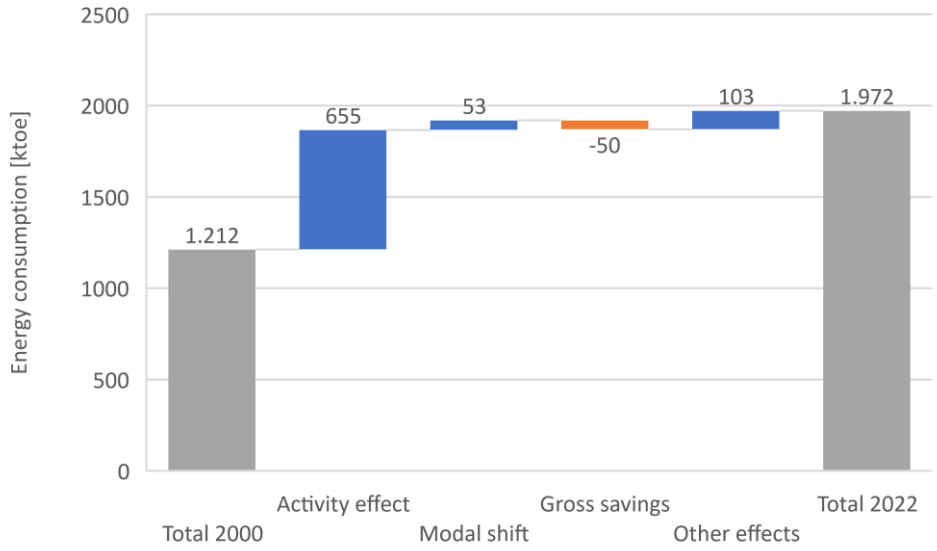


Figure 26: Decomposition of change in total transport energy consumption excluding air transport between 2000 and 2022

Decomposition of energy consumption change in passenger transport shows that the main factors contributing to growth are activity effect, modal shift and gross savings, while other effects minimally decrease energy consumption (fuel purchase of foreign vehicles). Gross savings are used in decomposition to show that increased weight and power of cars and lower load factor outweigh efficiency gains in passenger transport, that is why savings are positive meaning that they increase energy consumption.

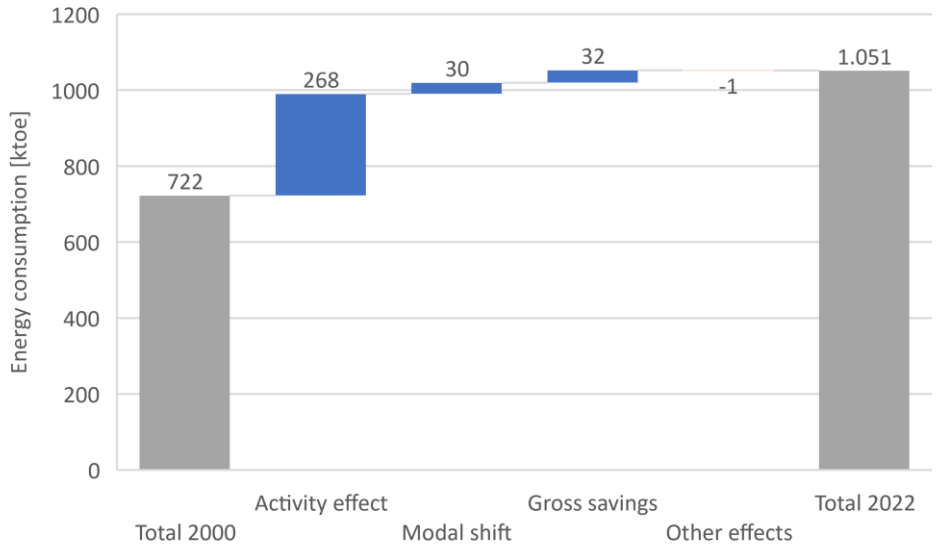


Figure 27: Decomposition of change in passenger transport energy consumption excluding air transport between 2000 and 2022

In freight transport improved logistics, efficiency improvement in vehicles and higher usage of long-haul trucks contributed to reduction of freight transport energy consumption that is being presented by factor gross savings. However, due to high growth of freight transport activity and also negative effect of higher share of freight transport on roads (modal shift), energy consumption in freight transport in the period 2000-2022 increased considerably.

