ODYSSEE-MURE

ENERGY EFFICIENCY TRENDS AND POLICIES IN LITHUANIA

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Notes

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List of abbreviations

GDP	Gross Domestic Product
VA	Value added
NEIS	National Energy Independence Strategy
NECAP	National Energy and Climate Action Plan
EU	European Union
GHG	Greenhouse gases

1 Introduction

The general objective of the ODYSSEE-MURE project is to provide a comprehensive monitoring of energy consumption and efficiency trends as well as an evaluation of energy efficiency policy measures by sector for EU countries, Switzerland and Energy Community countries (Bosnia-Herzegovina, Montenegro, Georgia, Ukraine, Northern Macedonia, Albania, Moldova, Kosovo and Serbia):

- Evaluate and compare energy efficiency progress by sector, and relate this progress to the observed trends in energy consumption.
- Contribute to the evaluation of national energy efficiency policy measures and analyse their dynamics of implementation.

The ODYSSEE-MURE project is coordinated by ADEME. It is supported by LIFE-CET programme of the European Commission and is part of the activity of the EnR Club.

This report relies on data contained in two complementary databases: the ODYSSEE database on energy efficiency indicators and the MURE database on energy efficiency policies. Both databases are regularly updated (one or twice a year) by network of national correspondents from all EU Member States. Enerdata provide the technical coordination for ODYSSEE and Fraunhofer-ISI for MURE database.

This report analyses the development of the energy efficiency in Lithuania at the level of the overall economy and all final energy consumption sectors between the years 2000 and 2022.

During the period 2000-2022 the total final energy consumption was increasing by 1.7% per annum. The main reason for such a rise was the high growth of economy. The total final energy consumption in 2022 amounted to 5.38 Mtoe in Lithuania.

The final energy intensity shows the steady decrease by 2.3% per annum from 2000 to 2022. The final energy intensity has decreased by 40.0% and in 2022 amounted 0.07 koe/EUR2015p, 5.6% lower than the average in EU countries.

In 2022, the global technical energy efficiency index (ODEX)[1] in Lithuania was 75.8 which represents an improvement of 24.2% on the overall energy efficiency since the 2000, or 1.3% per year. Most of the efficiency progress is observed in the industry (62.0% or 4.3% per year), followed by transport (31.0% or 1.6% per year) and households (30.0% or 1.6% per year). In the service sector, the energy efficiency improvements have been steady (0.6% per year).

The cumulated energy savings between 2000 and 2022 reached 2.21 Mtoe in Lithuania. The industry played a major role, as its non-consumed energy represents half of the total cumulated savings since 2000. The household and transport sectors each accounted for 25% of the total cumulated savings.

The cumulated energy savings led Lithuania to the 18th position in terms of overall energy efficiency level out of the 27 countries which are part of the ODYSSEE-MURE project.

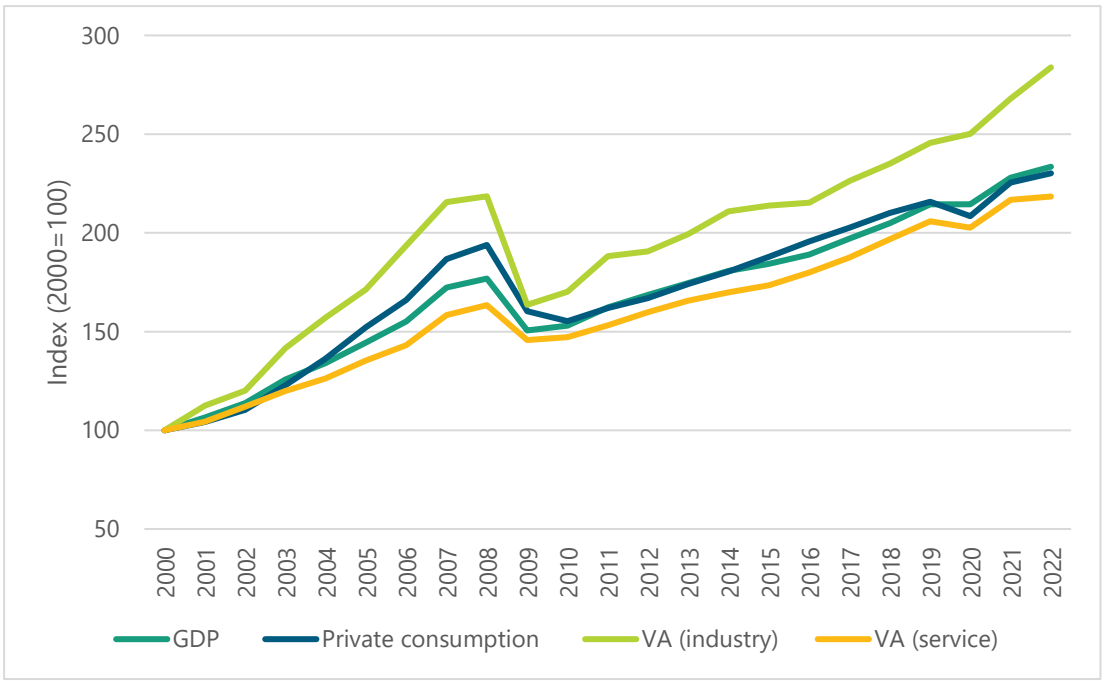
[1] https://www.indicators.odyssee-mure.eu/odex-indicators-database-definition.pdf

2 Economic and policy context

2.1 Economic context

The integration in the European Union (EU) positively impacts Lithuania's economic development. From 2000 to 2007, the average growth rate of gross domestic product (GDP) was 8.1% per annum (Fig. 1). The impact of the global economic recession was dramatic in Lithuania. The global economic crisis influenced the Lithuanian GDP in 2008, but the GDP growth rate in 2008 was still positive. In 2009, GDP decreased by 14.9%. In 2020, Lithuania resisted well to the COVID-19 pandemic induced global crisis. The Lithuanian economy did not contract in 2020, in contrast to the EU countries. The successful performance of exporters, the financial support provided by the Government, and the low dependence of the economy on the most restricted and affected activities caused 0% changes in real GDP in 2020. From 2010 to 2022, the GDP increased on average by 3.6% annually.

Figure 1: Macro-economic development in Lithuania from 2000 to 2022



Source: ODYSSEE database.

The economic crisis substantially affected the average value added (VA) and private consumption growth indicators. The average annual growth of VA in the industry from 2000 to 2007 was 11.6%, while from 2010 to 2022, this indicator was only 4.4%. A similar situation is seen in the services sector, where the average annual growth of VA was 6.8% (from 2000 to 2007) and 3.3% (from 2010 to 2022).

2.2 Policy background

Historically vision for energy policy was established through the **Law on Energy** adopted by the Lithuanian Parliament on 16 May 2002. In response to current affairs, the Law specifies that energy activities in the country are carried out and regulated in a way to assure energy security, availability

and sufficiency of energy resources and energy, efficiency of energy resources and energy consumption, harmonious and sustainable development of the energy sector, introducing energy innovations based on smart technologies, energy digitization, reducing the negative impact of energy activities on the environment, protection of consumer rights and legitimate interests, creation and development of conditions for effective competition in the energy sector, and development of the use of local and renewable energy resources.

In the area of energy efficiency, the Law defines that:

- effective energy and energy resource consumption measures are planned in the energy efficiency improvement and other national development programs approved by the Government;
- imported, manufactured, and sold household appliances that use electricity and other types of energy must have energy efficiency labels;
- imported, manufactured, and sold products related to energy consumption, the use of which has a significant direct or indirect influence on the consumption of energy and/or other resources, must have an energy efficiency label and a table of nominal parameters;
- companies operating boilers and other energy resource-consuming devices with a rated (nominal) thermal power greater than 0.4 MW shall check the energy resource consumption efficiency of these devices under the established procedure;
- in buildings, compliance with established energy efficiency requirements is checked:
    - for heating systems installed in buildings and combined heating and ventilation systems with a nominal output power greater than 70 kW - once every five years;
    - gas-fired boilers installed in buildings - at least once every four years;
    - air-conditioning, combined air-conditioning, and ventilation systems installed in buildings with a nominal output power of more than 70 kW - once every three years.

The Law states that many institutions are responsible for the formulation of energy efficiency policy and management, regulation, supervision, and control of activities:

- **The Government or its institution** determines the strategic goals and objectives in the national development plan, approves national development programs implementing the tasks of energy policy progress, determines the procedure and conditions for checking compliance with efficiency requirements, and establishes the procedure for monitoring energy resources and energy-efficient use.
- **The Ministry of Energy**, according to its competence, approves legal acts regulating the security of energy supply, energy objects and devices, installation, operation, use, technical safety, efficient use, and other technical issues of consumer energy devices, determines the procedure and conditions for the audit of energy consumption in buildings, facilities, and technological processes, organizes the exchange of experience in the field of efficient energy resources and energy consumption, and other.
- **The Ministry of Transport and Communications** prepares national development programs for increasing energy resources and energy efficiency in transport facilities, organizes, coordinates, and controls their implementation, provides recommendations, and implements measures that increase the efficiency of energy resources and energy consumption in transport facilities, jointly with the Ministry of Energy carries out information and education activities that encourage the efficient use of energy resources and energy in transport facilities.

- **Municipalities**, according to their competencies, implement measures to increase energy efficiency.
- **The Energy Agency** submits a draft action plan for increasing energy efficiency to the Ministry of Energy, evaluates and analyzes the data provided by state institutions and energy companies about the energy saved by energy efficiency measures, prepares reports based on them, and submits them to the Ministry of Energy. It carries out monitoring of energy and resource efficiency, promotion of energy from renewable resources and related publicity work, prepares progress reports on the promotion and use of renewable energy resources and submits them to the Ministry of Energy, performs monitoring of the implementation of energy utilization of renewable resources in the transport sector, as well as administers and/or implements measures, including financial incentive measures, which increase the energy efficiency, energy security and energy from renewable energy resources.

The Law on Energy Efficiency was adopted on 3 November 2016 by the Parliament of Lithuania. It establishes the legal basis for state management, regulation and supervision of energy efficiency improvement. The Law aims to ensure more economical energy consumption in all areas of the Lithuanian economy, which corresponds to the obligations of the Republic of Lithuania to increase the efficiency of energy consumption set out in the legal acts of the European Union, to create prerequisites for efficient production, supply and consumption of energy and to ensure that in 2030 in Lithuania:

- the primary energy consumption is not higher than 5,462 ktne,
- the final energy consumption is not higher than 4,526 ktne and
- the total energy saved by energy efficiency measures is not less than 27,280 GWh.

In addition, the Law defines the required annual amounts of energy saved from 2021 to 2030 and to 2050, which are equal to 0.8% of the average amount of final energy consumed from 2016 to 2018 in the country

Ministries of Lithuania are responsible for energy efficiency measures and related energy savings in the following way:

- The Ministry of Economy and Innovation is responsible for the implementation of measures to increase energy efficiency in the industrial sector to ensure the mandatory amount of energy savings of at least 5,456 GWh;
- The Ministry of the Environment and Ministry of Energy are responsible for the implementation of measures to increase energy efficiency in the service and household sectors, ensure a mandatory amount of energy savings of at least 10,366 GWh;
- The Ministry of Transport and Communications is responsible for the implementation of measures to increase energy efficiency in the transport sector to ensure the mandatory amount of energy savings of at least 10,912 GWh;
- The Ministry of Agriculture is responsible for implementing measures to increase energy efficiency in the agricultural sector. A mandatory energy savings of at least 546 GWh is ensured.

