"Jožef Stefan" Institute
Energy Efficiency Centre (EEC)

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

The gross domestic product (GDP) increased in the period from 2000 to 2008. Strong decline was noticed in 2009 due to the economic crisis, followed by a slow increase in 2010 and 2011 and again a slow decrease in 2012 and 2013.

The average yearly growth of gross domestic product (GDP) between 2000-2008 was 3.4%/year. The decrease of GDP in 2009 reached -7.5%. Drop was much larger than the decrease of GDP of EU (-4.3%) (Figure 3). Between 2009-2019 average yearly growth of 1.9 %/year was observed, while in EU economic growth of 1.6 %/year has been observed. The average yearly increase of GDP in the complete observed period 2000-2019 was 2.3%/year, which is higher than in EU-27 (1.4%/year) in the same period (Table 1).

The average yearly growth of private consumption of households was 2.1%/year and the growth of value added (VA) of industry was 2.2%/year in the period 2000-2013 as is shown in Table 1**Error! Reference source not found.**

The highest increase of the economy happened in the period 2000-2008 where the average yearly growth of GDP was 3.4%/year, VA of all sectors 3.3%/year and industrial VA 4.4%/year (Table 1).

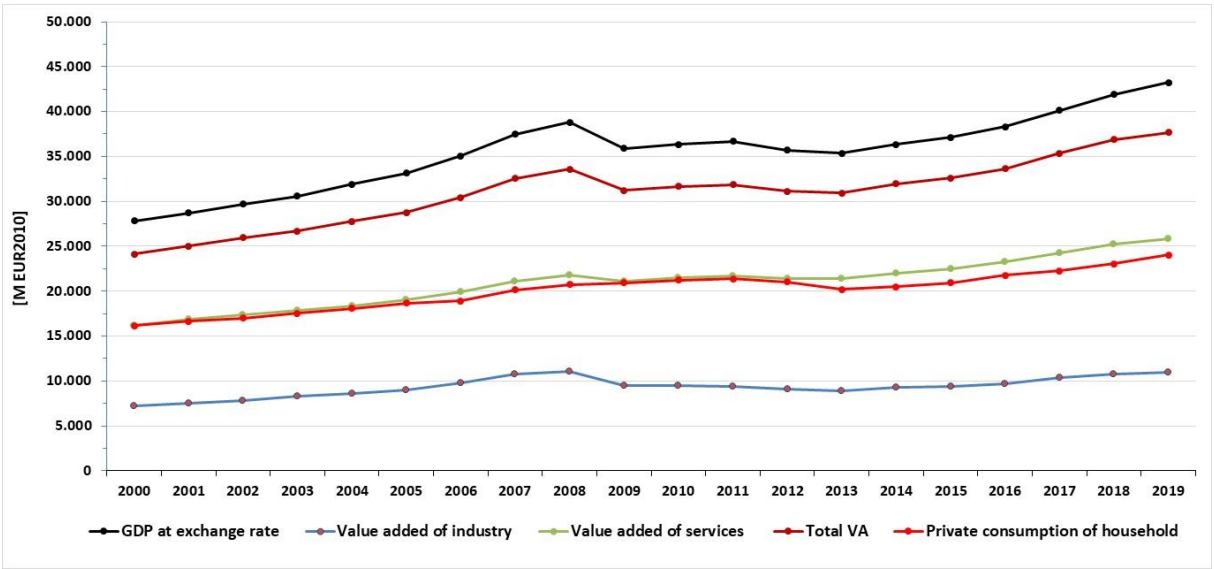


Figure 1: Trends of macro-economic developments in Slovenia in period 2000-2019

Table 1: Growth of GDP, private consumption of households and VA of manufacturing industry in Slovenia

		GDP	Total VA of sectors	Private consumption of households	VA of manufacturing industry
2000-2019	[%/year]	**2.3%**	**2,4%**	**2.1%**	**2.2%**
2000-2008		3.4%	3.3%	2.5%	4.4%
2008-2019		1.0 %	1.1%	1,4%	-0.1%

Source: Odyssee Mure databse 2021

Slovenian GDP has reached 43,238 M€$_{2010}$ in 2019, which presented 155% of GDP in 2000 (27,817 M€$_{2010}$).

The value added (VA) of all sectors and VA of manufacturing industry increased for 56% and 51% in between 2000-2019 and for 39% and 52% in the period of the highest economic growth (2000-2008) as is shown in Figure 2.

The private consumption in households has increased for 49% in the whole period (2000-2019) and for 28% in the period of the highest economic growth (2000-2008) as is shown in Figure 2.

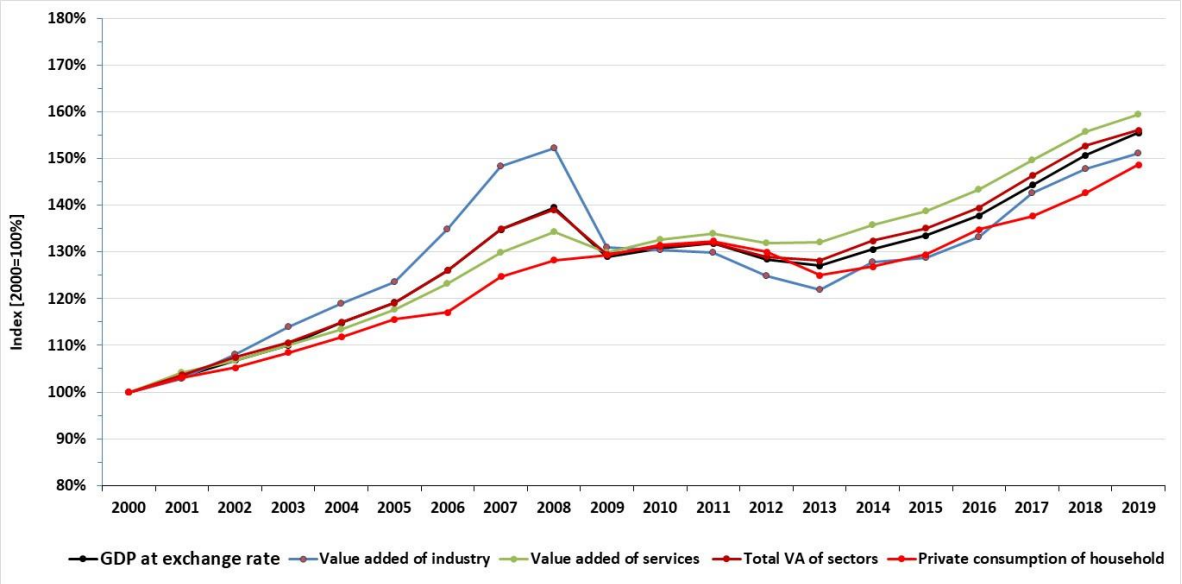


Figure 2: Trends of macro-economic developments in Slovenia in the period 2000-2019

Figure 3 shows the yearly growth of GDP in Slovenia and EU-27 in the period 2000-2019.

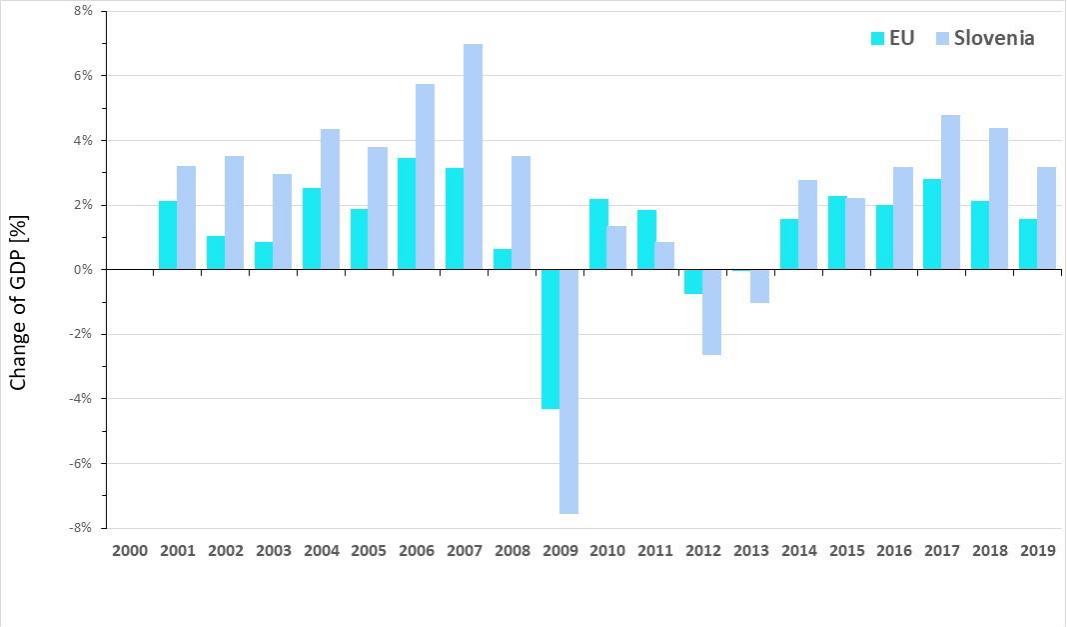


Figure 3: Yearly growth of GDP in Slovenia and EU-27 for the period 2000-2019

1.2. TOTAL ENERGY CONSUMPTION AND INTENSITIES

The primary energy consumption of Slovenia increased for 3.0% or in average for 0.2%/year in the period 2000-2019 (from 6.5 Mtoe in 2000 to 6.8 Mtoe in 2019), as is shown in Table 2 and Table 3.

Table 2: Primary and final energy consumption and energy intensity in Slovenia

	Unit	**2000**	**2008**	**2019**
Primary energy	[ktoe]	6483	7849	6679
Final energy	[ktoe]	4513	5461	4823
Energy intensity	[koe/€$_{2010}$]	0,233	0,202	0,154

High growth of energy consumption was observed between 2000-2008 with 21.1% increase or 2.4%/year. Due to economic crisis and implementation of energy policy consumption decreased for -17.1% or -2.6%/year in the period 2008-2015. Similar situation was in the final energy consumption. Between 2000-2008 final energy consumption increased by 21.0% or 2.4%/year followed by decline (-14.3% or in average -2.2%/year between 2008-2015). In the period 2000-2019 primary energy consumption increased by 3.0% and final energy consumption by 6.9%.

The intensity of primary energy decreased by -33.7% or on average for -2.1%/year in the period 2000-2019 (from 0.233 koe/€$_{2010}$ in 2000 to 0.154 koe/€$_{2010}$ in 2019), as is shown in Table 2 and Table 3.

Table 3: Trends of energy consumption and energy intensity in Slovenia

	2000-2008		**2008-2019**		**2008-2015**		**2000-2019**	
	Total	Per year	Total	Per year	Total	Per year	Total	Per year
	[%]	[%/year]	[%]	[%/year]	[%]	[%/year]	[%]	[%/year]
Primary energy	21,1%	2,4%	-15%	-1,5%	-17,1%	-2,6%	3,0%	0,2%
Final energy	21,0%	2,4%	-12%	-1,1%	-14,3%	-2,2%	6,9%	0,4%
Energy intensity	-13,2%	-1,8%	-23,6%	-2,4%	-13.3%	-2.0%	-33,7%	-2,1%

The development of energy consumption and energy intensity in Slovenia in the period 2000-2019 is shown in Figure 4.