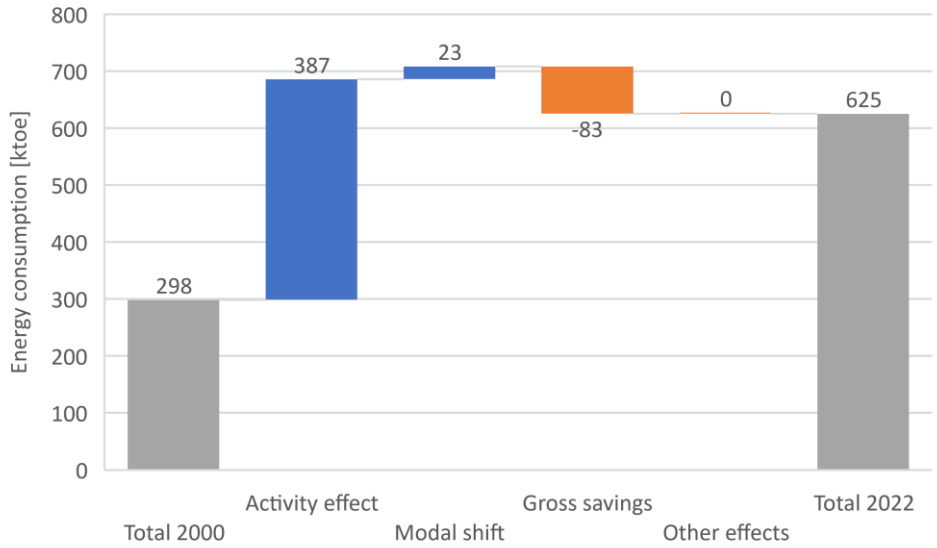


Figure 28: Decomposition of change in freight transport energy consumption between 2000 and 2019

3.2. ENERGY EFFICIENCY POLICIES

Energy efficiency measures in transport sector are presented in four programmes/strategies:

- Transport development strategy (TDS) from 2015 and National Programme for the Development of Transport in the Republic of Slovenia until 2030 from 2016
- National strategy for alternative fuels in transport from 2017
- National Energy and Climate Plan from 2020 and revised version from 2024

Energy efficiency policies in the field of transport can be grouped into the following group of measures:

- Promotion of sustainable transport in general
  The measure aims to continue the implementation of horizontal (e.g. local transport planning) and soft measures (awareness raising) covering all transport subsystems and levels of transport planning or management.
- Additional measures to promote sustainable transport in general
  The measure aims at intensifying the implementation of horizontal (e.g. transport planning) and soft measures (e.g. project evaluation) covering all transport subsystems and levels of transport planning or management.
- Measures to reduce the number or length of trips
  This group of measures is important to reduce the need to travel, or at least reduce travel distances. Therefore, both teleworking and the way in which travel costs are paid, as well as spatial planning, are important.
- Additional measures to reduce the number or length of trips
  This group of measures is important to reduce the need to travel, or at least reduce travel distances. Additional measures are foreseen to promote home working.
- Promoting public passenger transport
  Measures are aimed at improving the usability and attractiveness of public passenger transport, with a focus on providing adequate (especially rail) infrastructure, improving the conditions for combining different modes of transport, improving the user experience and competitiveness compared to the car.
- Additional actions to promote public passenger transport
  Additional measures to improve the usability and attractiveness of public passenger transport, with additional emphasis on strategic planning, multimodality, improving the user experience and competitiveness compared to the car.
- Measures to increase the share of trips made by active modes of transport
  The aim of the measure is to improve the conditions for the use of active mobility (walking, cycling), on the one hand through infrastructure improvements and on the other hand through promoting and awareness-raising measures.
- Additional measures to increase the share of trips by active modes of transport

The measure aims to improve the conditions for the use of active mobility, in addition to infrastructure and awareness-raising measures.