It is planned to increase energy efficiency by the following measures:

- assessment of value-added tax or excise duties applied to energy and energy resources, the effect of which is the reduction of final energy consumption;
- financial measures that encourage the implementation of energy efficiency improvement measures and the effect of which is the reduction of final energy consumption;

- construction or product labeling technical regulations that encourage the implementation of measures to increase energy efficiency and whose effect is to reduce final energy consumption;
- agreements with companies (including energy companies) that promote the implementation of energy efficiency improvement measures and the effect of which is the reduction of final energy consumption;
- standards and hygiene norms aimed at increasing the energy efficiency of products, including buildings and vehicles, and services, except for cases where they are mandatory and applicable under European Union law;
- energy efficiency labeling regulations;
- education that encourages the introduction of energy efficiency improvement measures and the effect of which is the reduction of final energy consumption.

The **National Energy Independence Strategy** (NEIS) of 2024 is the leading energy policy document. It sets the main strategic goals for Lithuanian energy sector development and their implementation directions up to 2050. The targeted indicator for energy efficiency is final energy consumption not exceeding 51 TWh in 2030, 46 TWh in 2040, and 42 TWh in 2050 in Lithuania. The main directions for achieving the goal of increasing energy efficiency are

- to promote the complex renovation of multi-apartment residential and public buildings;
- to increase the efficiency of energy consumption by developing high value-added created and energy-efficient industries; and
- to promote the electrification of transport, including heavy-duty road vehicles, the use of electric cars, and their charging infrastructure development.

Lithuania prepared the **National Energy and Climate Action Plan** (NECP). The Dimension of Energy Efficiency assumes implementing existing and planned policy measures. The cumulative energy savings target for 2030 will be achieved with 34.5 TWh from existing energy efficiency measures and 11.9 TWh from planned energy savings.

3 Overall energy efficiency progress and policies

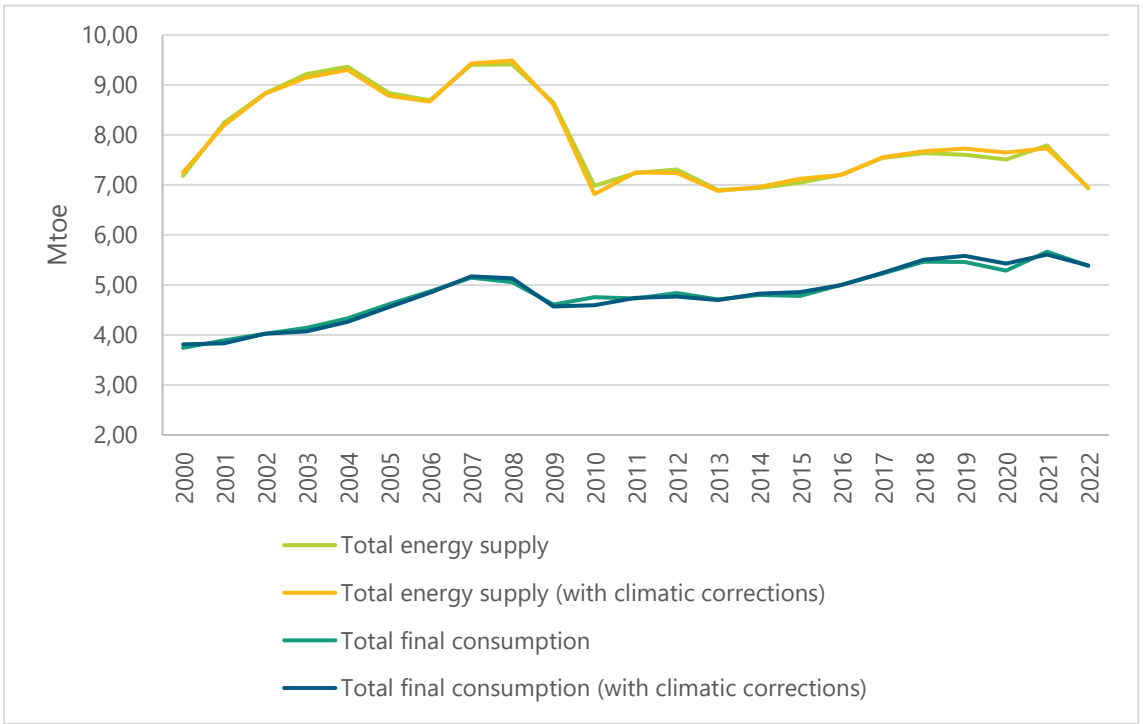
3.1 Development of energy consumption and energy efficiency trends

3.1.1 Energy consumption based on ODYSSEE

The dynamics of total primary and final energy consumption in Lithuania from 2000 to 2022 are presented in Figure 2. Total primary energy consumption in 2000 amounted to 7.18 Mtoe and in 2022 – 6.93 Mtoe. From 2000 to 2007 the primary energy consumption was increasing by 4.0% per annum. The global economic crisis and the closure of the Ignalina NPP have led to a 40% fall in primary energy consumption between 2008 and 2010. From 2010 to 2022 the primary energy consumption remained quite stable.

From 2000 to 2022, there was a trend toward a rapid rise in the total final energy consumption (1.7%/year and 1.6%/year with climate corrections). The main reason for such a rise was the economy's high growth. From 2000 to 2007, the final energy consumption increased by 4.7% per annum (Fig. 2). The recession of the economy stopped the tendency of growth and caused a significant decrease in energy consumption till 2010. From 2010 to 2022, the total final energy consumption increased on average by 1.0% annually. The total final energy consumption in 2022 amounted to 5.38 Mtoe in Lithuania.

Figure 2: Total primary and final energy consumption in Lithuania from 2000 to 2022

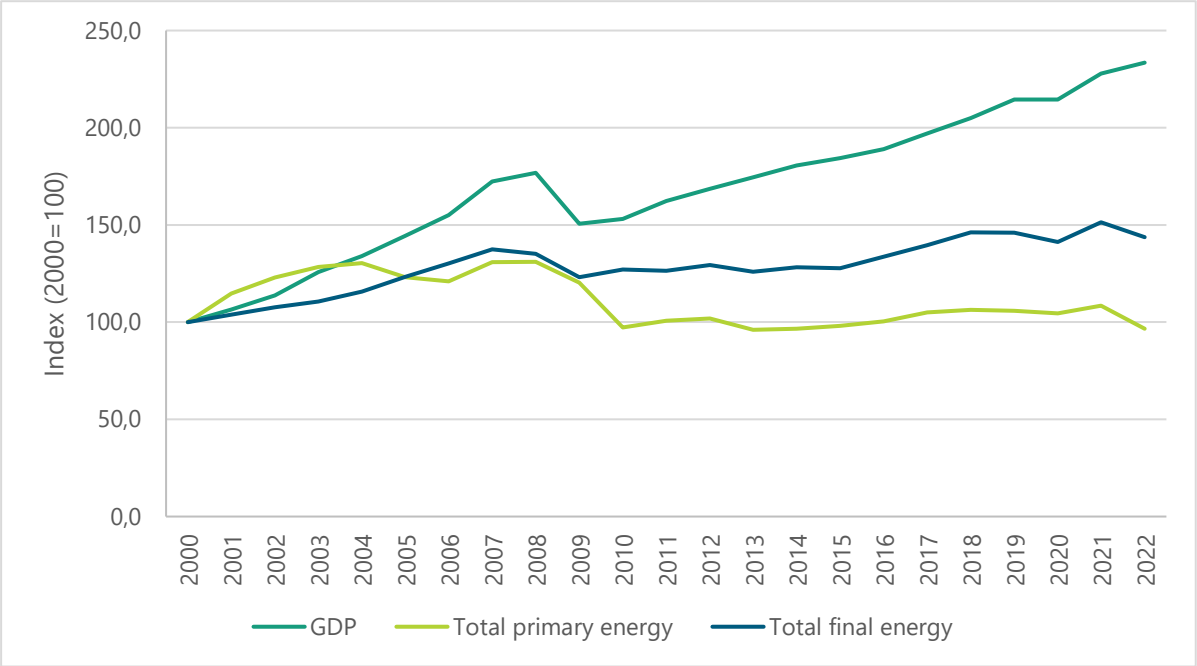


Source: ODYSSEE database

Figure 3 shows a more extensive decoupling between the GDP and primary and final energy consumption from 2010. From 2000 to 2022, the final energy consumption was growing slower than

the GDP. All the energy efficiency measures implemented have had a positive impact on all economic sectors. In the period 2010-2022, economic growth was around 60%, while primary energy consumption remained at the same level.

Figure 3: GDP, primary and final energy growth index in Lithuania from 2000 to 2022

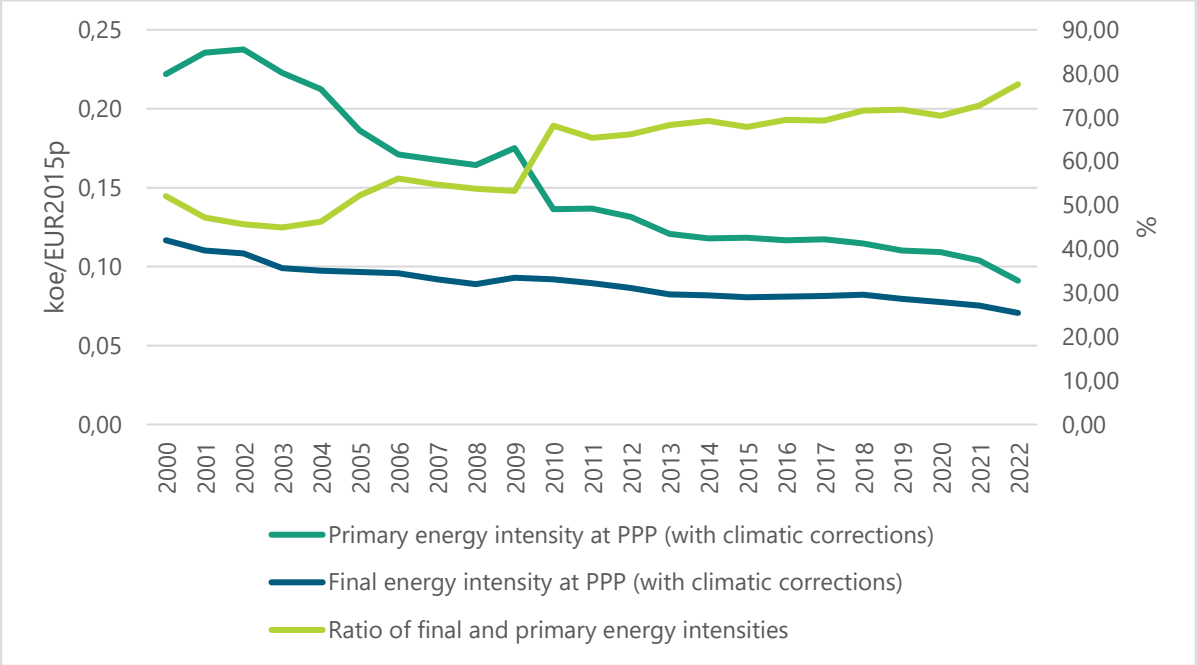


Source: ODYSSEE database

The overall energy efficiency from an economic viewpoint is characterized through the primary and final energy intensities, i.e. the ratio between the energy consumption and the GDP. The final and primary energy intensities (with climatic corrections) had decreased in Lithuania (Fig. 4). Substantial changes in the power sector and the changes in the primary energy balance have led to a significant reduction in the primary energy intensity. The primary energy intensity decreased by 60.0% with an average of 4.0%/year. In 2022, primary energy intensity amounted to 0.09 koe/EUR2015p. The final energy intensity shows a steady decrease of 2.3% annually from 2000 to 2022. The final energy intensity has decreased by 40.0% - from 0.12 koe/EUR2015p in 2000 to 0.07 koe/EUR2015p in 2022.

The ratio of final and primary energy intensities has increased from 52.1% in 2000 to 77.6% in 2022 (Fig. 4). This ratio shows that, on average, less primary energy is needed per unit of final energy consumption.