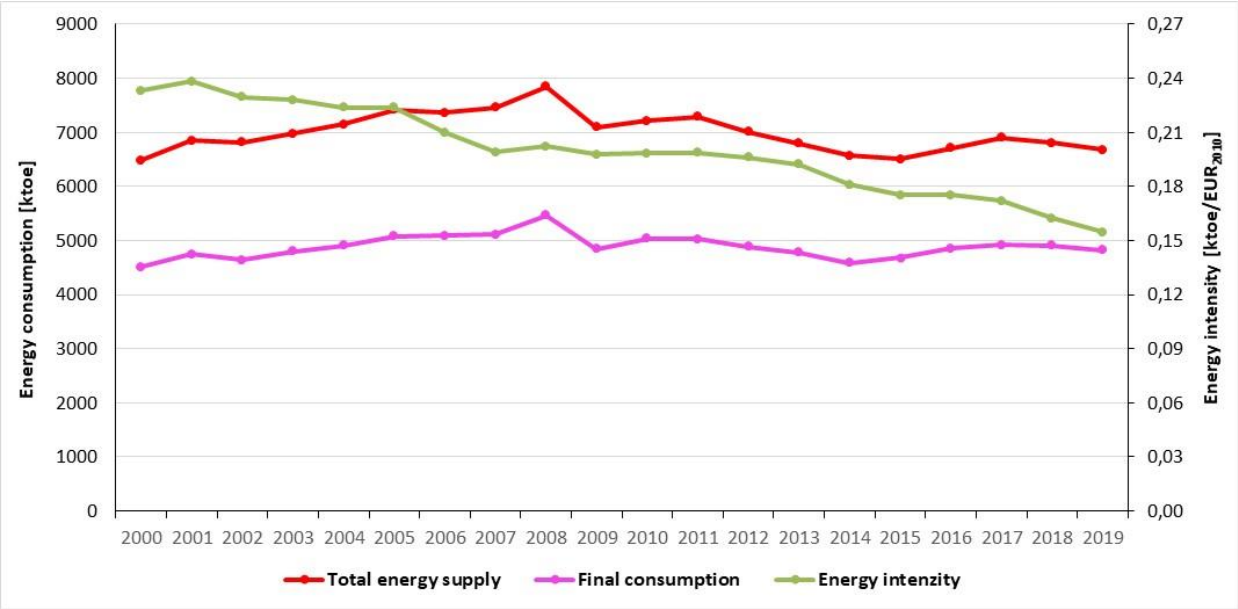


Figure 4: Energy intensity, primary and final energy consumption of Slovenia in the period 2000-2019

Structure of final energy consumption has changed significantly between 2000-2019. In 2000 the largest share of energy consumption fell on industry with 31.5%, followed by households with 27.4%, transport 26.9% and other 14.2%. Until 2008 energy consumption in transport grew rapidly (by 68%), while in other sectors consumption changes below 10%. This resulted in large increase of transport share in final energy consumption to 40%. In 2019 share of transport was slightly higher as in 2008 with 40%. Share of energy consumption of industry until 2019 decreased to 27.5%, share of households decreased to 21.1% and share of other decreased to 11.4%.

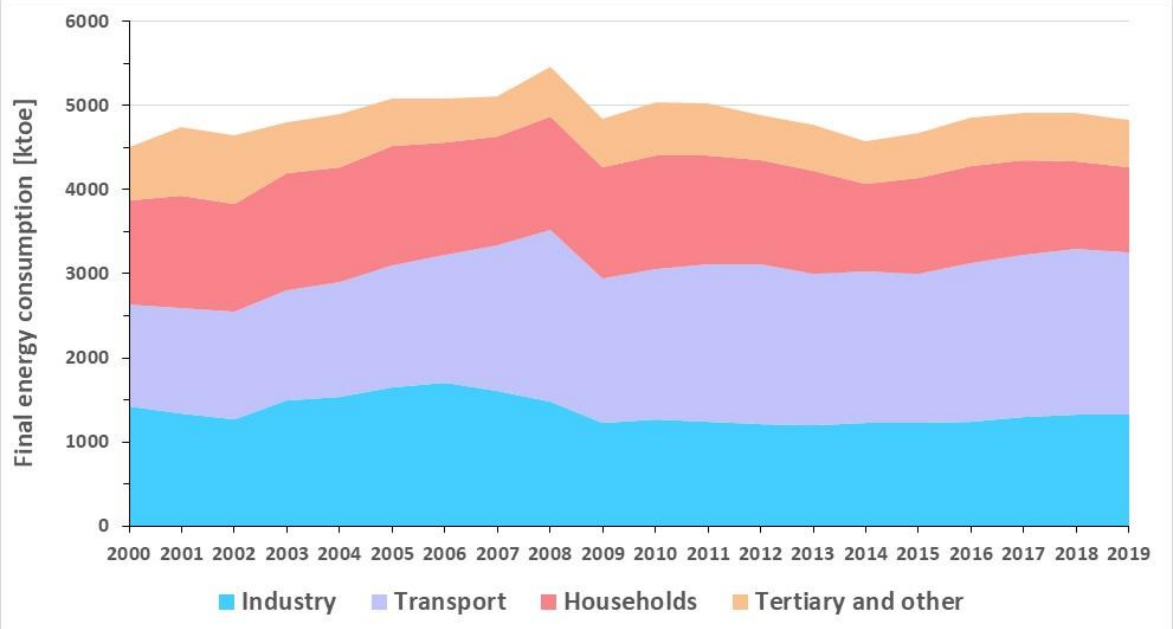


Figure 5: Final energy consumption of Slovenia in the period 2000-2019 by sectors

Energy efficiency index ODEX

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

As shown in Figure 6, the ODEX indicator for overall energy efficiency in all sectors improved by 24.2% between 2000 and 2019, which is a mean annual improvement of 1.4%/year.

Largest efficiency improvements were achieved in the households sector, which recorded an improvement of 41.8% within the period from 2000 to 2019. The ODEX indicator for industry shows an overall progress of 18.3% in the period under review. Efficiency in the transport sector (excluding international air transport) improved rather steadily with 0.2%/year or 4.5% over the whole period.

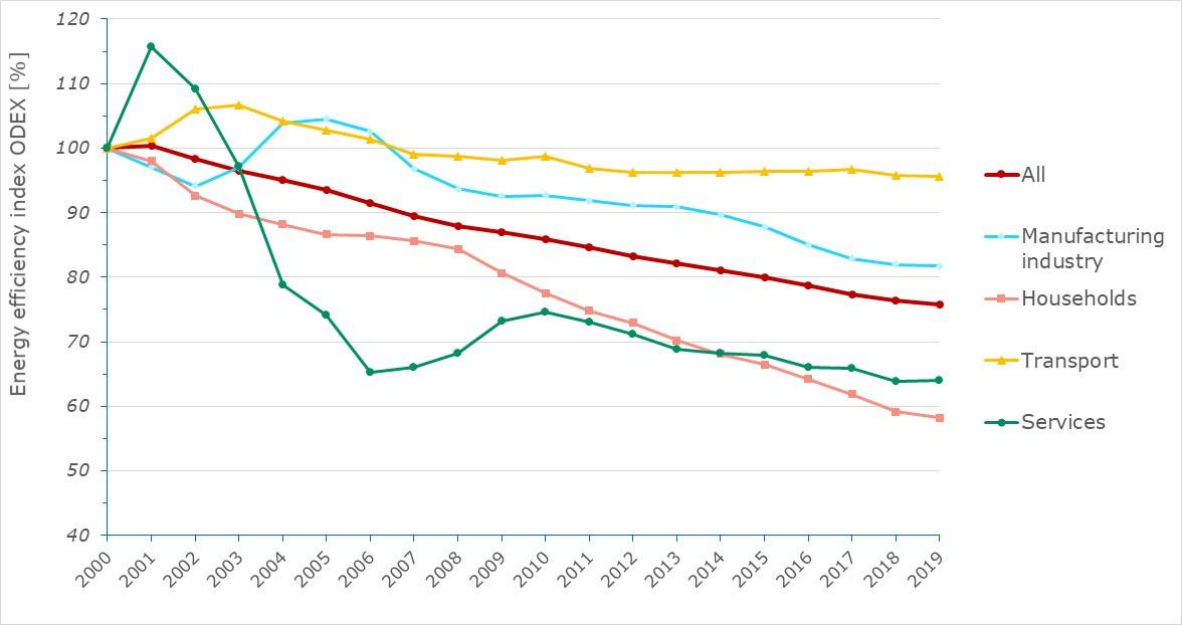


Figure 6: Development of the energy efficiency index ODEX by sectors and average in Slovenia for the period 2000-2019

Table 4 shows the total and annual improvement of overall energy efficiency index ODEX in Slovenia and by sectors.

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

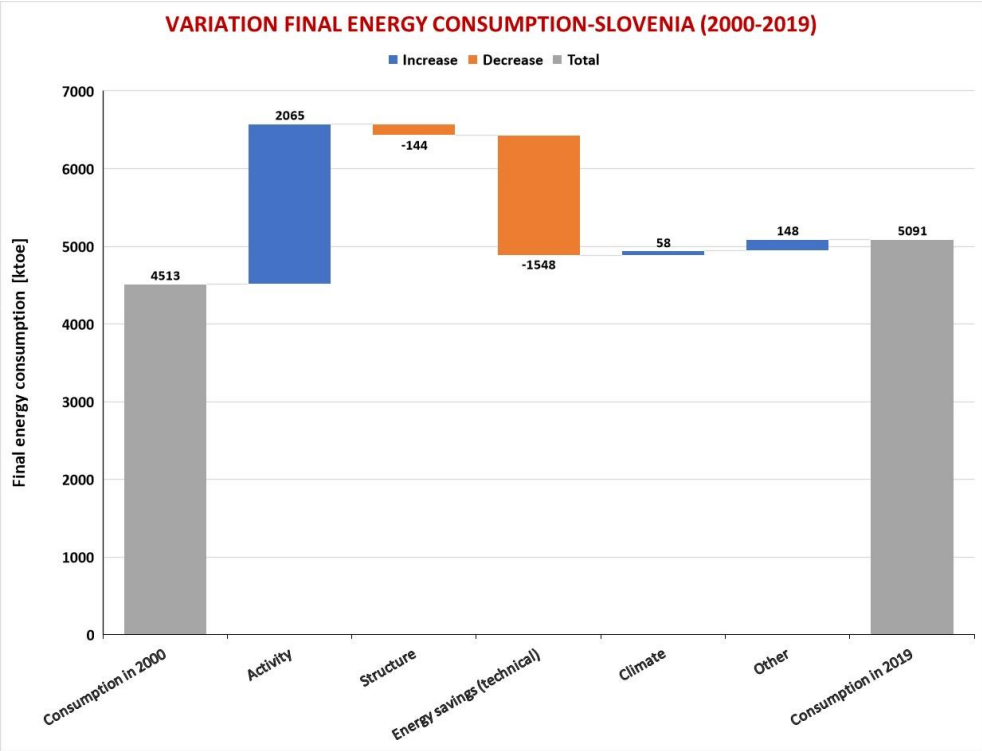
Table 4: Final energy consumption

	2000-2009		2009-2019		2000-2019	
	%	%/year	%	%/year	%	%/year
All sectors	-13,0%	-1,5%	-12,8%	-1,4%	-24,2%	-1,4%
Manufacturing industry	-7,5%	-0,9%	-11,7%	-1,2%	-18,3%	-1,1%
Households	-19,4%	-2,4%	-27,8%	-3,2%	-41,8%	-2,8%
Transport	-1,9%	-0,2%	-2,6%	-0,3%	-4,5%	-0,2%
Services	-26,8%	-3,4%	-12,6%	-1,3%	-36,0%	-2,3%

Decomposition

During the period 2000-2019, total final energy consumption in Slovenia increased from 4513 to 5091 ktoe (**Error! Reference source not found.**).

The activity, climate and other effects contributed to a total increase in final energy consumption by 2271 ktoe, being the activity effect the main driver with a share of 91%. These were compensated by the energy savings achieved 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- 2019.



Source: ODYSSEE

Figure 7: Decomposition of total final energy consumption in Slovenia for the period 2000-2019

Decomposition of total final energy consumption (excluding consumption of international air transport) is shown in Figure 8. The total final energy consumption (excluding consumption of international air transport) in Slovenia increased for 312 ktoe (from 4538 to 4850 ktoe) for the period 2000-2019.