- Measures to make the use of private motor vehicles more sustainable
  The aim of the measure is, recognising that cars will remain an important part of the mobility and accessibility of a large part of the population, to make car use more efficient in terms of car occupancy and car ownership, and to reduce the use of cars for journeys where alternatives are available (such as short trips or for journeys in public transport corridors).
- Additional measures to make the use of private motor vehicles more sustainable
  Additional measures aim at intensifying the approach of transport demand management and reducing the attractiveness of private motorised transport compared to alternative forms of mobility, while increasing the safety of all users. It also aims at a more equal and fairer distribution of the burdens (external costs) caused by car users.
- Promotion of sustainable freight transport
  The measure aims to reduce emissions from freight transport through two approaches - promoting rail freight transport (through investment in rail infrastructure) to increase the share of freight transported by rail and improving the efficiency of road freight transport to increase the load factor of freight vehicles. There is a strong emphasis on co-modality.
- Additional measures to promote sustainable freight transport
  Additional measures aim to take a more strategic approach to promoting sustainable freight transport and to implement additional infrastructure and fiscal measures to develop rail freight transport.
- Increasing vehicle efficiency and promoting the use of fuels with low co2 emissions
  The following activities are included CO2 emission requirements for new vehicles, incentives for electric vehicles, training for more economical driving and support for biofuels and the installation of charging infrastructure.
- Additional measures for increasing vehicle efficiency and promoting the use of fuels with low CO2 emissions
  NECP 2024 includes additional measures to promote the switch to low or zero emission vehicles, the development of refuelling infrastructure for alternative fuels, the increase of the share of renewables in transport and measures to reduce other emissions such as low emission zones and particulate measurements at roadworthiness tests.

4. ENERGY EFFICIENCY IN INDUSTRY

4.1. ENERGY EFFICIENCY TRENDS

The energy consumption in industry presents more than quarter (27%) of the total final energy consumption of all sectors (Industry, household, transport, other services) in Slovenia.

The yearly average decrease in final energy consumption of industry in the period 2000-2022 was -0.9%/year. Total final energy consumption of industry decreased by 10.7% or 1.1%/year in the period 2000-2010 and by 7.3% or 0.6%/year in the period 2010-2022. Energy consumption in industry decreased by 8.7% in 2022 compared to the previous year.

The final energy consumption in industry increased from 1265 ktoe to 1700 ktoe in the period 2002-2006 after the year 2006 decreased until 2009 (to 1221 ktoe) when it reached levels that were compared to consumption in 2000. After 2009 increase of consumption for one year followed and afterword slow decrease as is shown in Figure 29 and Figure 30.

The added value of industry and manufacturing increased by 68% and 94%, respectively, from 7951 $MEUR_{2015}$ and 4917 $MEUR_{2015}$ in 2000 to 13385 $MEUR_{2015}$ and 9556 $MEUR_{2015}$.(Figure 29 - Figure 30).