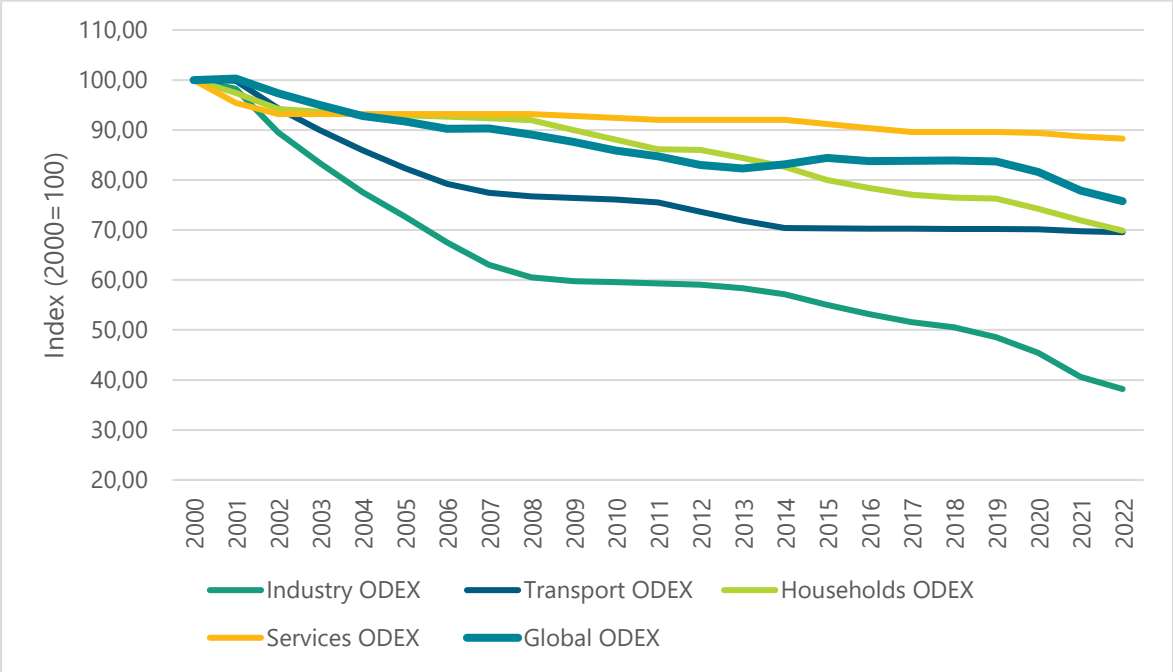
Figure 4: Primary and final energy intensities in Lithuania from 2000 to 2022



Source: ODYSSEE database

An aggregate energy efficiency indicator ODEX, developed in the ODYSSEE database, is used to assess the actual results of energy efficiency policies and measures. This indicator summarizes the measured variations in energy efficiency using a single indicator. The ODEX is calculated for the individual final consumption sectors and the economy as a whole and is corrected for structural changes, temperature influence and similar factors not ascribable to energy efficiency.

Figure 5: Technical energy efficiency index (ODEX) in Lithuania from 2000 to 2022



Source: ODYSSEE database

According to the development of the technical energy efficiency ODEX indicator (Fig. 5), in 2022, the global ODEX in Lithuania was 75.8, which represents an improvement of 24.2% on the overall energy efficiency since 2000, or 1.3% per year. Most of the efficiency progress is observed in the industry (62.0% or 4.3% per year), followed by transport (31.0% or 1.6% per year) and households (30.0% or 1.6% per year). In the service sector, the energy efficiency improvements have been steady (0.6% per year).

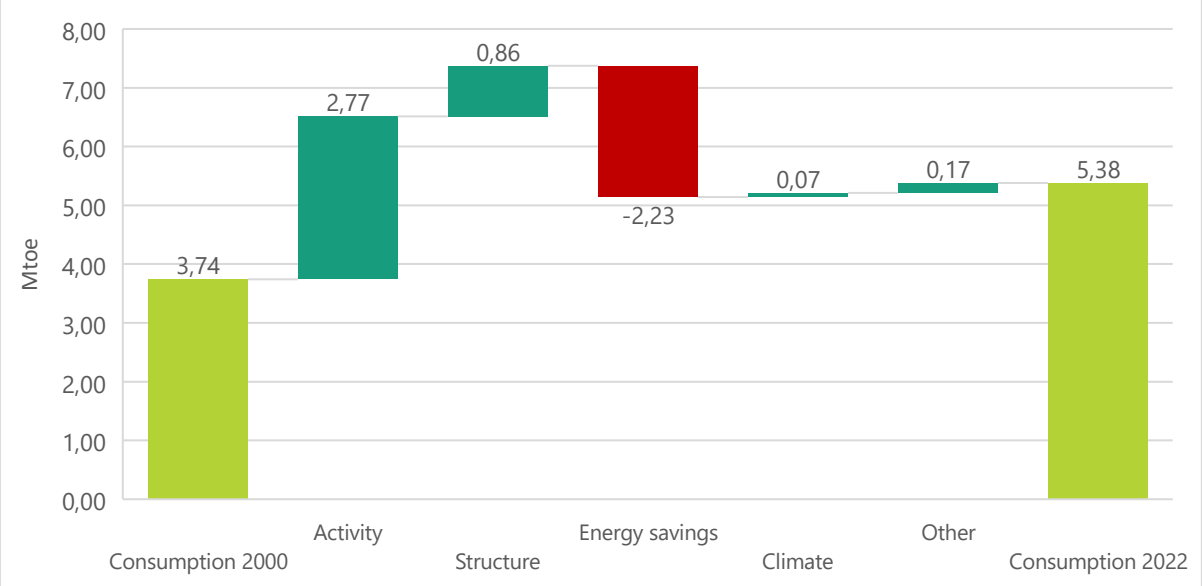
3.1.2 Decomposition of final energy demand

The variation of the final energy consumption between two years can be decomposed into several effects for each end-use sector:

- Activity: change in value added in industry, services, and agriculture, in transport, in the number of dwellings and appliances, and in the size of dwellings for households;
- Structural effects: industry (and services), modal shift in transport;
- Energy savings, which correspond to technical savings and consist of the sum of additional annual energy savings over the period;
- Climatic effect: households and services;
- Other effects: behaviours for households, the value of the product in the industry, labour productivity in services, and "negative" savings due to inefficient operations in industry and transport.

From 2000 to 2022, total final energy consumption in Lithuania increased by almost 1.64 Mtoe (from 3.74 to 5,38 Mtoe) (Fig. 6). The increase was mainly determined by the activity growth (2.77 Mtoe), structural changes (0.86 Mtoe), climate changes (0.07 Mtoe) and other effects (0.17 Mtoe). These increases were not compensated by technical energy savings (2.23 Mtoe). Therefore, the total final energy consumption was 43.7% higher in 2022 than in 2000.

Figure 6: Decomposition of total final energy consumption in Lithuania from 2000 to 2022

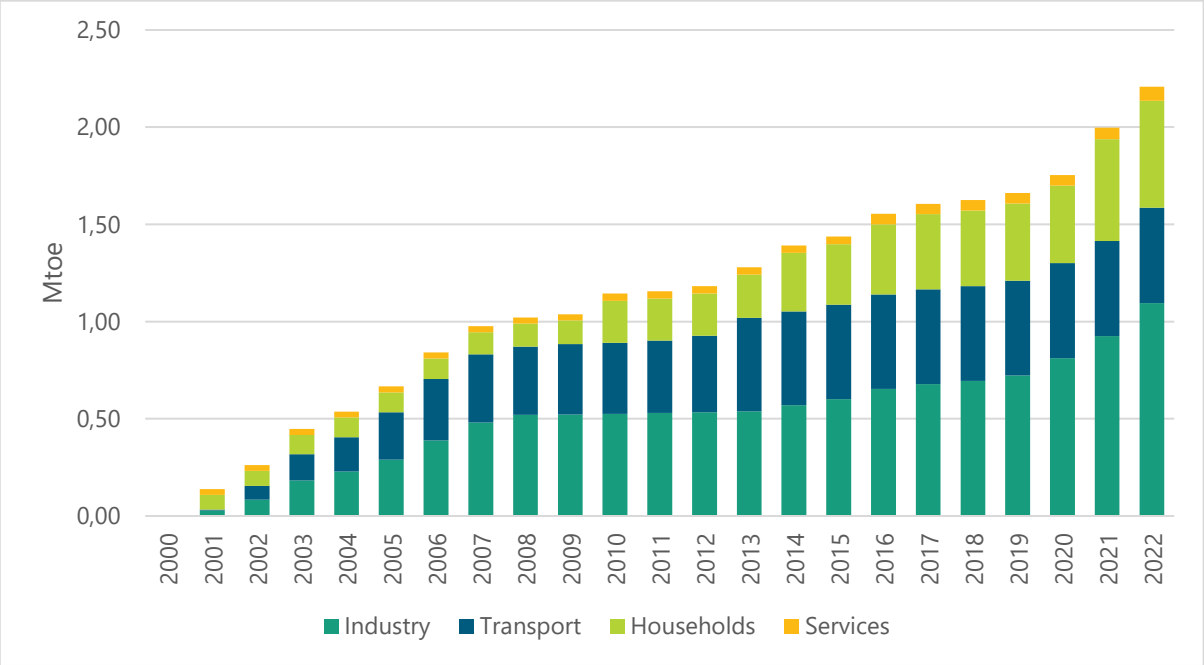


Source: ODYSSEE database

3.1.3 Energy Savings

Energy efficiency progress can also be analyzed by expressing the variations of the ODEX in terms of the amount of energy saved compared to a situation without energy efficiency progress. In ODYSSEE, energy savings represent the effect of a reduction in unit consumption at the level of up to 30 subsectors or end-uses. They are calculated year by year concerning the previous year ("annual new savings"). The savings shown in Figure 7 represent the annual savings cumulated since 2000 ("cumulative new energy savings").

Figure 7: Final energy savings in Lithuania from 2000 to 2022



Source: ODYSSEE database

The cumulated energy savings between 2000 and 2022 reached 2.21 Mtoe in Lithuania (Fig. 7). Without them, the final energy consumption would have been 30.0% higher in 2022 than in the year 2000. The industry played a significant role, as its no-consumed energy represents half of the total cumulated savings since 2000. The household and transport sectors each accounted for 25.0% of the total cumulated savings.