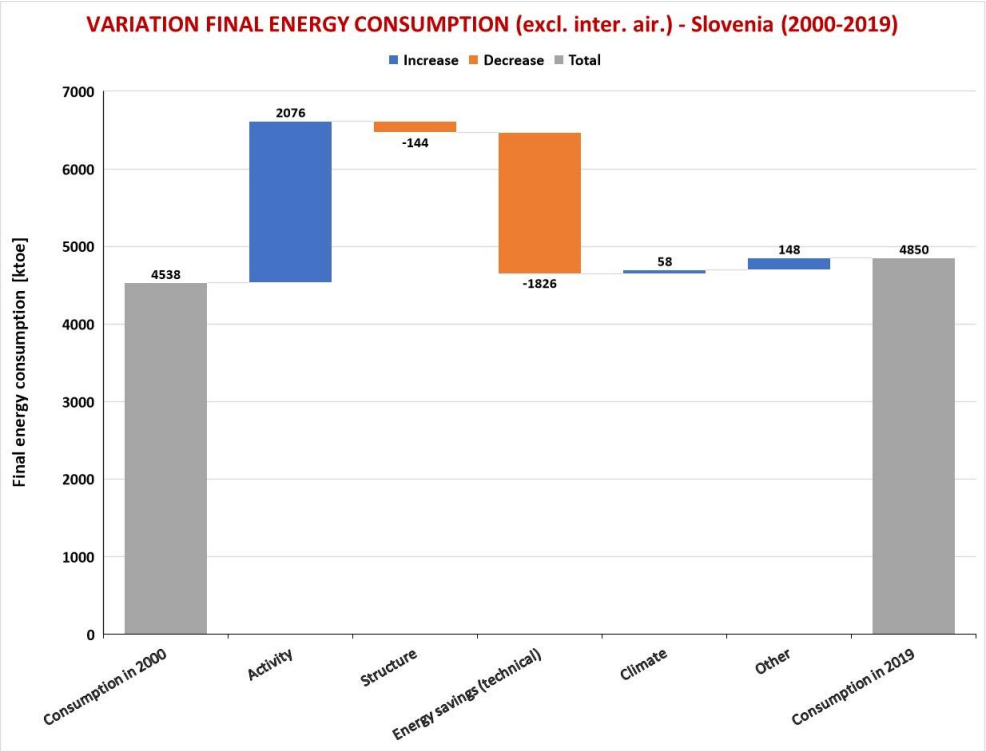


Figure 8: Decomposition of total final energy consumption (excluding international air) in Slovenia for the period 2000-2019

1.3. ENERGY EFFICIENCY POLICY BACKGROUND

Energy efficiency falls under responsibility of Ministry of infrastructure but requires cooperation of other ministries to.

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

National Energy and Climate Action plan has been adopted in February 2020. 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.

1.3.1. ENERGY EFFICIENCY TARGETS

Slovenian Government accepted a four Energy efficiency action plans according with the EED. The last National Energy efficiency action Plan in December 2017. The plan contains energy efficiency target for 2020 under the EED article 3, which was set in previous NEEAP, in the form of primary energy consumption of 7.125 Mtoe or 82.86 TWh. Target value for final energy consumption was also set at 59.53 TWh. Targets have been defined based on energy projections from 2013. Projections take into account implemented and adopted measures until the end of 2012 and assume their continuation until 2030.

The Slovenian Government accepted the Integrated National Energy and Climate Plan for Slovenia (NECP) in 2020. The new target value for primary and final energy consumption in 2030 was set at 73.9 TWh and 54.9 TWh (4.717 Mtoe). By achieving these targets Slovenia will improve its energy efficiency by at least 35% by 2030 compared to 2007 PRIMES Baseline scenario.

Indicative sectoral targets for reducing GHG in sectors that are not included in the Emissions Trading Scheme by 2030 (so called ESR sectors) are as following:

- transport: +12 %,
- general use: - 76 %,
- agriculture: - 1%,
- waste management: - 65%,
- industry: - 43%,
- energy: - 34 %

In the NECP Slovenia sets its renewable target to achieving at last 27% share of renewable sources in gross final energy consumption in 2030.

NECP also sets special targets for buildings. Until 2030 energy consumption in buildings has to decrease by 20 % compared to 2005, while GHG emissions from buildings have to decrease by 70 % until 2030 compared to 2005.

2. ENERGY EFFICIENCY IN BUILDINGS

2.1. ENERGY EFFICIENCY TRENDS

The share of energy consumption of buildings accounted for 31 % of final energy consumption in 2019, 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 2019 was 18 % lower than in 2000 and taking into account climate correction 11 % lower (Figure 9). In general consumption in households is decreasing with the faster decline observed after 2009. In 2020 renewable energy has been estimated with the model for the whole period 2000-2019, so data for the energy consumption in households are now consistent for the whole period.

In the period 2009-2019 energy consumption declined by 13 % and taking into account climate corrections by 11 %. In 2014 winter was exceptionally warm which can be seen by comparing final consumption and final consumption with climatic correction. In the period 2000-2009 energy consumption in households decreased by 6 5 and considering climate corrections by 1 %.

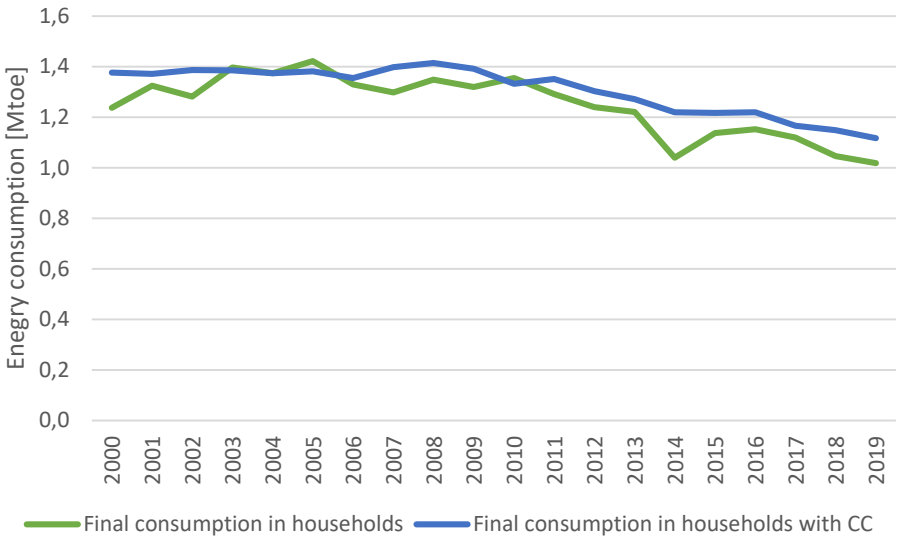


Figure 9: Final energy consumption in households (2000-2019)

The final energy consumption of tertiary sector is calculated as a residual in energy statistics, contributing to large deviations in energy consumption in this sector (Figure 10) 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.

Final energy use in tertiary sector in 2000 amounted to 0.57 Mtoe and in 2019 0.48 Mtoe, therefore decreasing by 15 %. Maximum level of consumption has been reached in 2001 with 0.76 Mtoe and minimum in 2007 with 0.40 Mtoe. In the last years consumption has been reaching levels round 0.5 Mtoe, with slight decrease in 2019.

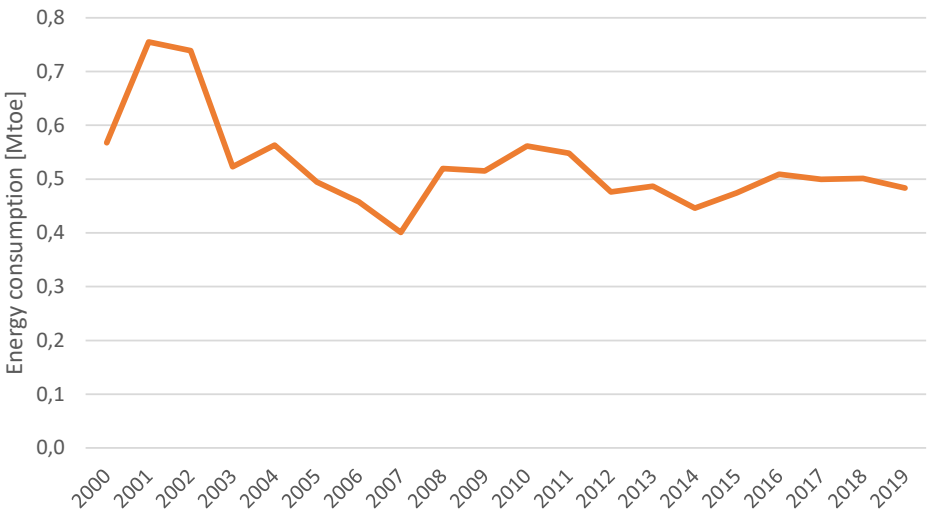


Figure 10: Final energy consumption in tertiary sector (2000-2019)

The largest share of energy consumption in households falls on heating with 66 % in 2019, followed by hot water with 14 %, large appliances 6 %, cooking 4 %, lighting 1 % and cooling also 1 % (Figure 11). Other electrical uses represent 8 % of the consumption in households. Comparison of consumption per purposes in 2000 and 2019 shows that the largest absolute reduction in consumption can be observed in heating, where 99 % of the total consumption reduction in households happened. In relative terms the largest energy consumption reduction happened in lighting, due to more efficient bulbs (by almost 50 %), closely followed by heating (by 32 %), due to more efficient buildings and boilers, and then in large appliances (by 18 %), due to more efficient appliances, and in hot water (by 17 %), due to more efficient boilers. In cooking energy use decreased by 10 %. On the other hand, consumption increased in cooling (due to larger number of air conditioners and higher demand for cooling) and other, due to higher number of devices using electricity in households.

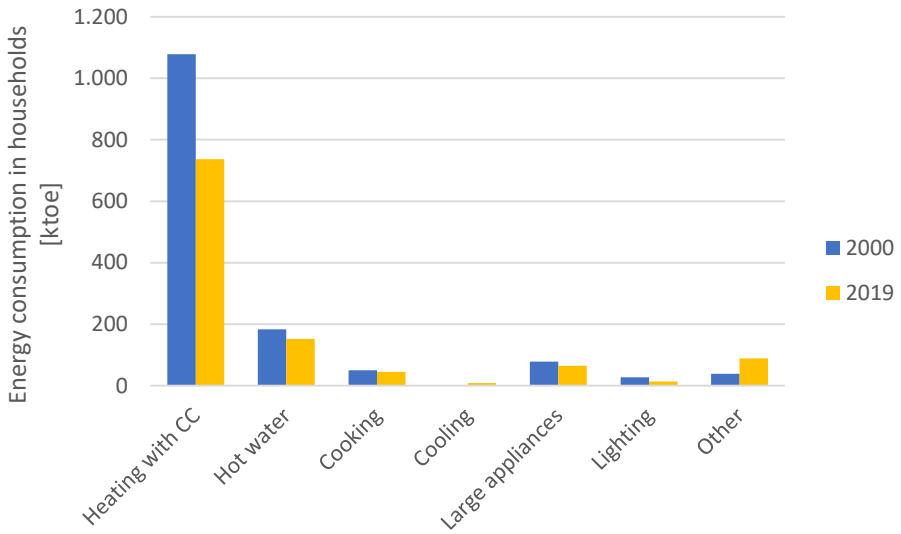


Figure 11: The structure of energy consumption of households by purposes in 2000 and 2019

Energy use for heating per square meter in households between 2000 and 2019 mainly decreased due to renovation of buildings, renovation of heating systems, building of new efficient buildings and change in behaviour (Figure 12). 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.