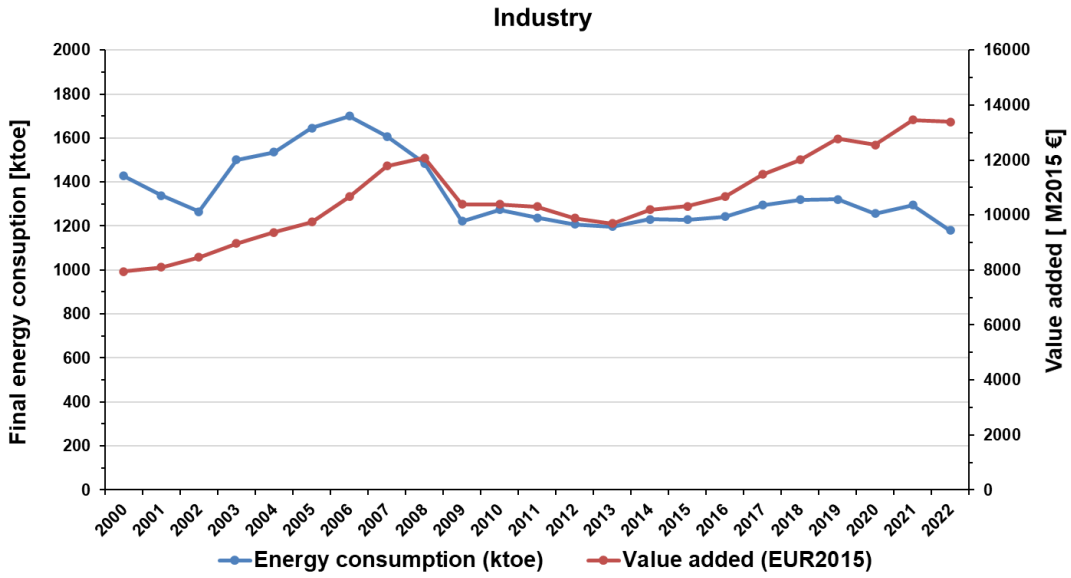


Figure 29: Final energy consumption and value added of industry in the period 2000-2022

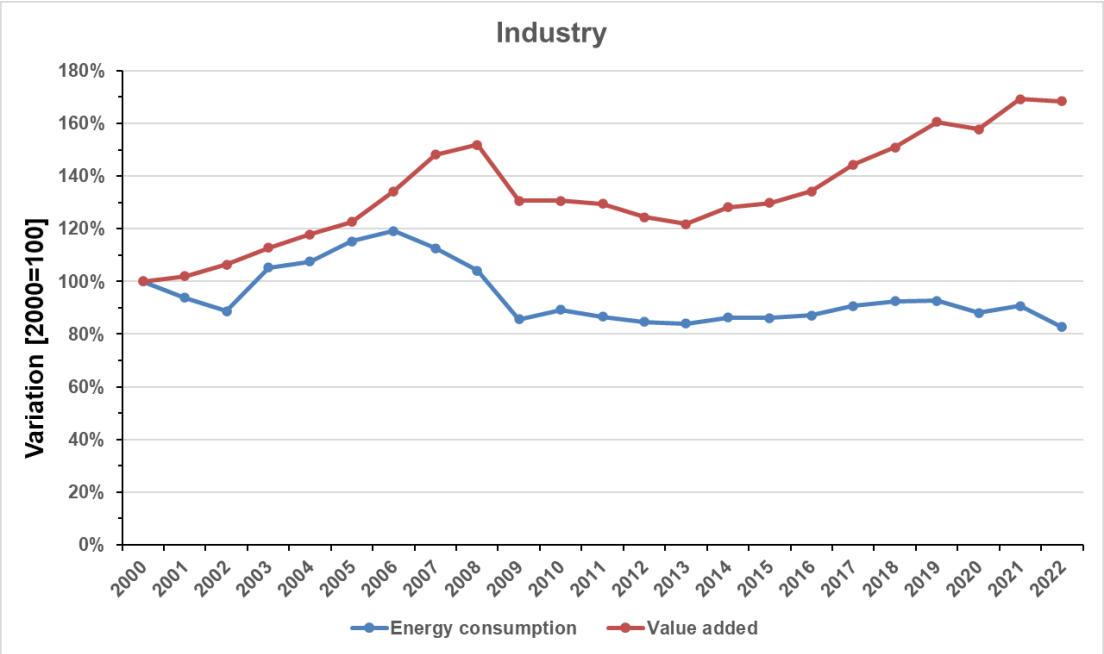


Figure 30: Trends of energy consumption and value added of industry in the period 2000-2022

The energy consumption of metallic (Ferro and non-Ferro metallic) and machinery manufacturing present about 40% of all final energy consumption of manufacturing industry. The share of energy consumption of non-Ferro mineral present about 18%, paper less than 13% and chemistry about 11% of total energy consumption in manufacturing industry by 2022. The energy consumption of manufacturing industry by branches in the period 2000-2022 is shown in Figure 31.