3.1.4 Comparison with other countries

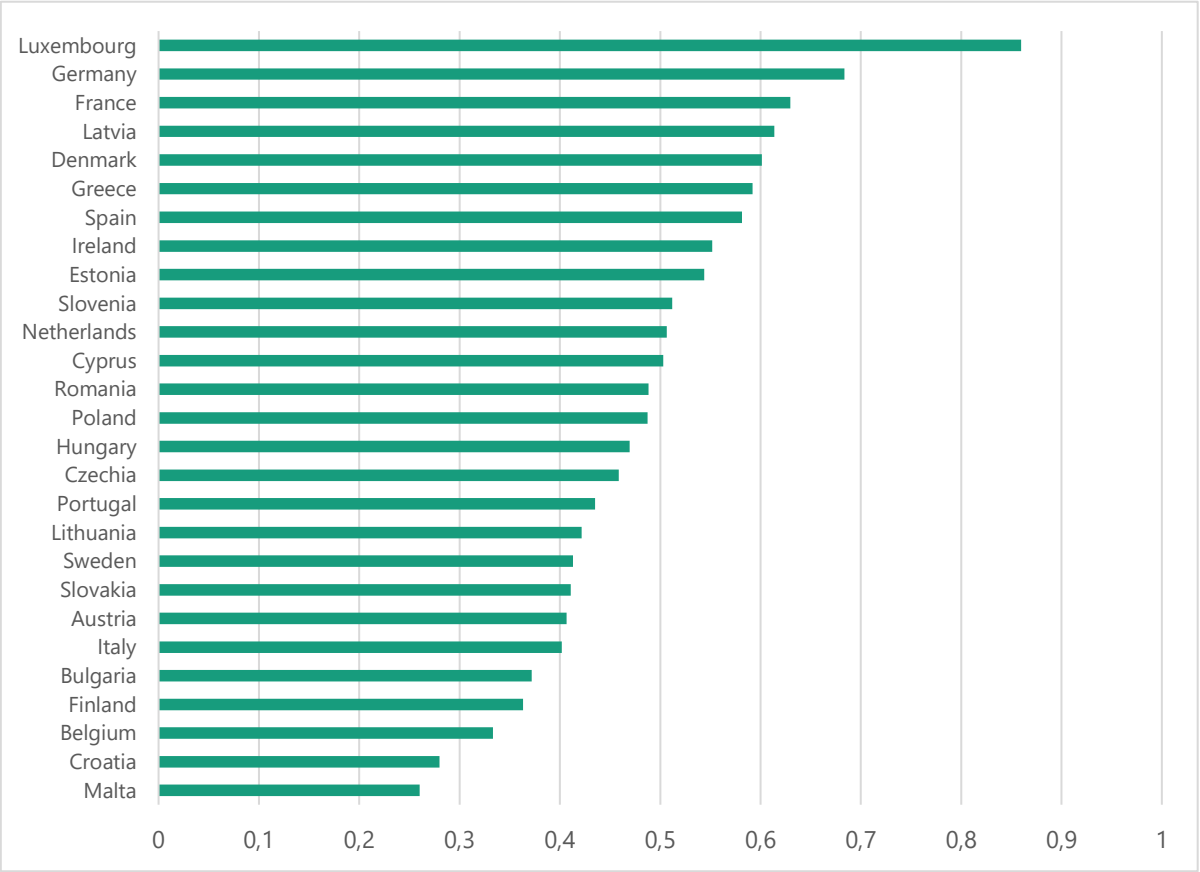
The objective of the ODYSSEE-MURE scoreboard[2] on energy efficiency indicators and policies is to score EU countries on different energy efficiency criteria:

- the energy efficiency level,
- the energy efficiency progress,
- the energy efficiency policies,
- a combination of all these criteria.

[2] https://www.odyssee-mure.eu/data-tools/scoring-efficiency-countries.html

The cumulated energy savings led Lithuania to the 18th position in terms of overall energy efficiency level out of the 27 countries that are part of the ODYSSEE-MURE project (Fig. 8). However, Lithuania ranks in second place considering the energy efficiency level but only 25th position considering the energy efficiency progress.

Figure 8: Overall energy efficiency score (2022)



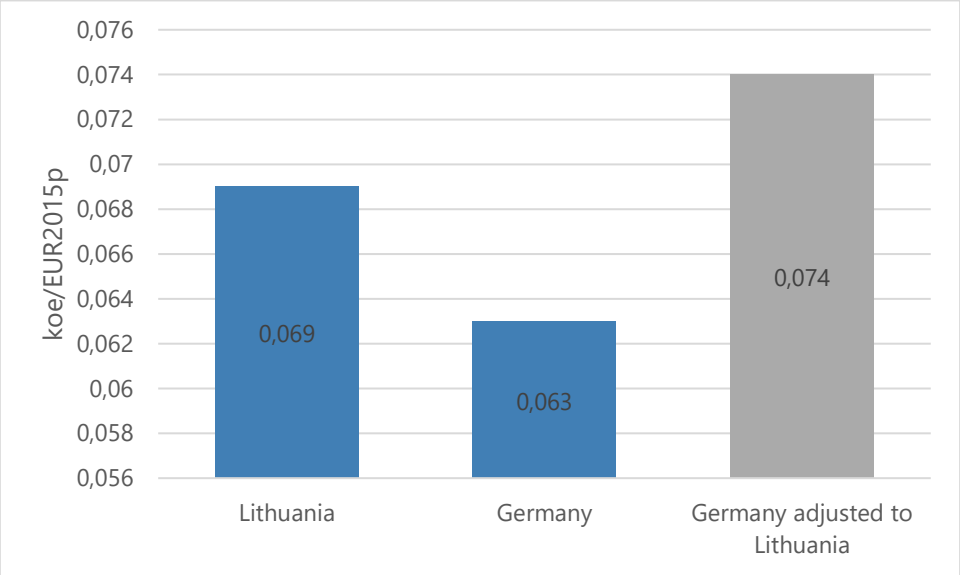
Source: ODYSSEE database

To understand a country's position in the energy efficiency scoreboard (Fig. 9), Lithuania can be compared with another country, for instance, with one that performed better globally (for example, Germany).

The comparison tool[3] enables a benchmark between the energy efficiency performances of one country and selected others based on adjusted indicators by sector and end uses. For the cross-country comparisons, energy consumption values are scaled to the climate and/or the power/fuel mix of the reference country. Adjustments to the same monetary units and cost-of-living as well as to the same economic structures are also considered. This allows a comparison of differences in technical performance between countries.

[3] https://www.indicators.odyssee-mure.eu/benchmarking.html

Figure 9: Final energy intensity adjusted to climate and GDP structure (2022)



Source: ODYSSEE database

3.2 Cross cutting energy efficiency policies

13 cross-cutting energy efficiency-related policies are included in the MURE database for Lithuania, the most important of which are performance testing, energy audits, eco-design, labeling, and other policies, including ones defined by EU Directives.

The **performance testing** requirements are defined by the Regulation on increasing the energy efficiency of heating systems and combined heating and ventilation systems installed in buildings with a nominal output power greater than 70 kW and the Regulation on increasing the energy efficiency of building air conditioning or combined air conditioning and ventilation systems with a nominal output power greater than 70 kW. The respective methodology for heating systems is approved to check that the heating system and the combined heating and ventilation system devices are properly adjusted, functioning, and maintained in such a way as to maximize their efficiency, to evaluate the current thermal and/or energy efficiency of parts of the heating system and combined heating and ventilation system and compare them with boiler efficiency limit values and analogs of the most efficient heating system and parts of the combined heating and ventilation system available on the market, as well as to develop recommendations on how to increase the efficiency of the heating system and the combined heating and ventilation system and optimize its utility under typical or average conditions. During the energy efficiency check of the air conditioning and the combined air conditioning and ventilation system, the testing is carried out on the compliance with the air conditioning and combined air conditioning and ventilation system project and its changes and the purpose of the building's air-conditioned premises; the efficiency and size of the air conditioning and combined air conditioning and ventilation system relative to the cooling needs of the building; functioning; management and control status; installation quality and performance of assemblies and assemblies; energy efficiency; potential effluent of fluorinated greenhouse gases.

Energy audits are carried out following the supervision procedure for conducting energy consumption audits and reporting for companies that are not small and medium-sized businesses; the application evaluation procedure of educational institutions wishing to hold specialized training

courses for specialists performing audits in energy consumption buildings and/or technological processes and devices; the description of the procedure and conditions for conducting audits of energy consumption in buildings, facilities and technological processes and the procedure for training and certification of specialists performing audits of energy consumption in buildings, facilities and technological processes; the granting the right to hold training courses for specialists performing audits of energy consumption devices and technological processes; the rules regarding the establishment of an attestation commission for persons seeking to obtain auditor qualifications for conducting audits of energy consumption in buildings, facilities and technological processes; the methodology for performing an audit of energy, energy resources and water consumption in technological processes and facilities, the methodology for conducting a detailed audit of energy, energy resources and cold water consumption in public buildings.

Labeling regulations are relevant. They are applied for many equipment and devices, including solid fuel boilers and sets consisting of a solid fuel boiler, additional heaters, temperature controllers and solar energy devices (2015), local space heaters (2015), industrial refrigeration cabinets (2015), energy-related products (2014), household tumble dryers, electric lamps and luminaires, air conditioners, household dishwashers, household refrigerators, household washing machines, television sets (2014), residential ventilation devices (2014), domestic ovens and hoods (2014), space heaters (2013), water heaters and other that have significant energy saving potential.

Eco-design regulations are of high importance. They establish tolerances used in inspections (2016). Eco-design regulations are applied for air heating products, cooling products and high-temperature technological coolers and fan convectors (2016), solid fuel boilers (2015), local space heaters (2015), solid fuel local space heaters (2015), industrial refrigeration cabinets, blast cabinets, condensing units and process chillers (2015), ventilation equipment (2014), transformer (2014), domestic ovens (2014), office equipment (2013), directional lamps, LED lamps (2012) and many other items which have a high volume of sales and trade, which have a significant impact on the environment and which would have a high potential for reducing environmental impact without excessive costs if their construction was improved.

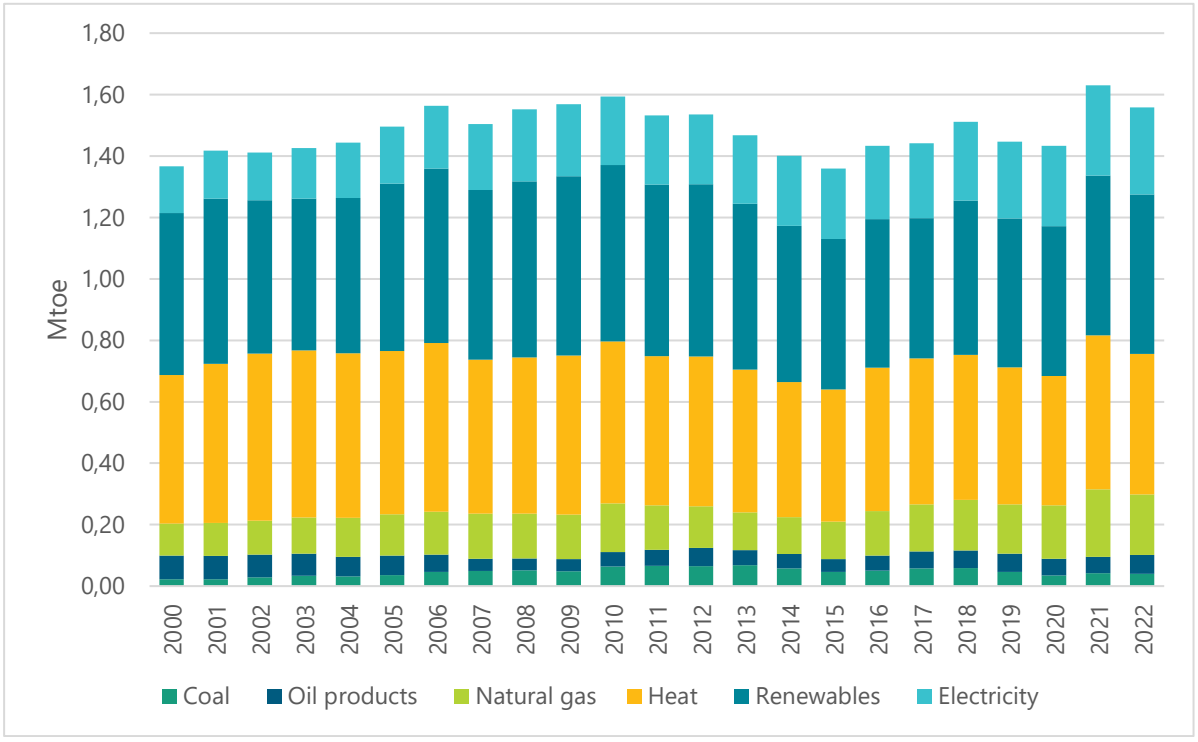
Other legal acts are relevant in the area. They define the procedure for concluding energy-saving agreements and establishing rules for providing information related to energy activities to state institutions, institutions, and third parties. Legal acts fix that procuring organizations are subject to energy efficiency requirements for goods, services and buildings. They form the list of goods, except for road vehicles, which are subject to energy efficiency requirements during public procurement and provide a description of the procedure for calculating and maintaining the saved energy of measures to increase energy efficiency.