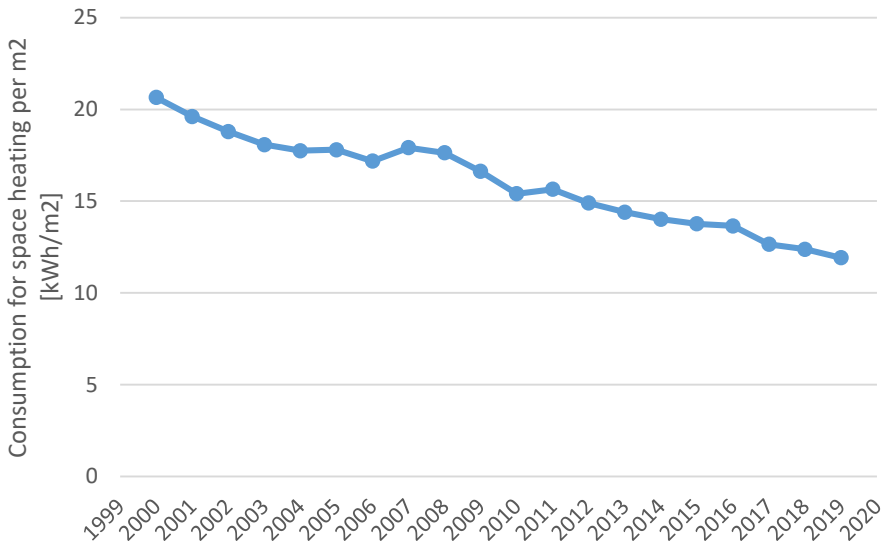


Figure 12: Energy consumption for heating in households per surface area

The structure of energy use in households changed considerably in the period 2000-2019 (Figure 13, Figure 14). Consumption of heating oil fell sharply, especially after 2009. Consumption in 2019 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. Consumption decreased by 22 %. Slight 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. Use of other RES has on the other hand increased, so total RES consumption decreased by 11 %. On the other hand increase has been observed in consumption of natural gas, especially between 2000 and 2008, and electricity consumption.

Wood biomass is the most important fuel in Slovenian households with 41 % share in households final consumption in 2019, followed by electricity (29 %), heating oil and natural gas, each with 10 %, district heat with 7 % and LPG with 3 %.

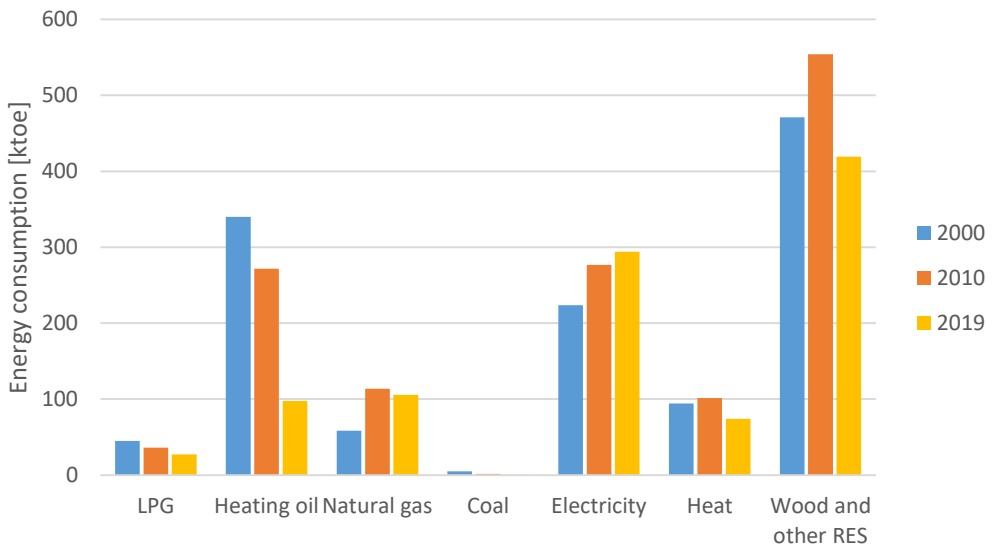


Figure 13: Fuel structure of energy consumption in households in 2000, 2010 and 2019

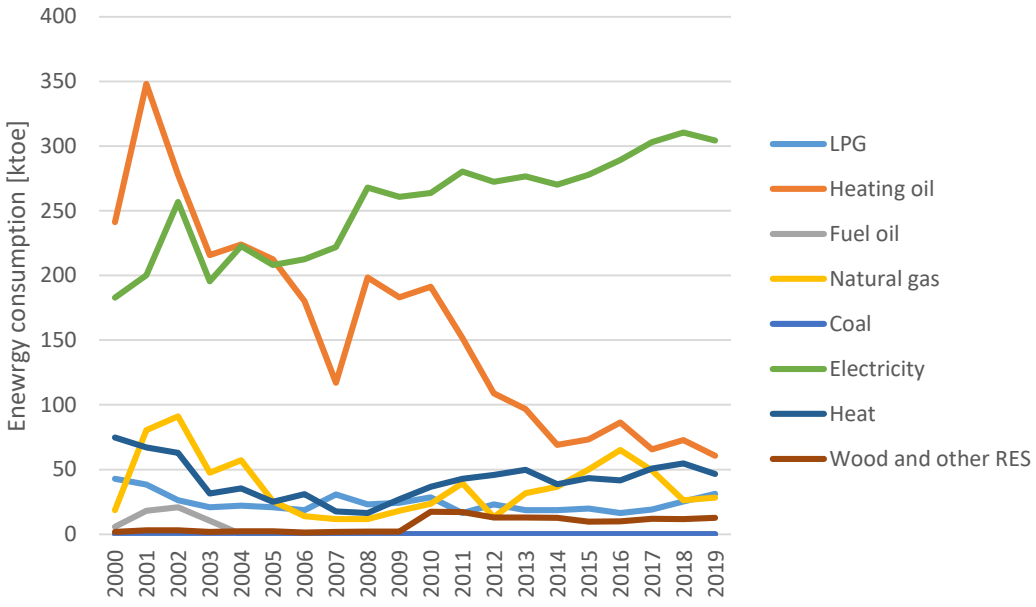


Figure 14: Fuel structure of energy consumption in tertiary sector between 2000 and 2019

In the service sector electricity is the most important fuel with 63 % of sectors final consumption in 2019. Second fuel is heating oil with 13 % and district heat with 10 %. Natural gas represented 6 % and LPG also 6 %. RES (biogas and geothermal) represented 3 %. Sharp decline of heating oil can be observed in the period 2000-2019 (decrease by 181 ktoe), which has not been compensated by growth in other fuels. Use of district heating and LPG also declined by 28 ktoe and 12 ktoe respectively, natural gas being the only fuel, used mainly for heating and hot water preparation purposes, with increase, but only minor. Based on this and also on data on supported measures in service sector we can make strong claim that in the period 2000-2019 use of RES in service sector increased and since this is not taken into account in the statistics we can say that final energy consumption in service sector is underestimated. Growth of electricity use 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.

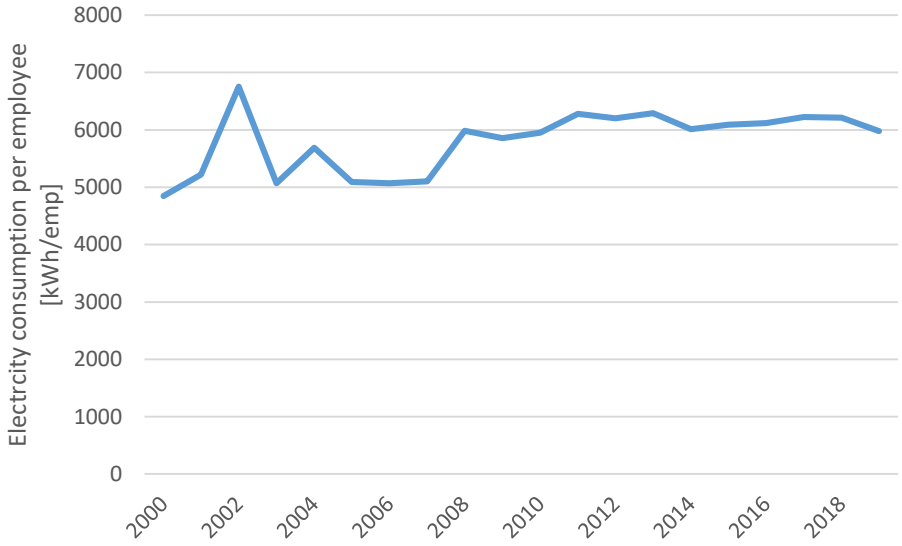


Figure 15: Electricity consumption in service sector per employee in the period 2000-2019

Electricity use growth in the period 2000-2019 was higher than the growth of employees in the service sector which resulted in increase in unit consumption by 23 %. Majority of the increase happened before 2008, while in 2008-2019 period no increase has been observed. After 2011 the indicator remained broadly flat, with exception of year 2019.

Improvement in energy efficiency is measured by energy efficiency index so called ODEX (Figure 16), 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.

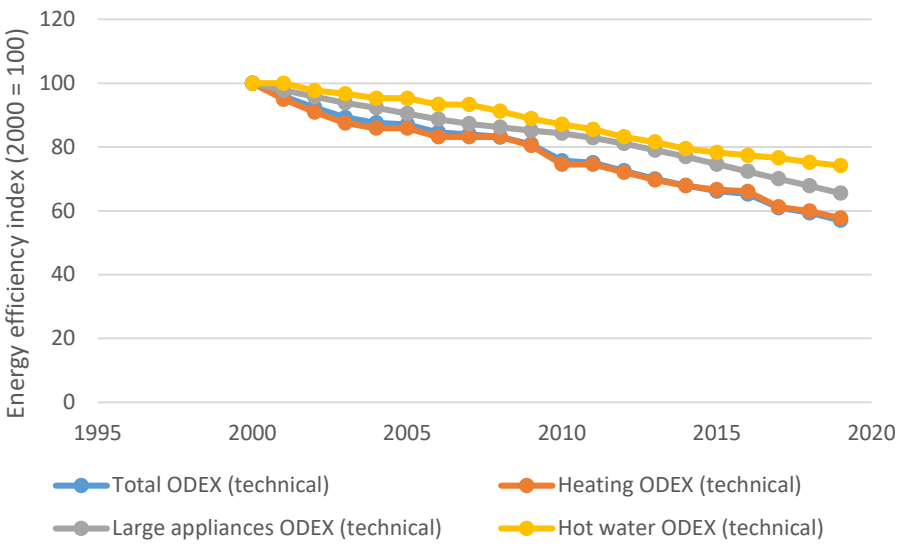


Figure 16: Energy efficiency improvement of households in the period 2000-2019

Energy efficiency in households improved by 43 % between 2000 and 2019 (Figure 16). Efficiency of heating, hot water preparation and large household appliances improved constantly through the whole period reaching 42 %, 26 % and 34 % efficiency improvement in 2019 respectively.

Due to energy efficiency improvement in 2000-2019 period energy savings in the households amounted to 836 ktoe in 2019, which is 75 % of the climate corrected consumption in 2019. If these savings would not be realized energy use in the 2000-2019 would increase while in reality it decreased (Figure 17)

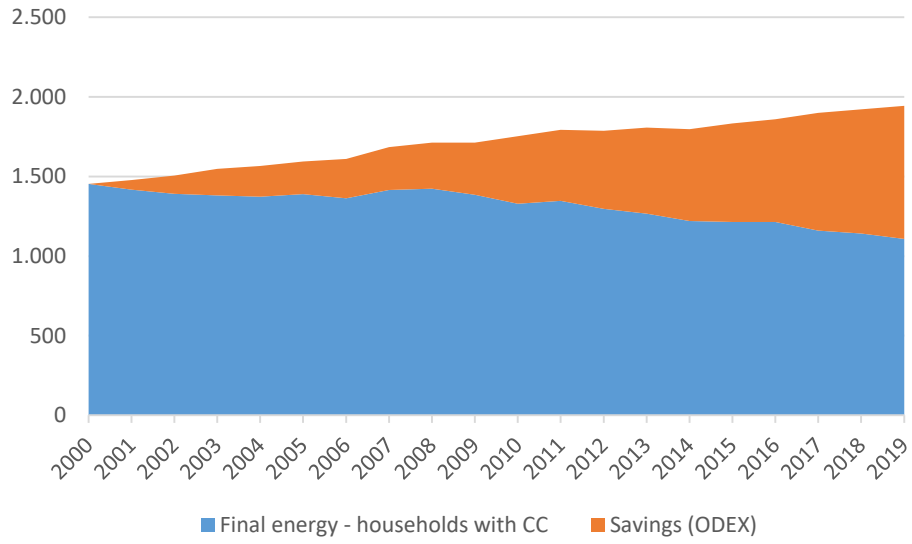
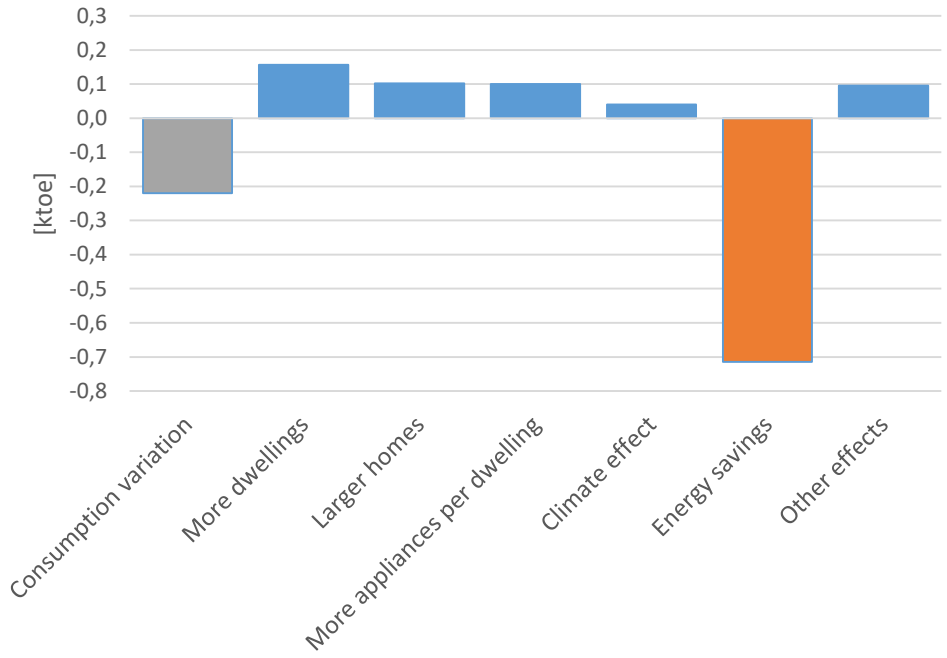