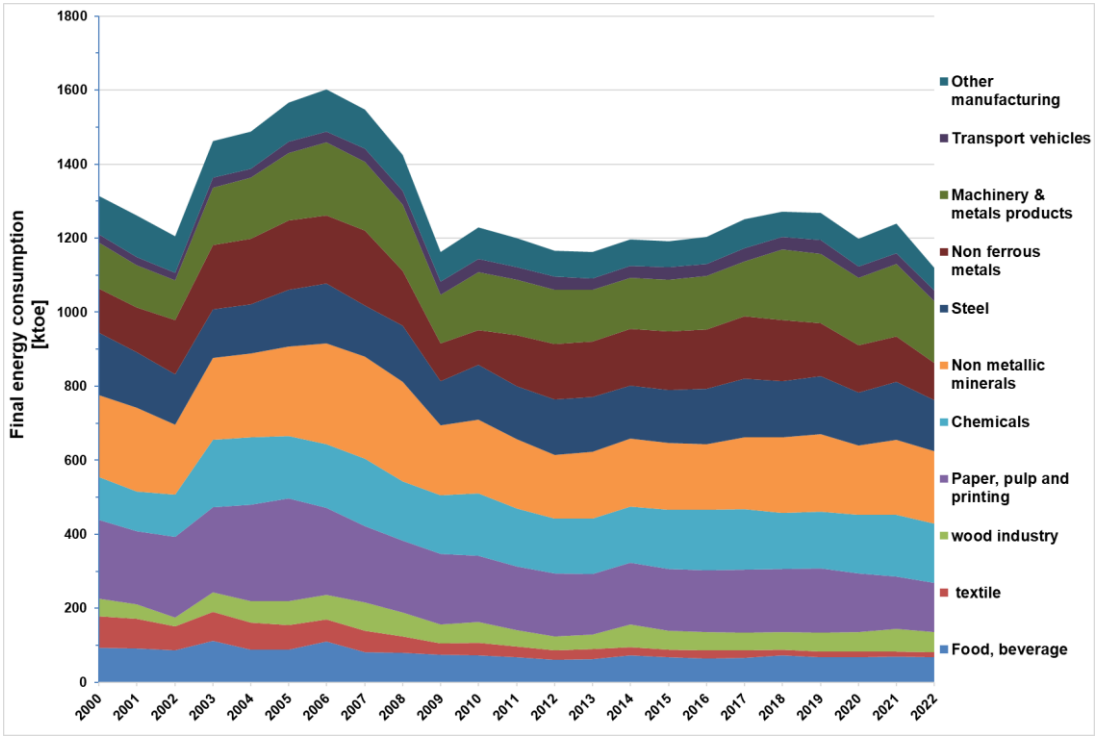


Figure 31: Final energy consumption of manufacturing industry by branches in the period 2000-2022

The specific energy consumption (measured by ktoe per ton of product) of steel and paper was slowly decreased in the period 2012-2022 from 0.22 to 0.19 ktoe/t for paper and from 0.24 to 0.23 ktoe/t for steel (Figure 32).

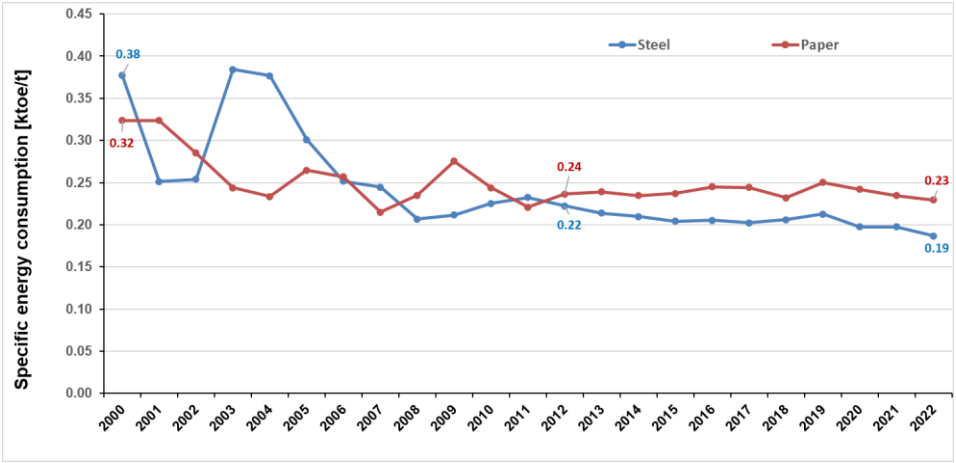


Figure 32: Specific energy consumption of steel and paper in the period 2000-2022

The improvement of energy efficiency in industry and manufacturing industry measured by energy efficiency index ODEX is presented in Figure 33.