4 Sectoral energy efficiency progress and policies

4.1 Residential sector

Final energy consumption in the residential sector from 2000 to 2022 increased by around 14%, while electricity consumption increased essentially – by 86.0%. The most significant change in the final energy consumption, next to the above-mentioned increase in electricity consumption, was the consumption increase of natural gas – by almost 90.0% and decrease of district heating – by 5.4% and wood fuel – by 1.4%. In 2022, wood fuel dominated the structure of final energy consumption by accounting for 33.0%. In 2022, fuel consumption decreased by 4.0% compared to 2021 due to climatic conditions. In 2022, 1.56 Mtoe of final energy was consumed in the residential sector.

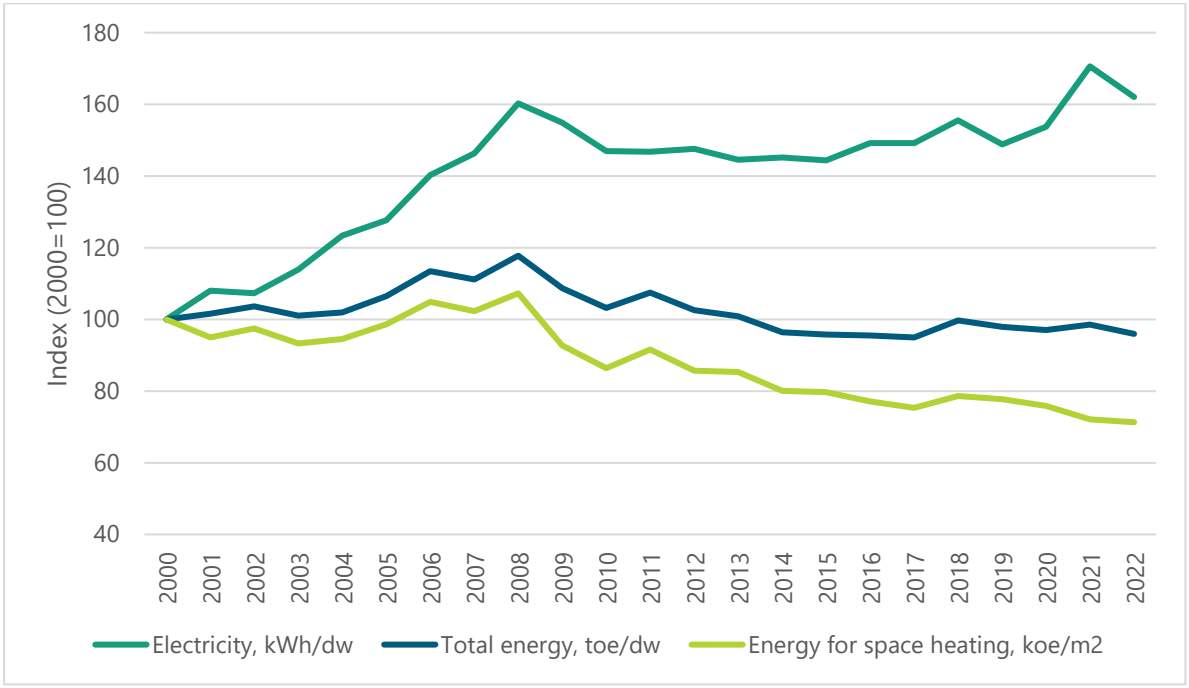
Figure 10: Final energy consumption in residential sector (not climate corrected) from 2000 to 2022



Source: ODYSSEE database

Unit consumption for total energy per dwelling, electricity consumption per dwelling, and energy consumption per m^2 for space heating are presented in Figure 11. The electricity consumption per dwelling (kWh per dwelling) show increase by 62.0% since 2000. The growing number of appliances (e.g. PCs, dishwashers, freezers, washing machines and other small appliances) utilized in households is the main reason of the increased electricity consumption. Space heating is the most important end-user in the residential sector. Energy consumption per m^2 precisely describes changes in the energy efficiency in household sector. The energy consumption per m^2 for space heating decreased by almost 30.0%. In 2022, energy consumption per m^2 for space heating amounted to 9.77 koe/m^2 in Lithuania and was about 6% higher in comparison to the EU countries average. The reduction in the space heating consumption per m^2 was influenced by several factors: the penetration of new buildings, which are much more efficient than old stock of buildings, the renovation of existing old dwellings, the use of more efficient heating appliances and etc. The total energy consumption per dwelling decreased by 4.0%.

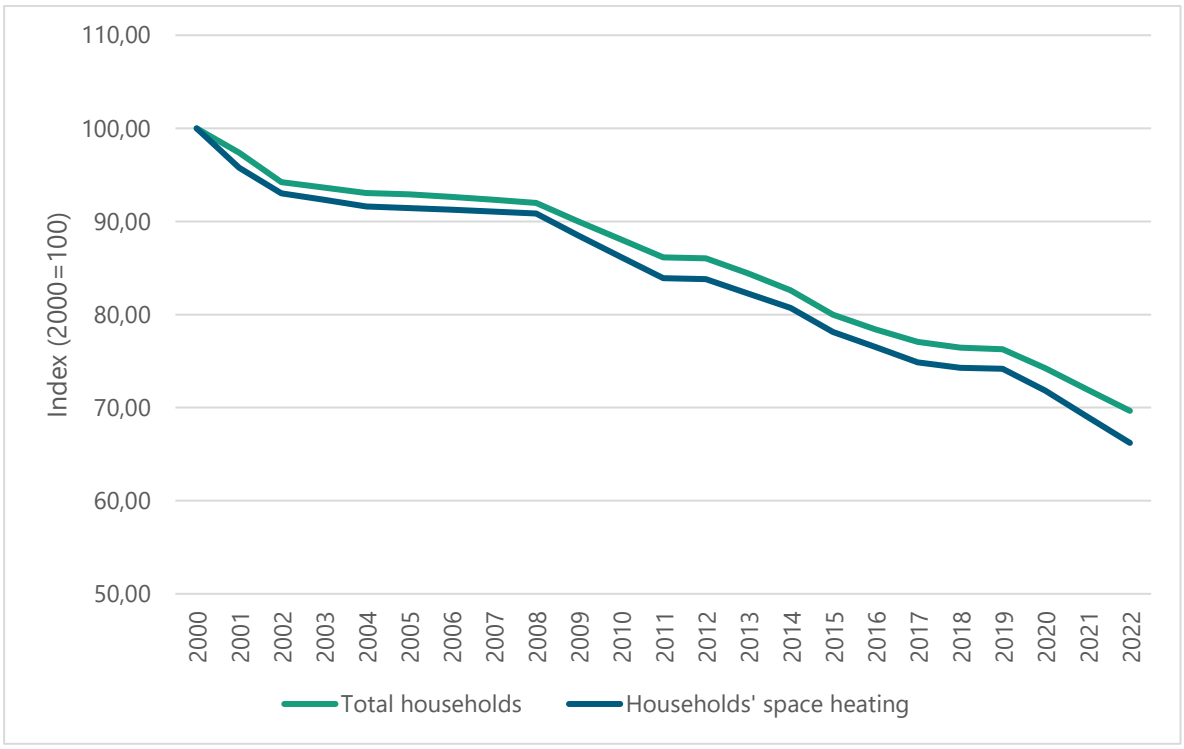
Figure 11: Unit consumption of households (total energy, electricity, and energy for space heating) from 2000 to 2022



Source: ODYSSEE database

For the residential sector, the bottom-up energy efficiency index (ODEX) is calculated at the level of the total household sector and household space heating (Fig. 12).

Figure 12: Energy efficiency index of households from 2000 to 2022



Source: ODYSSEE database

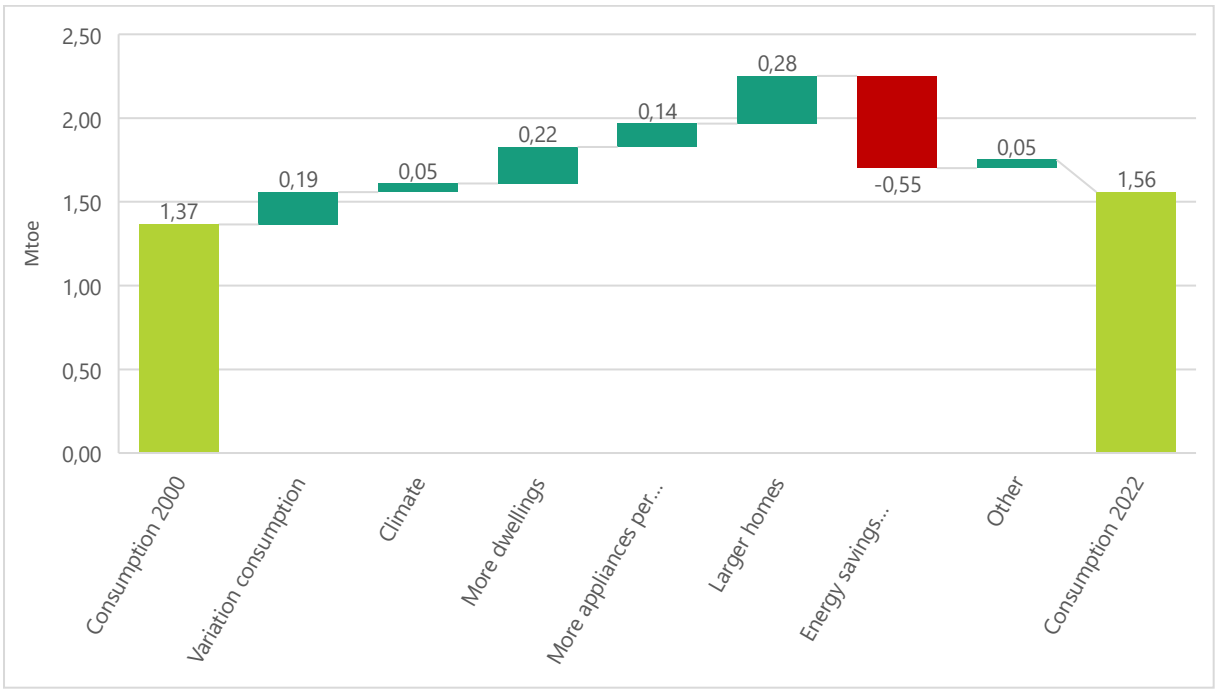
The technical ODEX in the household sector decreased by about 30.0% compared to 2000, representing an average energy efficiency improvement of 1.6% per year. The heating sector strongly influences the development of the household ODEX. The energy efficiency index of households' space heating decreased by almost 34.0% compared to 2000, or 1.9% per year.

Figure 13 decomposes the changes in final energy consumption from 2000 to 2022. The variation in the households' energy consumption is explained by:

- Climatic difference between two dates ("climate");
- Change in the number of occupied dwellings ("more dwellings");
- Change in the appliances ownership ("more appliances per dwelling" for electrical appliances and central heating);
- Change in the average floor area per dwelling ("larger homes");
- Energy savings (measured from technical ODEX);
- Other effects: increased consumption of ambient heat, which contributes to higher consumption, and changes in heating behaviour, which have tended to reduce consumption in recent years.

Over 2000-2022, the residential sector perceived an increase of around 0.19 Mtoe in total energy consumption (from 1.37 to 1.56 Mtoe). The residents' choice to have larger homes (0.28 Mtoe), the increased number of dwellings (0.22 Mtoe), the increased number of appliances (0.14 Mtoe), the climate (0.05 Mtoe), and some other reasons (0.05 Mtoe) explained the increasing energy consumption in residential dwellings. Technical energy savings did not fully compensate for these increases (0.55 Mtoe). Therefore, the total residential energy consumption was 14.0% higher in 2022 than in 2000.