Figure 17: Savings due to energy efficiency measures in households compared to climate corrected final energy consumption

Decrease of the households energy consumption between 2000 and 2019 by 0,22 ktoe can be decomposed to:

- Change in number of occupied dwellings ("more dwellings") – increase of energy consumption by 0,16 ktoe– negative effect ;
- Change in floor area of a dwelling for space heating ("larger homes") - increase by 0,10 ktoe– negative effect;
- Change in number of large appliances per dwelling (“More appliances per dwelling”) – increase by 0,10 ktoe – negative effect
- Climatic difference ("climate effect") – small increase in consumption (0,04 ktoe) = small negative effect;
- Energy savings, as measured by (technical) ODEX – large decrease of consumption (by 0,71 ktoe) – positive effect;
- Other effects (mainly change in heating behaviours) increase of consumption by 0,10 ktoe – negative effect;

Variation of energy consumption of households in Slovenia is presented in the figure below (Figure 18).



Source: Odyssee database

Figure 18: Variation of energy consumption of households for the period 2000-2019

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 and in new Long term strategy for mobilising investments in the energy renovation of buildings.

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
- Setup of 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
- 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

3. ENERGY EFFIENCY IN TRANSPORT

3.1. ENERGY EFFICIENCY TRENDS

Energy consumption in transport increased heavily in the 2000-2019 period. In 2019 it was 59% higher than in 2000. 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 effected transport through Slovenia and at the same time fuel prices were not anymore lower compared to the neighbouring countries. This resulted in a large drop of energy consumption in transport with -16 %. In 2009 Slovenian government introduced tax exemption for trucks and buses in the form of payback of excise duty to the level of minimal excise duty. Partially because of this measure and also because of slow economic recovery energy consumption after 2009 slowly increased until 2012. In 2013-2015 again reduction has been observed, which is a consequence of reduced transport and to a large extent of fuel price situation. In years 2016-2018 transport activity increased which also caused increase of fuel consumption. In 2019 fuel consumption again decreased mainly due to decrease in fuel sales to heavy duty vehicles. Some insight into trends can be gain by comparison of driven kilometres of all types of vehicles on state roads and energy consumption in transport (i.e. fuel sold in Slovenia) (**Error! Reference source not found.**).

Figure 19: 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 21 %. As can be observed from **Error! Reference source not found.** consumption of gasoline slowly decreased over the whole period with slowdown in the last

two years, meaning that increase in energy consumption in transport sectors can almost solely be attributed to diesel fuel. In the last years share of biofuels increased a lot, representing 5 % in 2019. Shares of other fuels In 2019 are electricity 1.0 %, LPG 0.7 %, gas 0.2 % and fuel in domestic air transport 0.03 %.

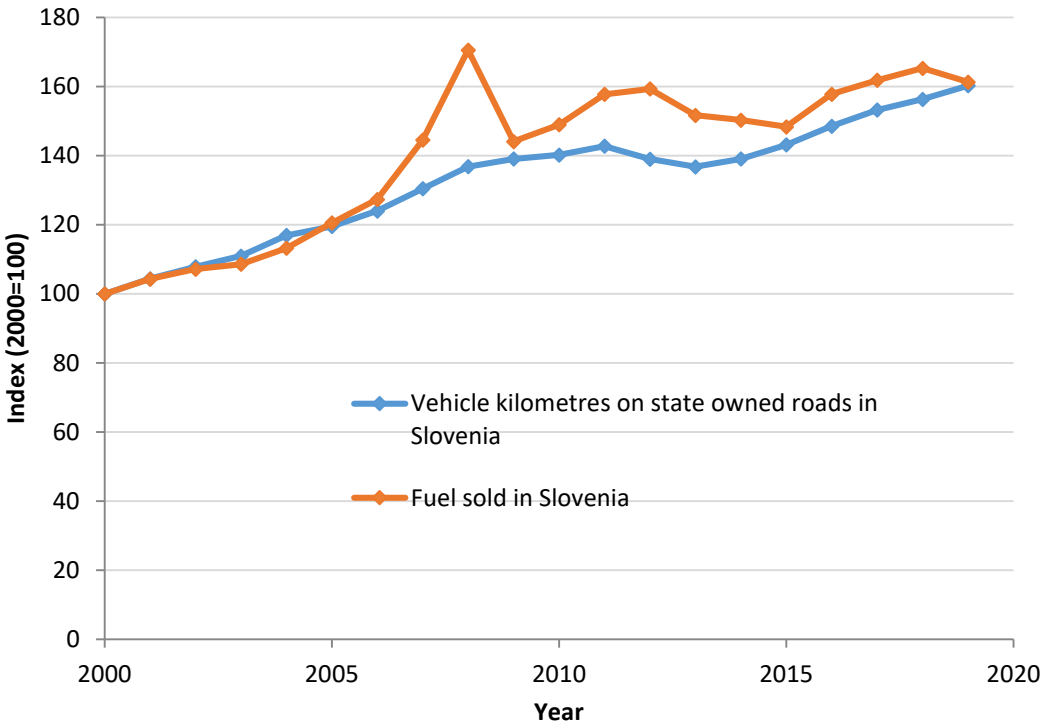


Figure 20: Comparison of trend for vehicle kilometres on state owned roads in Slovenia and fuel sold in Slovenia (source: DRI, SORS)

Road transport dominates in structure of energy consumption per type of transport and its share is increasing. In 2000 its share was 97 % and in 2019 it was 99 %. Shares of rail transport decreased from 2% in 2000 to 1% in 2019, while share of domestic air transport is negligible (Figure 21). Share of non specified use in transport in 2000 is 1 %, and in 2019 it is also negligible.

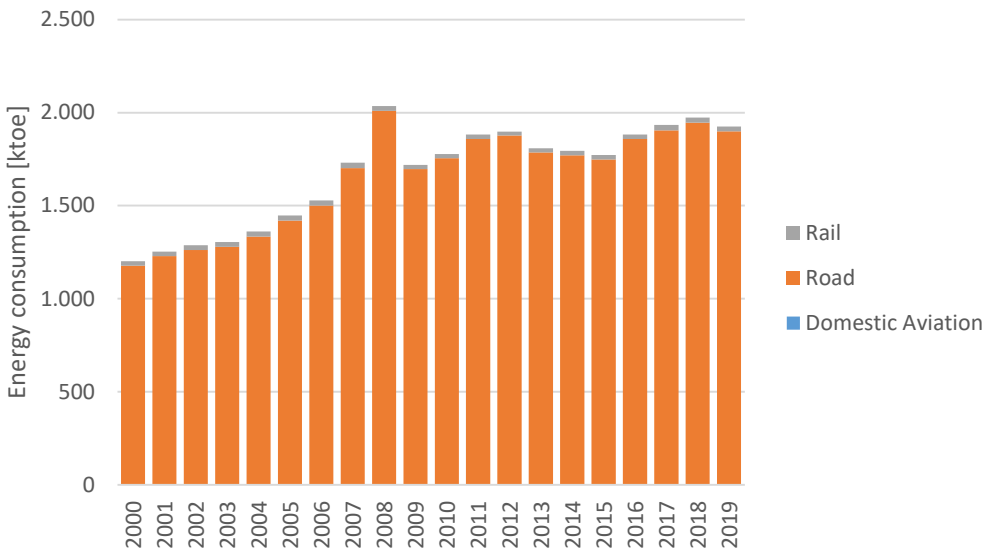


Figure 21: Structure of energy consumption in transport sector per type of transport (source: SORS)

Road transport

In 2000 78% of energy in road transport was consumed by cars, 16% by trucks, 4% by light duty vehicles and 2% by buses. Improved methodology for estimeting consumption of foreign vehicles has been used, which shoved that 24 % 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 important influence on energy consumption in road transport. Peak of energy consumption attributed to foreign vehicles was observed in 2008, with 25 % share in energy consumption of road transport. After that, fuel purchase of foreign vehicles decreased sharply due to economic crisis and changes in prices. Slow increase in purchase has then been observed until 2012 and after that decline until 2015, after which it stayed on low levels. In 2019 purchase of foreign vehicles dropped to the lowest values in the period 2000-2019. In 2019 domestic cars consumed 63 % of energy in road transport, domestic trucks 25 %, light duty vehicles 8%, buses 2 %, foreign trucks also 2 % and motorcycles and mopeds 1 % (Figure 22). Share fuel purchased by foreign cars dropped to 0.3 %. The model estimates fuel consumption of domestic vehicles based on number of domestic vehicles and their driven kilometres. Since no data are available for cars where the purchase fuel it is assumed that they do it in Slovenia although this is not always the case. Results for foreign cars can be based on that 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 growth and fuel consumption in freight transport of domestic trucks is very high with factor being 0.96. 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 0.95.

The largest growth of energy consumption in absolute terms in the 2000-2019 period was observed in domestic cars (495 ktoe), followed by domestic trucks (273 ktoe) and light duty vehicles (105 ktoe). Purchase of foreign truck increased by 35 ktoe while purchase of foreign cars decreased by 215 ktoe. Growth for other types of vehicles is below 29 ktoe.