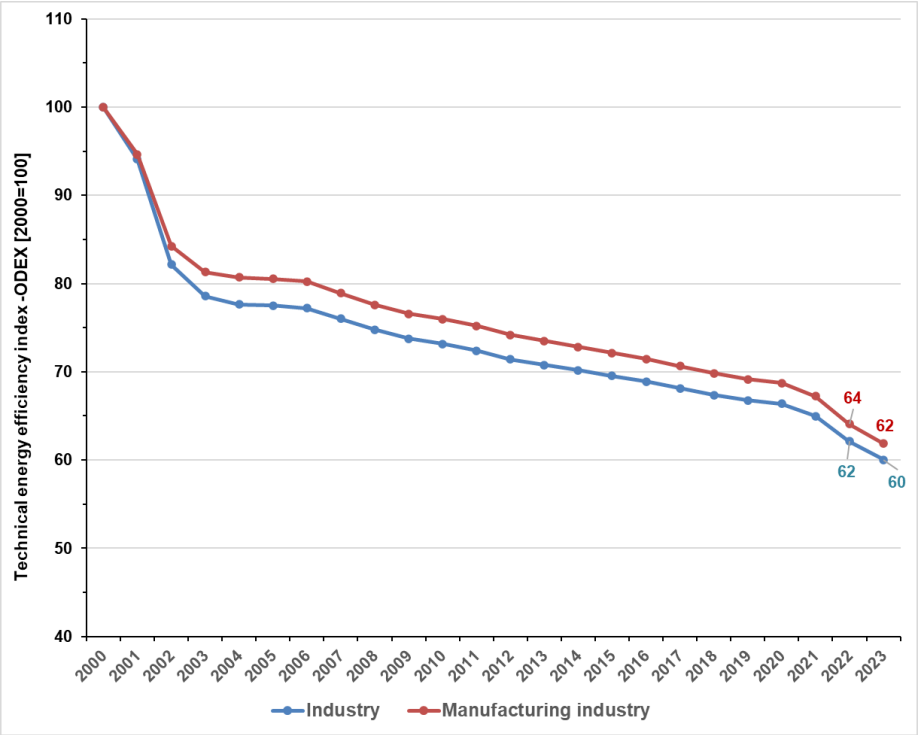


Figure 33: Energy efficiency index of industry and manufacturing industry in the period 2000-2023

The energy efficiency in industry and manufacturing industry has improved for 38% and 40%, respectively, in 2023 in comparison to 2000. Fast improvement in energy efficiency was observed/achieved in the period between 2000 and 2003, followed by constant/even improvement between 2005 and 2020 and faster improvement between 2020 and 2023.

4.2. DECOMPOSITION OF ENERGY CONSUMPTION IN INDUSTRY AND MANUFACTURING INDUSTRY

DECOMPOSITION OF ENERGY CONSUMPTION IN INDUSTRY

Decomposition analysis of energy consumption in industry (Figure 34) shows that decrease of energy consumption between 2000 and 2022 is due to two factors with negative effect (-976 ktoe: structural change and energy savings), while two factors had positive effect (+730 ktoe: activity and others).

The interpretation of factors is:

- Change in industrial activity (measured with the production index) (“activity effect”);
- Structural changes (“structural effect)”, i.e. the fact that the production of individual branches, measured with their production index (or physical production for steel, cement and paper) does not increase at the same rate as the average production index of industry;

- Energy savings calculated from changes in energy consumption per unit of production at branch level;
- Other effects, which are structural changes within branches and, in times of recession, "negative" savings due to inefficient operations in industry.

Energy savings correspond to technical savings, i.e. to gross savings corrected of negative savings due to inefficient operation of facilities or behaviours.