Figure 13: Decomposition of final energy consumption in the households from 2000 to 2022



Source: ODYSSEE database

Intending to increase energy efficiency, Lithuania implements programs and measures in the residential sector. Historically, 21 programs and measures have been implemented in Lithuania. Today the most relevant energy efficiency policies and measures in the building sector are:

- **Programme for Renovation of Multifamily Buildings**. It aims to improve energy efficiency in multifamily buildings constructed before 1993. The programme supports renewal (modernization) of heating and/or hot water systems, installation of facilities producing energy from RES (solar, wind, geothermal or aerothermal energy), repair or reconstruction of the ventilation system, insulating the roof, repairing or installing a rain drainage system, renewal, replacement or installation of lightning protection, replacement of windows in common rooms and/or replacement of common external doors (entrance, vestibule, balconies, basement, container room, heat point, garage), replacement of windows and balcony doors of apartments and other rooms with windows of lower thermal conductivity, insulation of the basement floor or insulation of the floors of common rooms, renovation (modernization) of elevators by replacing them with technically more energy-efficient elevators, including adaptation of the elevator to the needs of the disabled., renovation (modernization) of general use electrical engineering system and/or lighting system (replacement of electrical cables, installation of light emitting diode (LED) lighting and automatic lighting control system). The Government supports energy efficiency measures and related activities by covering 100% of expenses for the preparation of the project or its part; 100% project implementation administration and construction maintenance costs; 30% of investments falling on energy efficiency improvement measures; 10% additional state support (from the cost of implementing the measures mentioned below), when a separate or modernized existing non-automated heat point is installed in an apartment building during the renovation project; 100% expenses for poor residents for the preparation of the renovation project, including supervision of the execution of the renovation project and the performance of the renovation project expertise, when it is mandatory according to the Construction Law, its implementation administration, construction maintenance costs, credit insurance premium, monthly credit and interest payments; a preferential credit is also granted, the part of which annual interest exceeding 3% is paid for five years from the date of disbursement of the first part of the credit. Till January 2024, a total of 3743 multifamily buildings were renovated.
- **Programme for Climate Change**. It finances several measures. In 2024, the 5th invitation was announced to renew old, inefficient heat points. Representatives of multi-apartment buildings and heat suppliers were invited to submit applications for support and renovation of internal heating and hot water systems. The main objective of the measure is to reduce GHG emissions in the household sector and increase energy efficiency. 20 million EUR are provided. State support is allocated for replacing heat points with a new automated heat point, including installing balance valves on heating and hot water risers. These are mandatory activities to be implemented during the Project. Also it supports remodeling or replacement of the heating system (including replacement of radiators, installation of thermostatic valves, replacement of pipelines and/or insulation of pipelines, preparation of balance valves); installation of individual heat metering devices or a system of heat dividers and/or installation of smart metering that enables simultaneous reading from dividers and hot water meters in apartments; remodeling of the hot water system, replacement of related elements (towel dryers, etc., including replacement of pipelines and/or pipelines insulation).

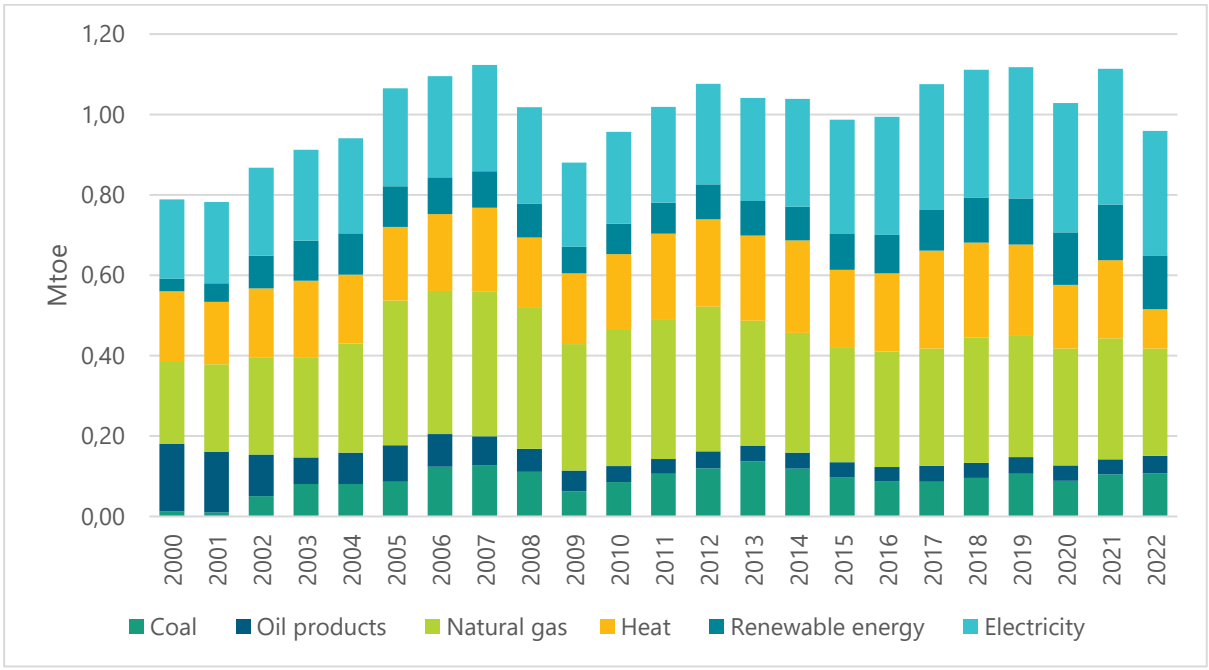
Since 2020, the installation of renewable energy sources in apartment buildings has been financed by the programme. Governmental support was 30%.

– **EU Structural Funds 2021-2027**. Presently, support is provided for the acquisition of the solar power part of natural persons from the parks, installation of private solar power plants in households (increasing the power of an already existing power plant), installation of private solar power plants in households (newly installed solar power plant), pilot panel renovation, renovation of apartment buildings, change of boilers in households, prosumers' investment into development of RES-E production capacities in Lithuania.

4.2 Industry sector

In 2022, the total final energy consumption of industry (consisting of manufacturing, construction, and mining) amounted to 0.96 Mtoe, which was 22.0% higher than the consumption of 0.79 Mtoe in 2000 (Fig. 14). Natural gas and electricity are the main energy sources used in industry. From 2000 to 2022, natural gas has contributed 25.0–36.0% of total energy used in industry and electricity – 23.0-32.0%. In 2022, electricity accounted for 32.2%, natural gas – 27.8%, renewables – 14.0%, oil products – 4.6%, coal – 11.1%, and heat – 10.2% in the total structure of fuel consumption.

Figure 14: Final energy consumption in the industry from 2000 to 2022

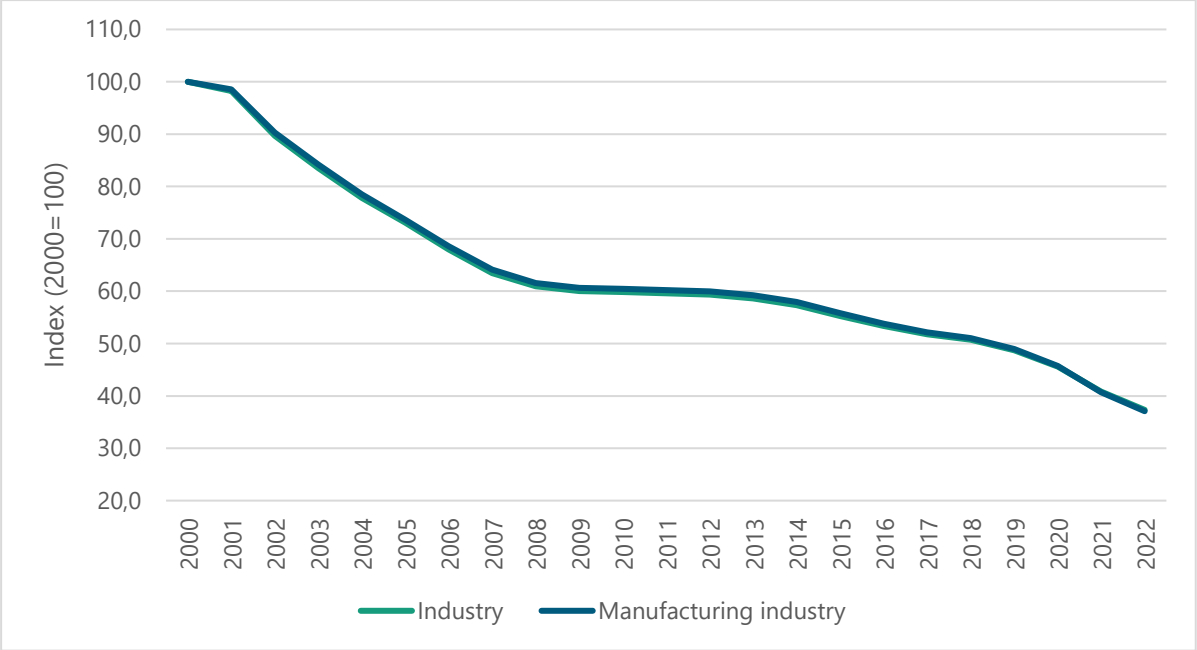


Source: ODYSSEE database

The most important energy consumer in the manufacturing industry is the chemical industry. In 2022, its share was 25.0%, followed by non-metallic minerals - 19.0%. The final energy consumption in the chemical industry has been increasing by 1.8% per year during the period.

In 2022, the technical energy efficiency index (ODEX) amounted to 37.3, which means an energy efficiency improvement of almost 62.0% compared to the base year 2000 in the industry (Fig. 15). The efficiency progress of the adopted technology over the past 22 years shows the same improvement in energy efficiency in the manufacturing industry.

Figure 15: Energy efficiency index of industry from 2000 to 2022



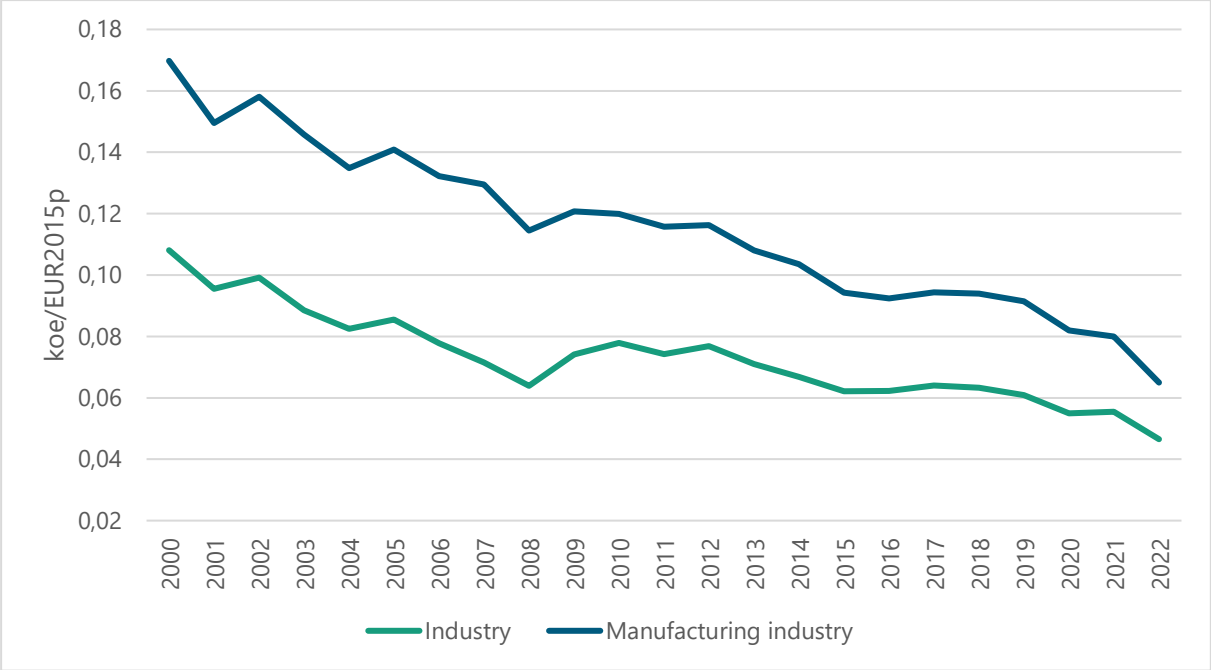
Source: ODYSSEE database

The aggregate energy consumption indicator describes energy efficiency in the industry compared to VA per branch, i.e. energy intensity (Fig. 16). There is an expanding decoupling of these two variables. The final energy intensity in the industry between 2000 and 2022 dropped by 57.0% (3.8%/year) and in the manufacturing industry by 62.0% (4.3%/year).