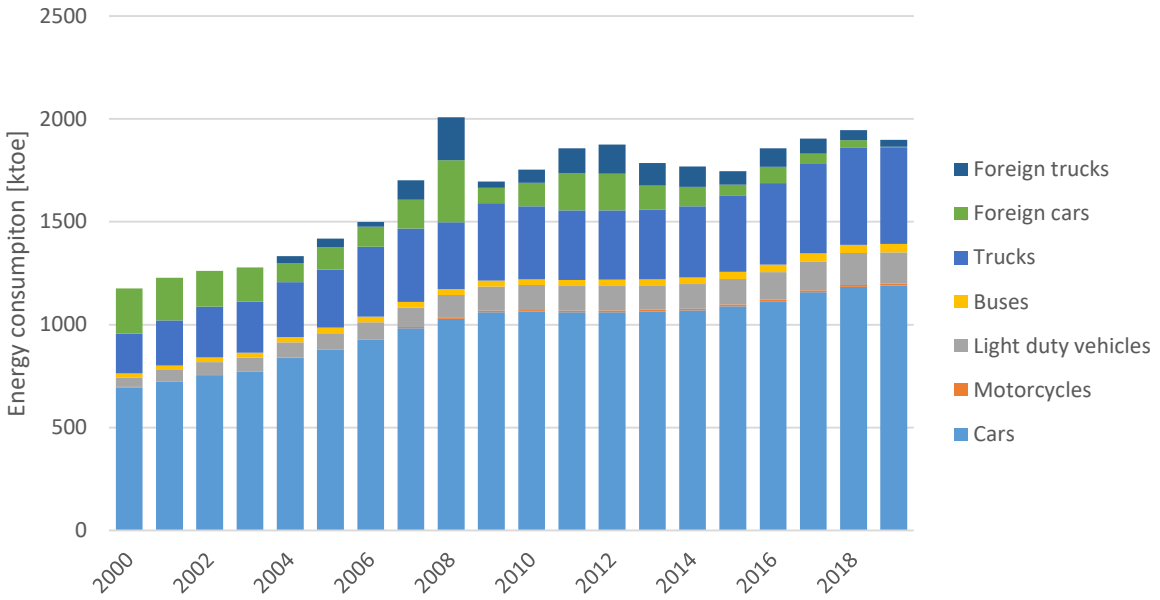


Figure 22 : Structure of energy consumption in road transport per type of vehicles (source: EARS, JSI-EEC)

Increase in energy consumption of cars can to a large extent be attributed to increase in car ownership which resulted in higher car use. Number of cars increased by 43% between 2000-2019, while energy use in domestic cars increased by 71%. Also the structure of cars has changed. Share of more powerful and larger cars has increased and share of smaller cars has declined as can be seen from Figure 23. Change in structure influenced specific energy consumption of cars offsetting efficiency improvements, resulting in only 8 % decrease of specific energy consumption of cars per driven kilometre in the period 2000-2019. Specific energy consumption per pkm on the other hand did not decrease.

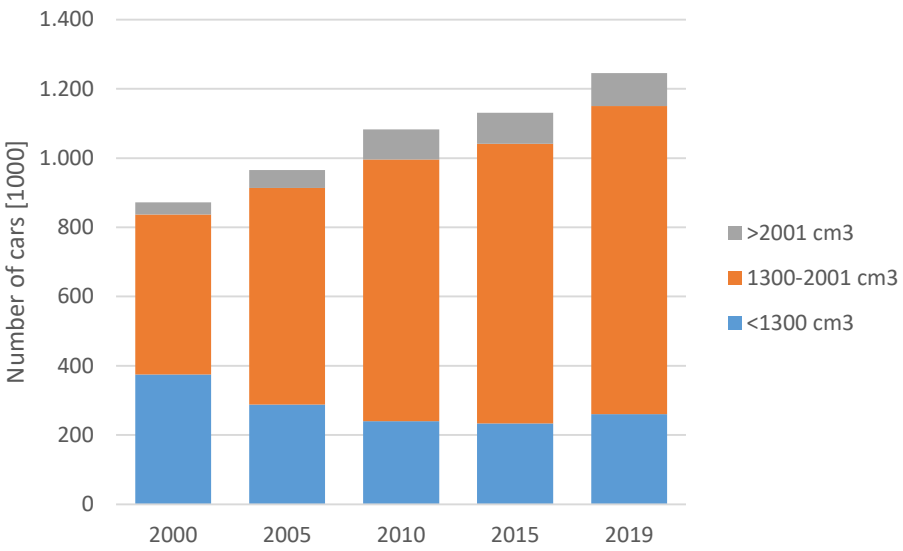


Figure 23 : Number of cars and structure per engine size (source: JSI-EEC)

ODEX indicator

Energy efficiency in transport sector has increased by 10% in 2000-2019 period based on technical ODEX. Analysis have been made excluding transit transport and air transport. Largest efficiency gains have been observed for rail with 36 % and trucks and light duty vehicles with 29% improvement largely due to improved logistics. Efficiency in cars has not improved and since cars have by far the largest share in energy consumption this has an important effect on total efficiency improvement.

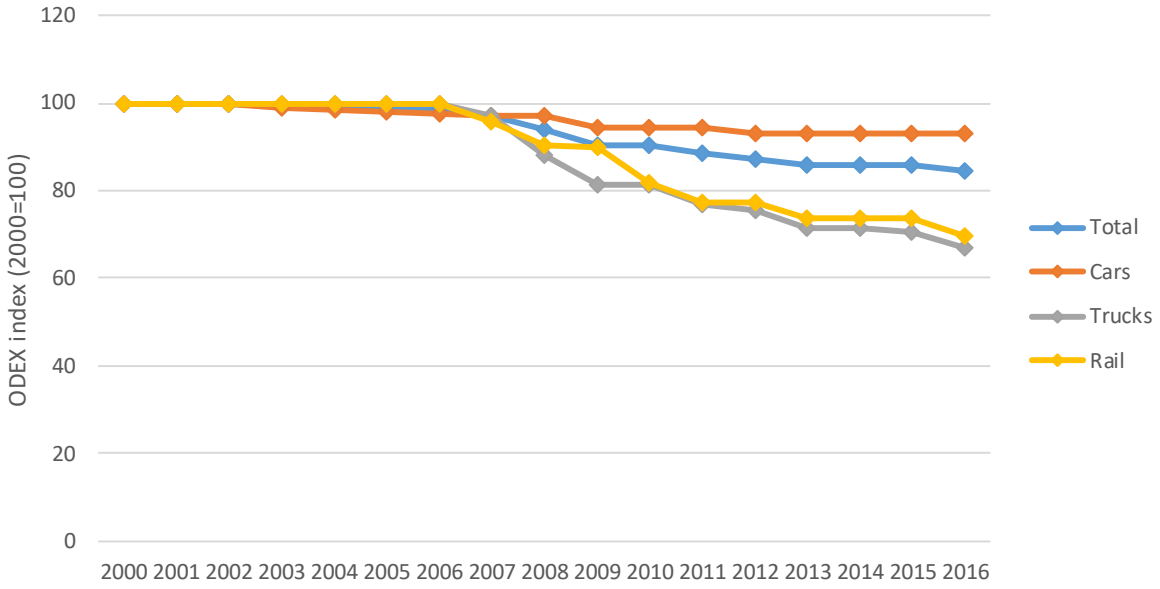


Figure 24: ODEX indicators for transport (source: ODYSSEE)

Decomposition

Decomposition of total transport energy consumption excluding air transport (Figure 25) shows that growth of energy consumption between 2000 and 2019 is due to two factors – increase in passenger and tonne kilometres – activity effect and shift to transport modes that use more energy like cars in passenger transport and heavy trucks in freight transport– modal shift. On the other hand two factor decreased energy consumption behavioural changes and decrease in fuel purchase by foreign vehicles – other factors and efficiency improvement in vehicles, but their effect was far from being enough to outweigh activity effect.

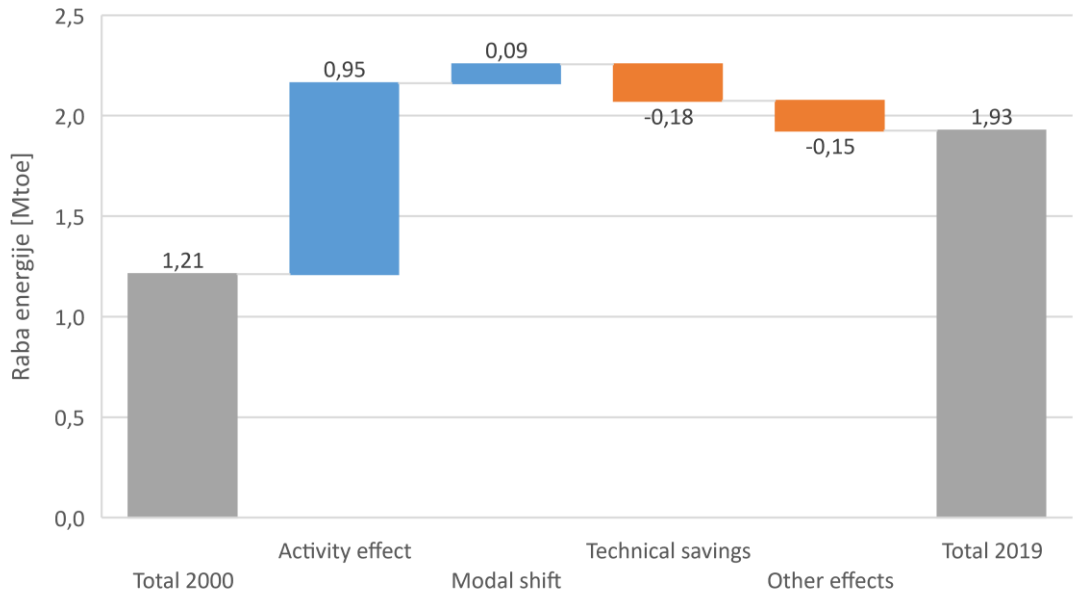


Figure 25: Decomposition of change in total transport energy consumption excluding air transport between 2000 and 2019

Decomposition of energy consumption change in passenger transport shows that the main factors contributing to growth are activity effect, modal shift and behavioural changes and fuel purchase of foreign vehicles (Other effects). Decomposition also shows that there was no efficiency improvement of cars so technical savings are 0.

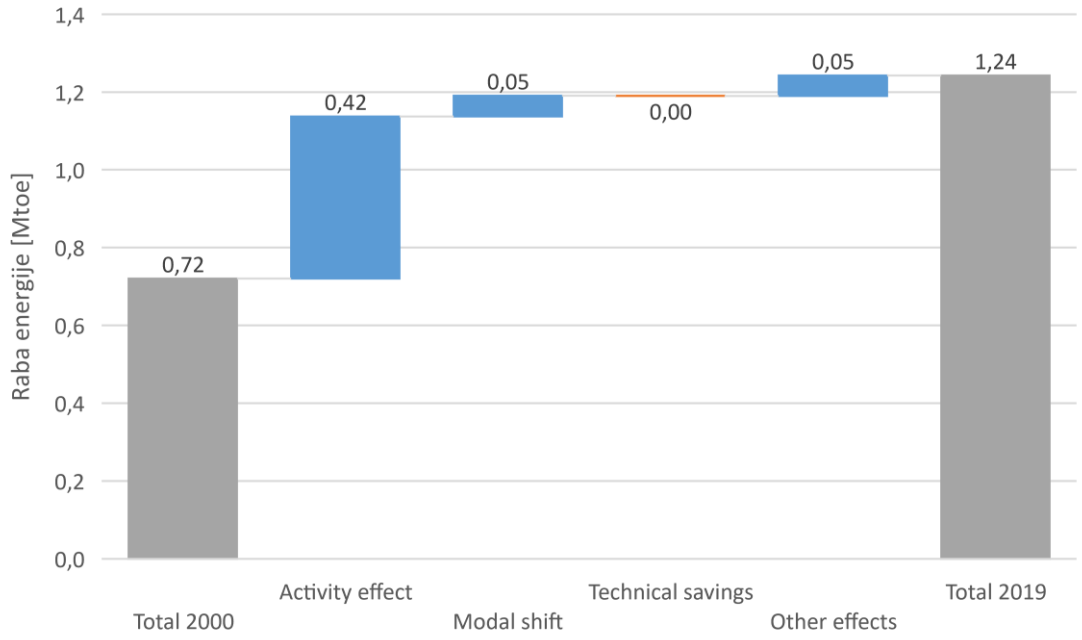


Figure 26: Decomposition of change in passenger transport energy consumption excluding air transport between 2000 and 2019

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 factors energy savings and other. However, due to high growth 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 2000-2019 increased by 147 %.