The variation of the industrial energy consumption (-246 ktoe) has been calculated by Odyssee database tools and presented in Figure 34.

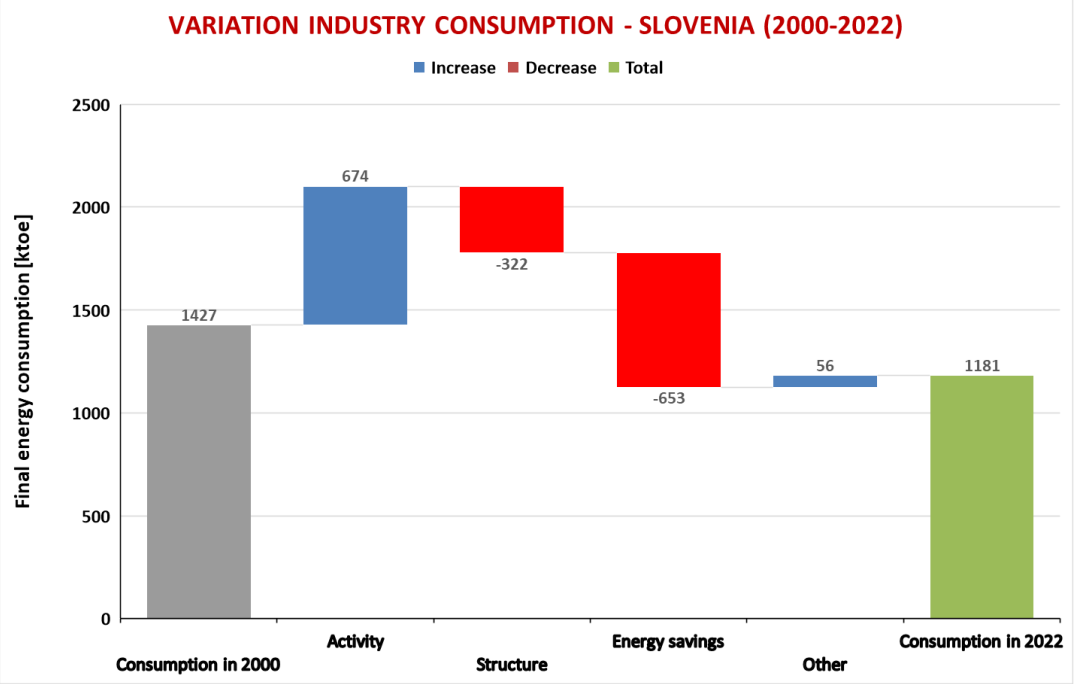


Figure 34: Decomposition of energy consumption in industry for the period 2000-2022

DECOMPOSITION OF ENERGY CONSUMPTION IN MANUFACTURING INDUSTRY

Variation of energy consumption in manufacturing industry is similar to variation of energy consumption in industry. Decomposition analysis of energy consumption in manufacturing industry (Figure 35) shows that decrease of energy consumption between 2000 and 2022 is due to decompose of two factors with negative effect (-1050 ktoe: structural change and energy savings) and two factors with positive effect (+855 ktoe: activity and others).

The variation of the industrial energy consumption (-195 ktoe) has been calculated by Odyssee database tools and presented in Figure 35.