In 2022, the final energy intensity in the industry was 0.05 koe/EUR2015p. The final energy intensity in manufacturing decreased from 0.17 koe/EUR2015p in 2000 to 0.06 koe/EUR2015p in 2022.

In 2022, the final energy intensity in the Lithuanian manufacturing industry was about 30.0% lower than the average in EU countries.

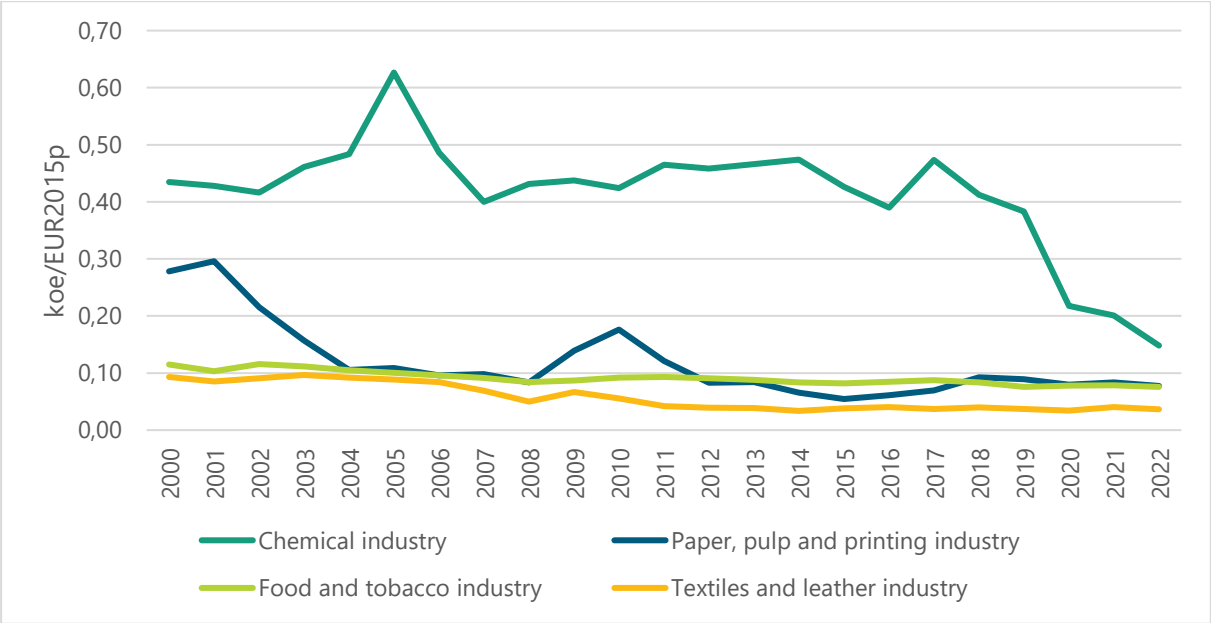
Figure 16: Energy intensity in industry and manufacturing from 2000 to 2022



Source: ODYSSEE database

The most representative branches of the manufacturing sub-sector showed an improvement (Fig. 17) in energy intensity. The most significant improvements in energy intensity were in the paper and chemicals branches. The final energy intensity in the paper, pulp, and printing industry has decreased from 0.28 koe/EUR2015p in 2000 to 0.08 koe/EUR2015p in 2022 with an average of 5.7%/year. The final energy intensity in the chemicals industry has decreased from 0.43 koe/EUR2015p in 2000 to 0.15 koe/EUR2015p in 2022 with an average of 4.8%/year.

Figure 17: Energy intensity in manufacturing branches from 2000 to 2022



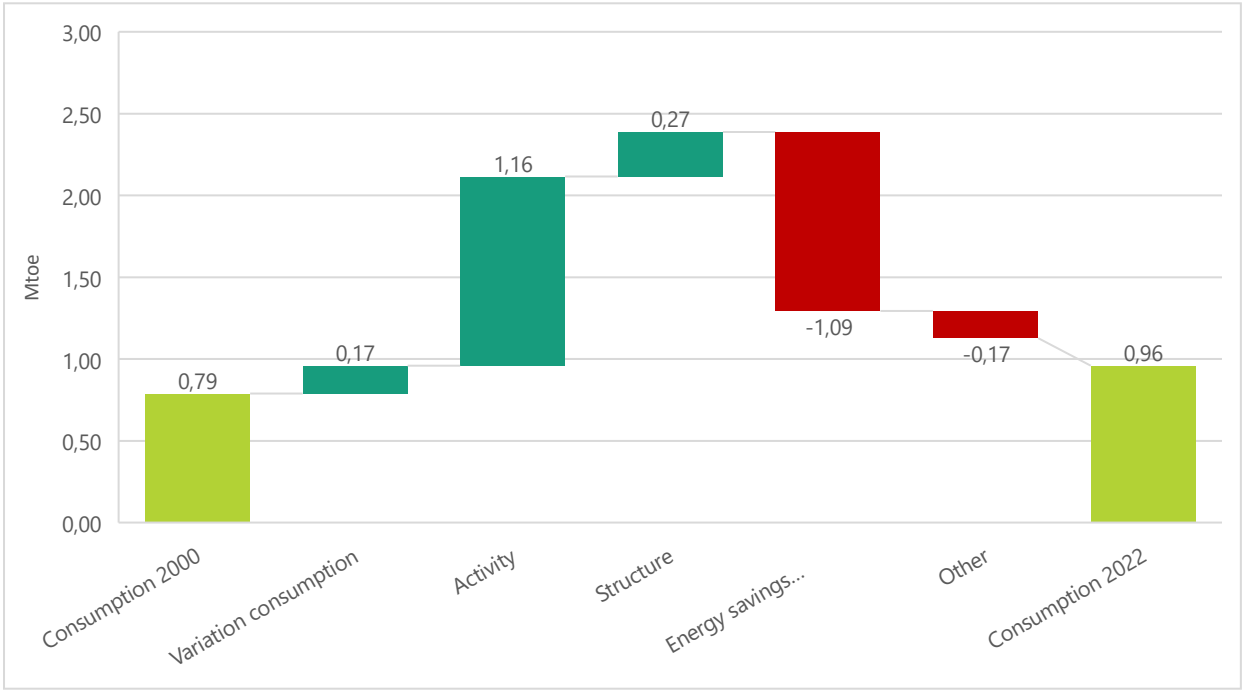
Source: ODYSSEE database

Figure 18 displays a decomposition analysis in industry for the period 2000 to 2022. The following factors explain the variation of industrial energy consumption:

- Change in industrial activity (measured with the production index) ("activity effect");
- Structural changes between the main industrial branches ("structural effect");
- Energy savings calculated from changes in energy consumption per unit of production at the branch level;
- Other effects are structural changes within branches and, in times of recession, "negative" savings due to inefficient operations in the industry.

In 2022, the industry sector represented about 17.0% of the final energy consumption in Lithuania. The final energy consumption in industry was 0.17 Mtoe higher in 2022 than in 2000 (Fig. 18). Industry economic growth and structural changes pushed up the energy consumption (by 1.16 Mtoe and 0.27 Mtoe respectively). These effects were not fully offset by energy savings (1.1 Mtoe) and other effects (0.17 Mtoe).

Figure 18: Decomposition of final energy consumption in the industry from 2000 to 2022



Source: ODYSSEE database

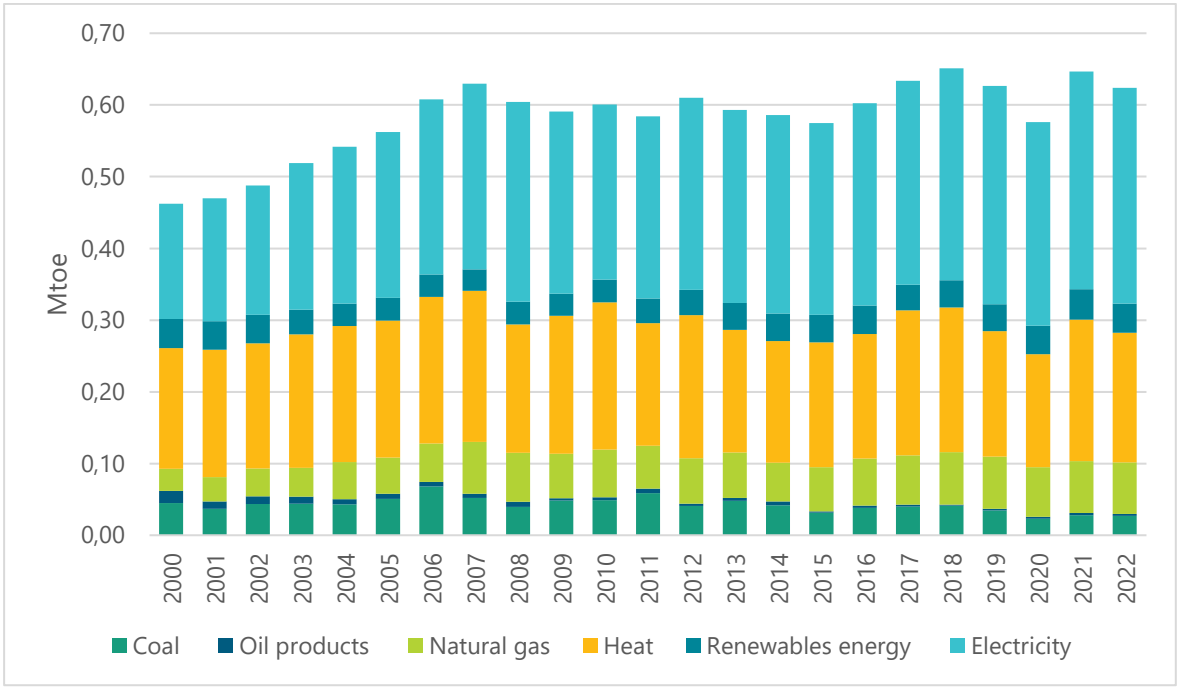
Lithuania implements programs and measures in the industrial sector to increase energy efficiency. Historically, 14 programs and measures have been implemented in Lithuania. They focused on financial incentive measures for energy efficiency, CHP, and investments in clean fuels and generation capacities (renewables and waste). The EU Structural Funds, the Lithuanian Environment Investment Fund, and the Special Programme for Climate Change provided investment subsidies and partial interest compensation for energy efficiency and renewable energy projects. The financial resources were oriented towards improving energy production efficiency by supporting more efficient cogeneration and heat supply systems. Today, the industrial sector's most relevant energy efficiency policies and measures are **EU Structural Funds 2021-2027**. Presently, investment sup-

port is provided to onshore wind power plants, solar PV power plants on land, and individual electricity storage devices. Funds are used to develop building data banks, promote shield production, and encourage companies to move towards a climate-neutral economy.

4.3 Service sector

The total energy consumption in the service sector increased from 0.46 and 0.62 Mtoe (not climate-corrected) from 2000 to 2022 (Fig. 19). Significant increase occurred in electricity and natural gas consumption. From 2000 to 2022, natural gas consumption increased on average by 3.9% annually and electricity – by 2.9% annually. In 2022, electricity accounted for 48.2%, heat – 29.0%, natural gas – 11.5%, renewables – 6.6%, coal – 4.3%, and oil products – 0.4% in the total structure of fuel consumption.