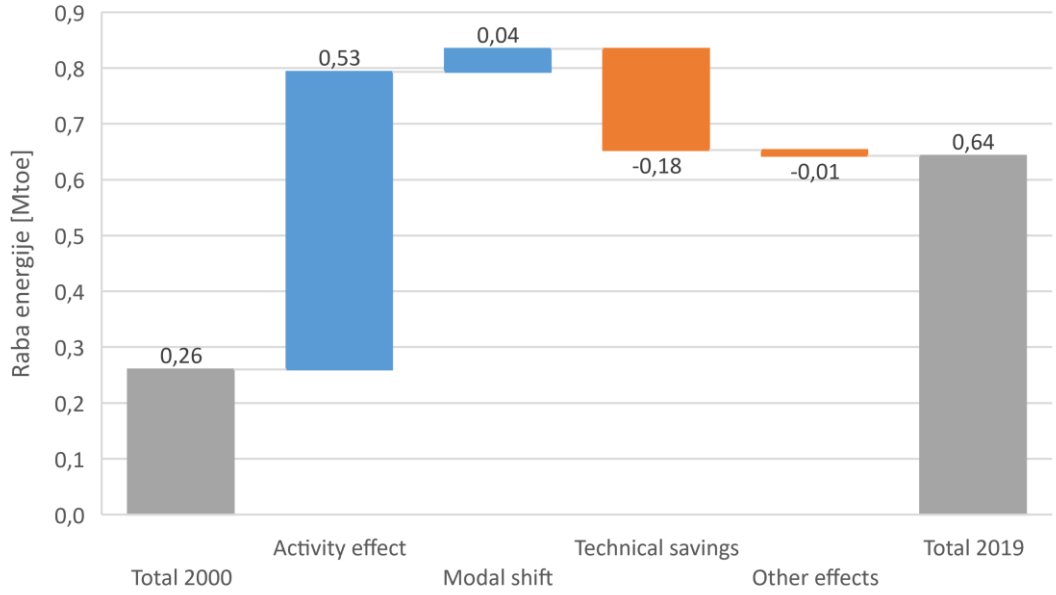


Figure 27: Decomposition of change in freight transport energy consumption between 2000 and 2019

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

Energy efficiency policies in the field of transport can be grouped into three categories:

- Decreasing motor transport activity
- Promoting public transport and non-motorized transport
- Improvement of energy efficiency of transport (technical and behavioural)
- Promoting sustainable freight transport

Decreasing motor transport activity

The construction of cycle paths and accompanying promotional activities are intended to promote cycling as an alternative mode of transport, which particularly in association with other modes of public transport represents an efficient alternative to private transport with minimal environmental impact. The strategic plan for the construction of national cycle paths is set out in the Transport Development Strategy up to 2030 and funds are available for construction on new bike lanes.

In capital citiy of Ljubljana, Bicikelj bike share scheme has been set up in the recent years. In 2014 in total 750,000 borrowings were recorded. Ljubljana has approximately 270,000 inhabitants. Other cities are following. Bike sharing schemes have been set up also in other cities.

Walking is also being actively supported through improvement of infrastructure and promotion.

Promotion of work at home and better support environment will be an important factor for decreasing need for travel. Better spatial planning will also contribute to this goal by providing all necessary services to the people within 15 minute reach on foot or bicycle. An important step in this direction are Comprehensive Transport Strategies on local, regional level and state level

Support to public transport and non-motorized transport

Use of public transport has rapidly decreased in the previous years. Downward trend has stopped in the most recent years, but to reach targets regarding quality of air in cities, increase of energy efficiency and reduction of GHG emissions large increase in use of public transport is needed in the future. Public transport is heavily subsidised by the government but it still cannot compete with cars. To improve competitiveness, the following existing measures are in place:

- Subsidies for public transport for specific categories of passengers
- Concessions for public transport as a service of general economic interest
- Integrated public passenger transport system
- Transport management measures for promotion of public passenger transport

- Additional transport management measures improving public passenger transport

The following additional measures will also be implemented:

- Promoting a sustainable choice of transport in the context of the calculation of compensation for transport costs to work
- Additional improvement of integrated public transport
- Additional investments in railway infrastructure and other measures aiming at improved railway infrastructure

Promoting sustainable freight transport

In sustainable freight transport the emphasis is on co-modality, for which the construction and modernisation of existing transport infrastructure (especially railway) is of vital importance. The measure is given additional support in the Transport Development Strategy of the Republic of Slovenia up to 2030 with the objectives of establishing efficient railway transport (electrification of the entire Slovenian rail network, modernisation, upgrading and new construction) and efficient road freight transport (introduction of electronic toll-collection for freight vehicles, introduction of IT for better utilisation of existing roads, inclusion of external costs in tolls and other charges for freight). Along that development of logistic centres and intermodal hubs is also very important.

Increasing the energy efficiency of road vehicles

Since Slovenia has no direct sway in terms of increasing energy efficiency in the manufacturing of vehicles, it may only influence, through additional measures, the vehicle market and the consumer choice (raising consumer awareness) to opt as much as possible for vehicles that run on alternative fuels (hybrid vehicles, electricity vehicles, hydrogen vehicles) or are very efficient. The activities under this measure are based essentially on the use of fiscal measures (motor vehicle tax and road use charge) and subsidies (financial incentives and loans with a favourable interest rate for purchase of electric or hybrid vehicles and gas vehicles) to stimulate the purchasing of more environment-friendly and more energy-efficient road motor vehicles, and also on the introduction of new regulations to reduce CO2 emissions in exhaust gases and to raise vehicle efficiency. Promoting the use of electric and hybrid plug-in vehicles is also defined in the Transport Development Strategy of the Republic of Slovenia to 2030 with the aim of increasing the energy efficiency of road transport. Strategy for alternative fuel in transport sets ambitious goals regarding number of purchased electric vehicles in 2020 and 2030.

The following additional measures will be implemented:

- Additional measures for improvement of charging infrastructure for alternative fuels
- Additional support for low CO2 emissions vehicles
- Additional measures for mobility management

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 (household, Industry and construction, transport, other sectors) in Slovenia.

The total final energy consumption of industry in Slovenia has decreased in the period 2000-2002 for -11% then increased in the next years to 2006 by 19% or 34% in comparison to 2000 or 2002.

The final energy consumption after the year 2006 decreased until 2009 (1220 ktoe) when it reached levels that were compared to consumption in 2000 lower by -14 %. After 2009 increase of consumption for one year followed and afterword slow decrease slowly increase as is shown in Figure 28 and Figure 29. The yearly average decrease in final energy consumption of industry in the period 2000-2019 was -0.4%/year.

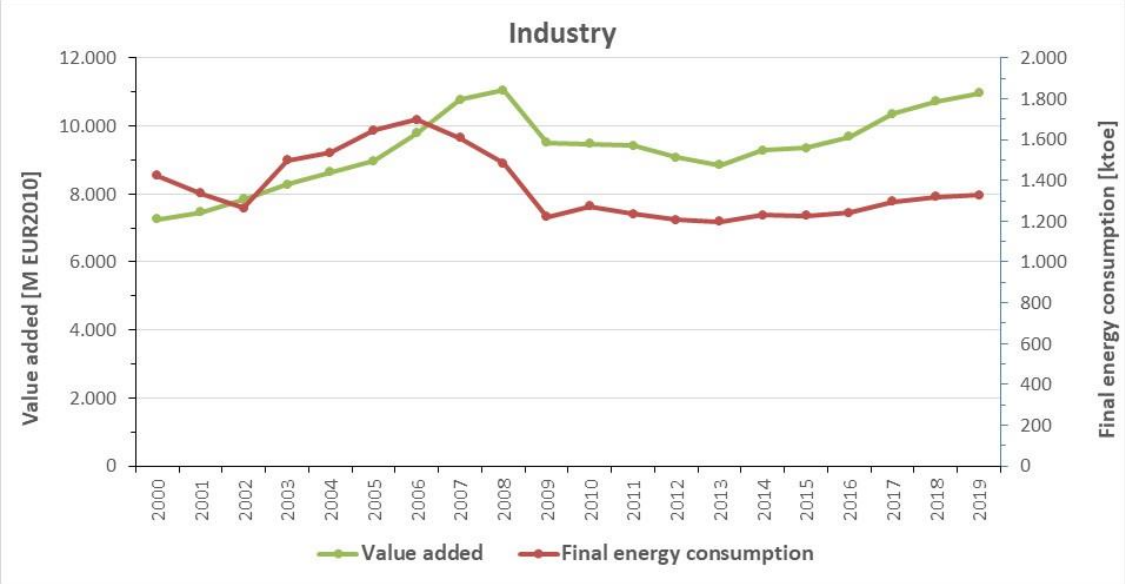


Figure 28: Final energy consumption and value added of industry in the period 2000-2019

The Figure 29 shows trends of energy consumption and value added of industry in Slovenia for the period 2000-2019.

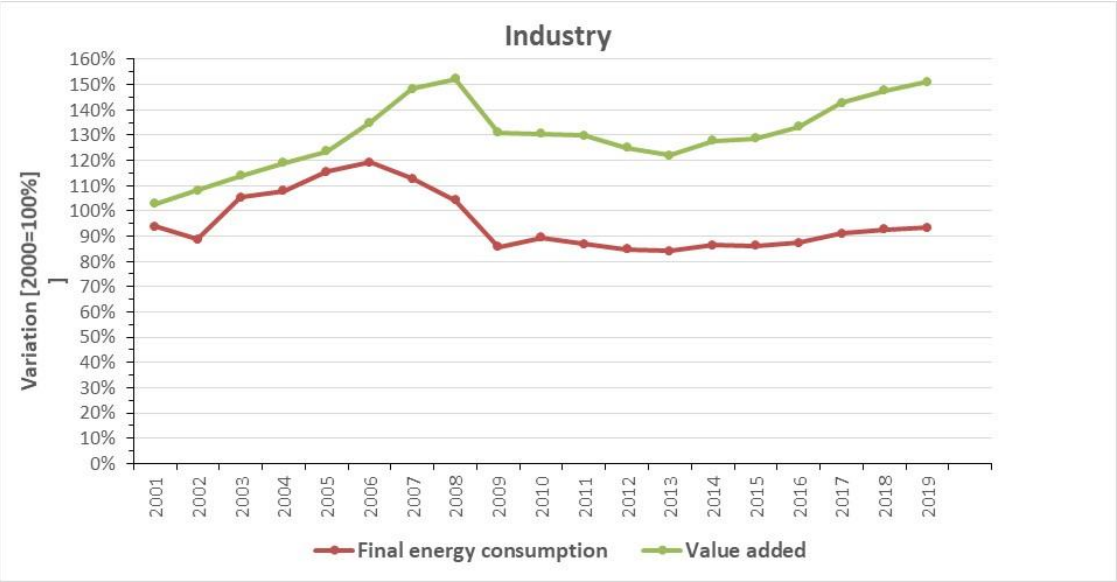


Figure 29: Trends of energy consumption and value added of industry in the period 2000-2019

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 15%, paper more than 14% and chemistry about 13% of total energy consumption in manufacturing industry. The energy consumption of manufacturing industry by branches in the period 2000-2019 is shown in Figure 30.

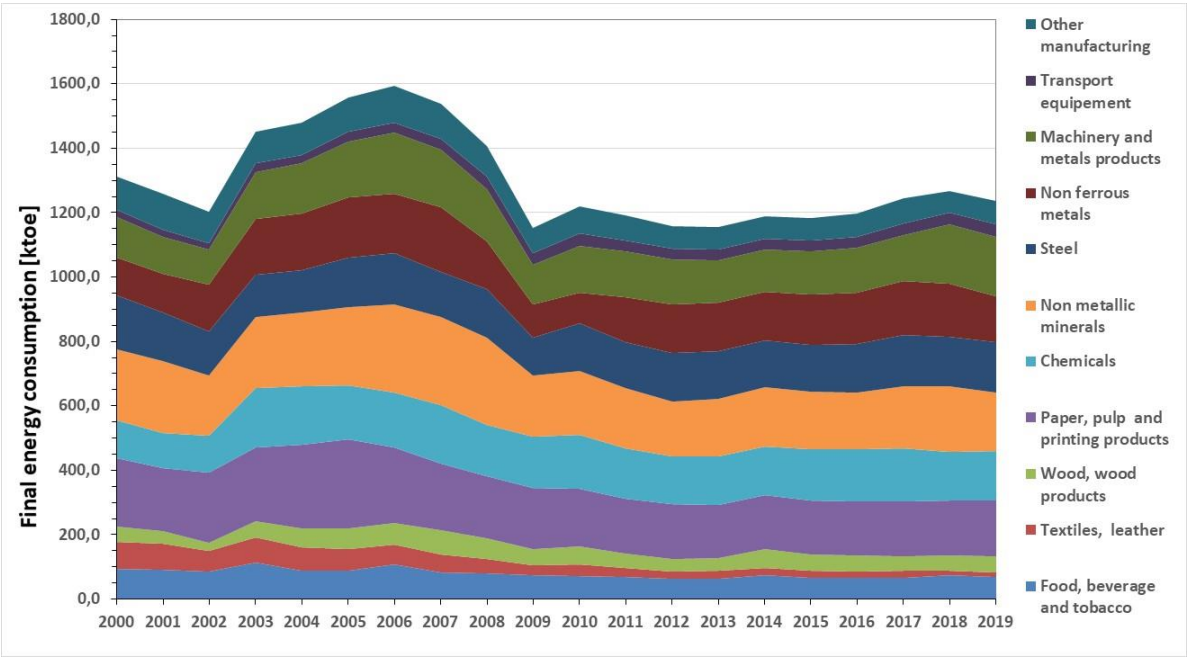


Figure 30: Final energy consumption of manufacturing industry by branches in the period 2000-2019

The specific energy consumption (measured by ktoe per ton of product) of steel and paper was slowly increased in the last years at 0.22 ktoe/t for paper and 0.24 ktoe/t of steel (Figure 31).