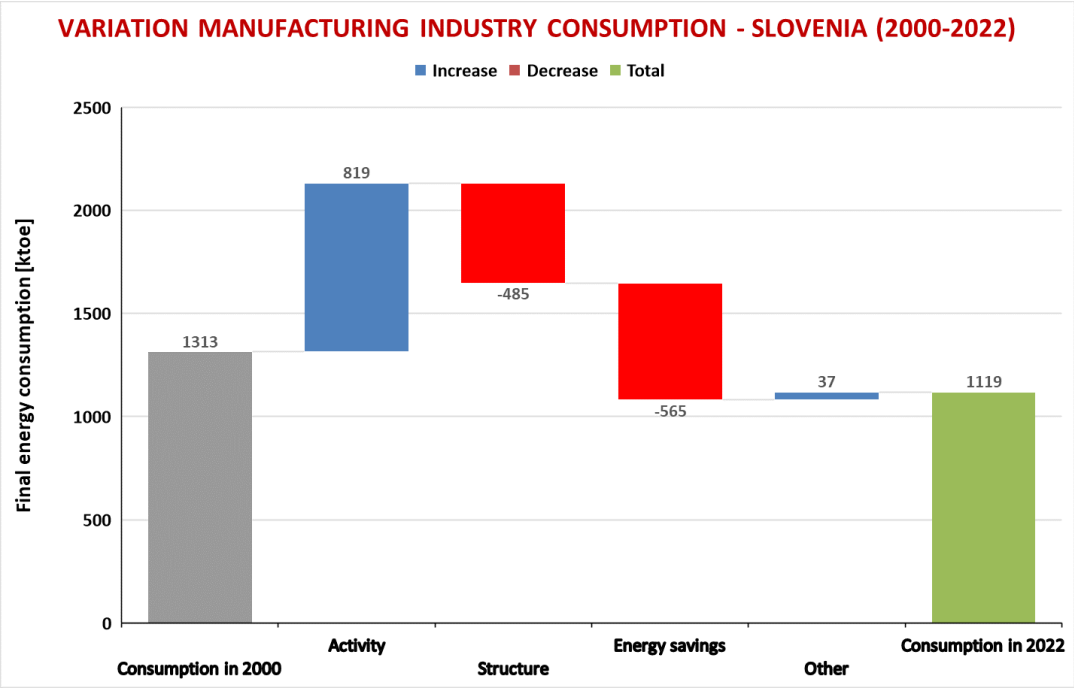


Figure 35: Decomposition of energy consumption in manufacturing industry for the period 2000-2022

4.3. ENERGY EFFICIENCY POLICIES

Energy efficiency measures for industry are contained in NECP 2024. The main objective of these measures is a long-term increase in the competitiveness of enterprises by controlling energy costs and greater orientation of enterprises towards providing sustainable products and services with higher added value and demand on the global market.

The content of the measures in industry are oriented towards the following key areas:

- Introduction of energy management systems,
- Increase in efficient electricity consumption,
- Reduction in the consumption of heat and the exploitation of RES and excess/waste heat ,
- Increase in the scope of CHP and the generation of electricity from RES,
- Development and production of new sustainable products and services.

The measures include a financial incentive for efficient electricity consumption, introduction of energy management systems, increase in efficient electricity and heat consumption (energy-efficient technologies and regulation), energy audit for SMs, consumption of RES and excess (waste) heat and financing of investments in environmental protection.

The financial incentives are in the form of grants financed by cohesion policy funds, energy suppliers' programmes, loans at a favourable interest rate and other sources:

The support scheme for electricity generated from RES and CHP has been a measure for efficient electricity and heat consumption in industry (and service sector). A new scheme is being redesigned according to the definition of the Act on the Promotion of the Use of Renewable Energy Sources (ZSROVE). The entries into the renewed scheme are regulated by tenders, thereby ensuring its financial sustainability.

Additional energy efficiency measures for industry in the NECP are:

- Incentive for energy efficiency in industry contains an incentive for energy efficiency and renewable energy sources in SMEs provided from grants and returnable OP EKP[2] funds.
- Financial incentives for demonstration projects in industry provided from the funds for acceleration of the implementation of demonstration projects within the OP EKP.
- Promotion of industrial action (BAT technologies, etc.) through grants; preparation of targeted support mechanisms, including for promoting energy contracting [2020-2030].
- Development of the EEU and RES incentive scheme in industry (BAT technologies, etc.) within the framework of the Eco fund incentives and EU funds; expanding the range of measures, increasing the volume of resources, supporting activities [2020-2030],
- Incentives for measures to improve energy and material efficiency, energy production from RES and investments to reduce process GHG and emissions of other pollutants under the Decree on indirect costs.

The energy audit is obligatory for large industrial and other enterprises or organization every four years according to the Act on Energy Efficiency.

[2] OP EKP: Operational Programme for the Implementation of European Cohesion Policy 2014–2020