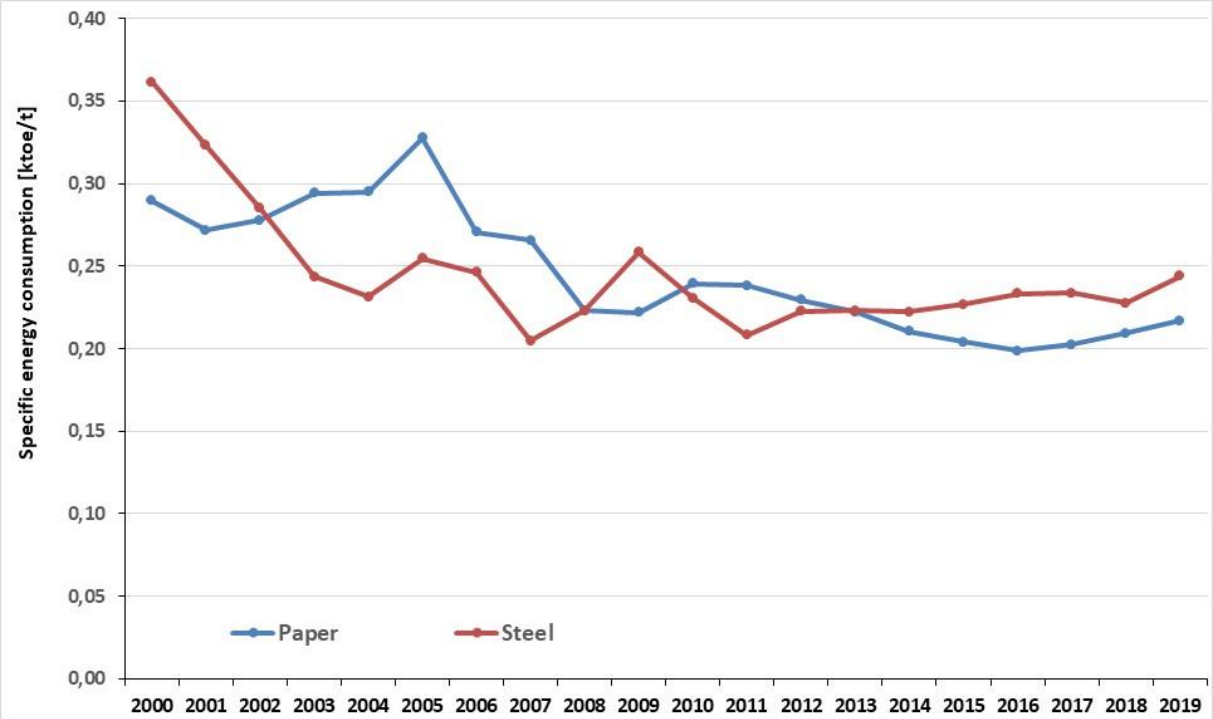


Figure 31: Specific energy consumption of steel and paper in the period 2000-2019

The improvement of energy efficiency in industry or manufacturing industry measured by energy efficiency index ODEX is presented in Figure 32.

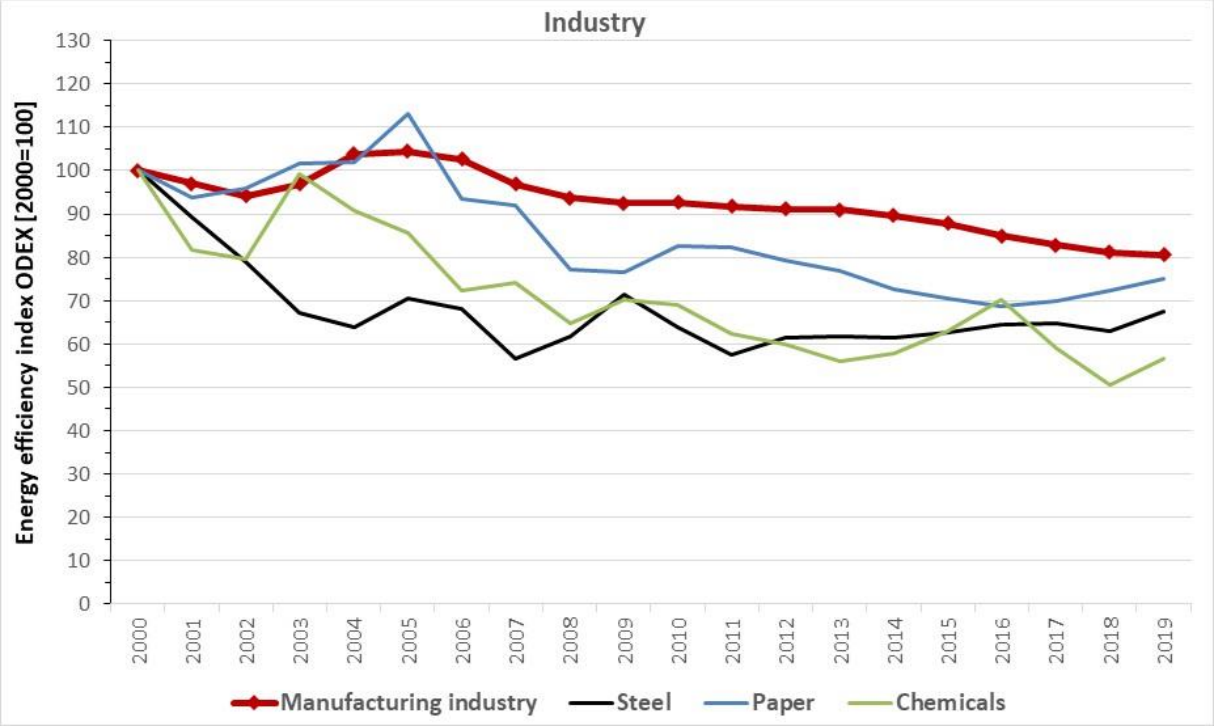


Figure 32: Energy efficiency index of manufacturing industry in the period 2000-2019

The energy efficiency in manufacturing industry has improved for 20% in 2019 in comparison to 2000. The improvement of energy efficiency has been achieved in the period between 2005 and 2019. The improvement of energy efficiency in steel and paper sectors has achieved 33% and 25% at the end of the observed period in 2019.

Decomposition

Decomposition analysis of energy consumption in industry[2] (Figure 33) shows that decrease of energy consumption between 2000 and 2019 is due to decompose of two factors with negative

[2] The variation of the industrial energy consumption is influenced by the following factors:

- 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 index of production (or physical production for steel, cement and paper) are not growing 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: mainly "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.

effect (structural change and energy savings) and two factors with positive effect (activity and others).

The variation of the industrial energy consumption has been calculated by Odyssee database tools and presented in Figure 33Figure 33.

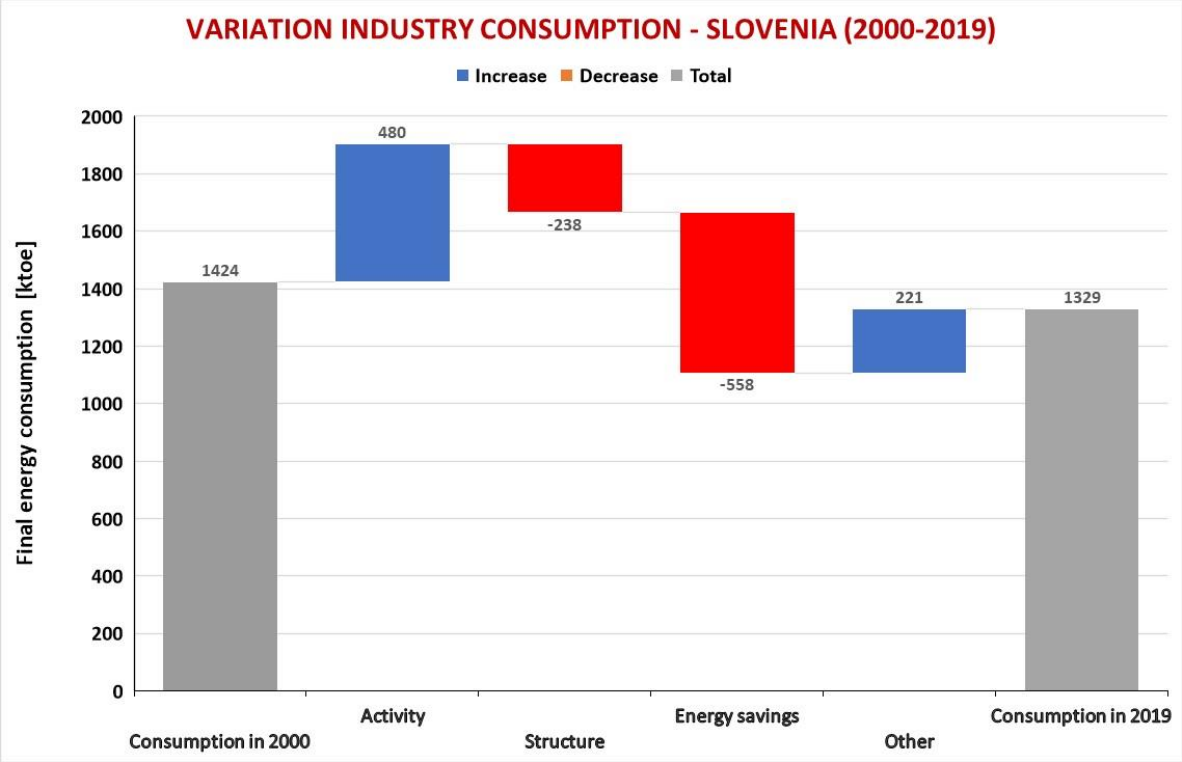


Figure 33: Decomposition of energy consumption in industry for the period 2000-2019

4.2. ENERGY EFFICIENCY POLICIES

The energy efficiency measures in industry (for Non-ETS companies) in the first National energy plans (NEEAP 1 and NEEAP 2) for the period 2008-2016 have included a set of energy efficiency measures for industry: financial incentives for efficient electricity consumption, introducing energy management systems, preparation of feasibility studies for investment in energy efficiency and RES. The measures have included financial incentives to significantly increase the electricity generation from renewable energy sources (RES) and in combined heat and electricity production systems (CHP).

Energy act of Slovenia (2014) has defined that energy efficiency measures have to be included in the energy efficiency action plans.

The recent energy efficiency measures in industry are included in the all energy efficiency action plans “NEEAP 2020” and continue in the Integrated National Energy and Climate Plan for Slovenia (NECP). All measures for industry in the Integrated National Energy and Climate Plan for Slovenia

(NECP) are continuing to 2030. The main objective of these measures are 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.

The additional energy efficiency measures for industry are:

- Incentive for energy efficiency in industry contains an incentive for energy efficiency and renewable energy sources in SMEs will be provided from grants and returnable OP EKP[3] funds in the 2015–2020 period.
- Financial incentives for demonstration projects in industry will be 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].

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

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

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