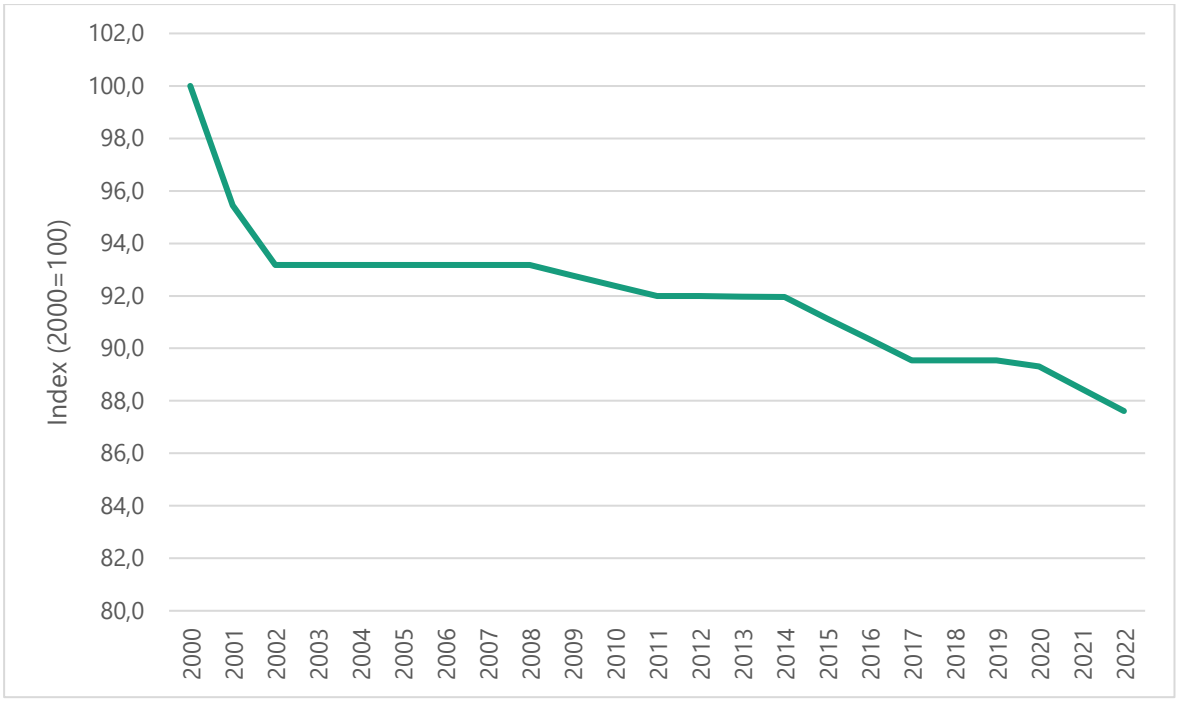
Figure 19: Final energy consumption in the service sector from 2000 to 2022



Source: ODYSSEE database

In 2022, the technical energy efficiency index (ODEX) amounted to 87.6, which means an energy efficiency improvement of almost 12.4% compared to the base year 2000 in the service sector (Fig. 20).

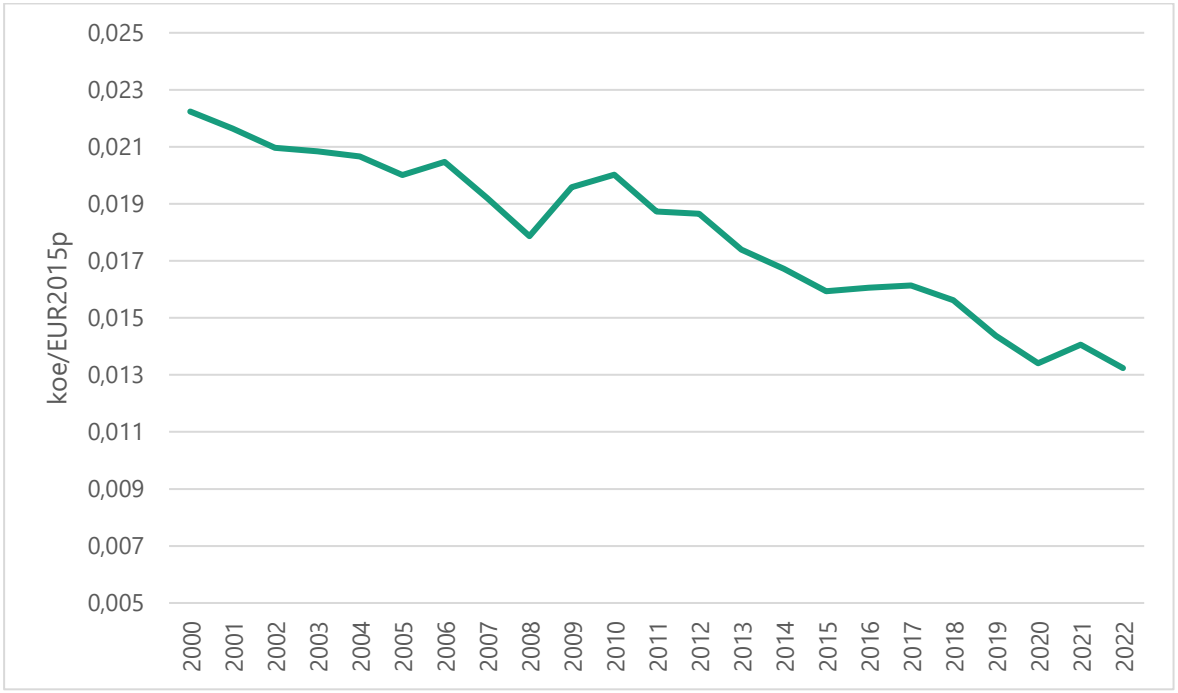
Figure 20: Energy efficiency index of service sector from 2000 to 2022



Source: ODYSSEE database

The energy intensity per VA in the services sector (Fig. 21) decreased by 40.0%, but electricity intensity decreased by 18.0%. The energy intensity in the service sector has been decreasing on average by 2.3% annually and reached the EU average (0.013 koe/EUR2015p) in 2022.

Figure 21: Energy intensity in the service sector from 2000 to 2022

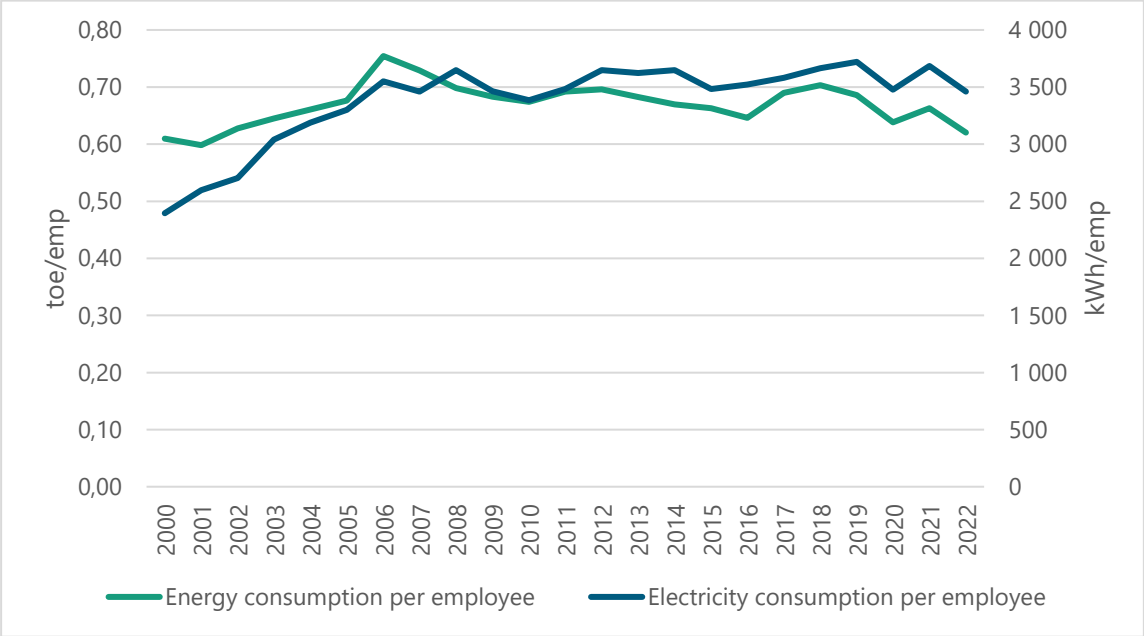


Source: ODYSSEE database

The electricity consumption per employee has been increasing by 1.7%/year since 2000 due to the growing number of new electrical appliances, such as IT devices, telecommunication devices, and

air conditioning. This trend is not only observed in Lithuania but in almost all EU countries. The total energy consumption per employee has increased by 0.1%/year over the same period (Fig. 22).

Figure 22: Unit consumption per employee from 2000 to 2022



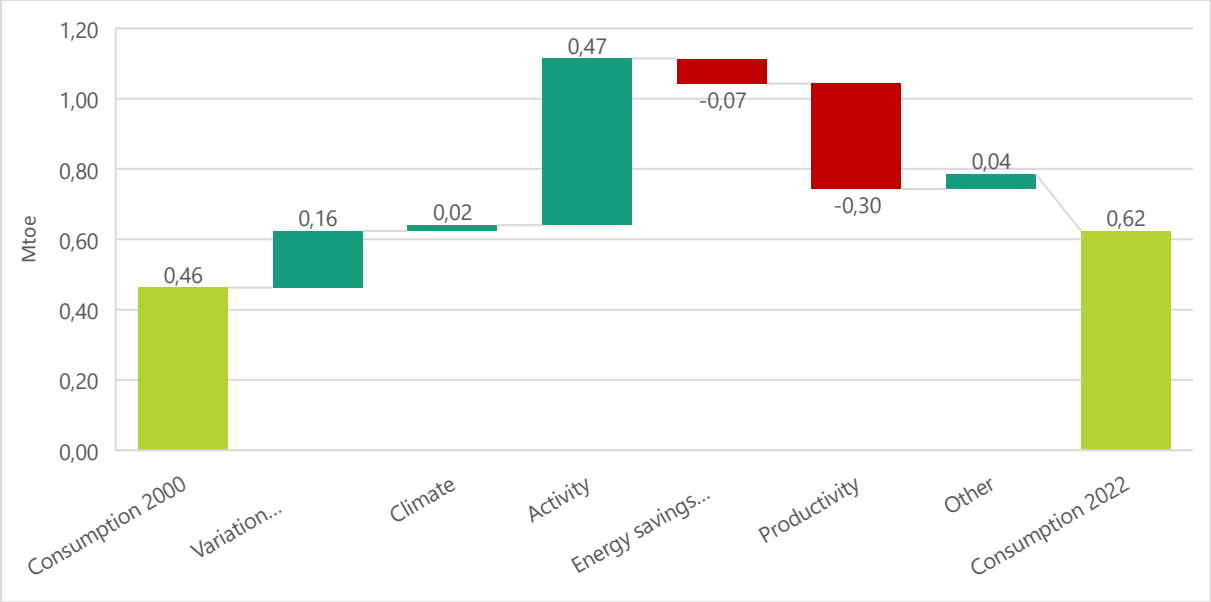
Source: ODYSSEE database

Figure 23 represents a decomposition analysis of the service sector from 2000 to 2022. The variation of the energy consumption of services is explained by:

- Climatic difference between years t and t_0 ("climatic effect");
- Change in economic activity, measured with the value-added ("activity effect");
- Technical energy savings, measured from changes in energy use per employee;
- Changes in labour productivity, i.e. changes in the ratio value added per employee;
- Other effects, i.e. behavioural effects and "negative savings".

From 2000 to 2022, the service sector perceived an increase of around 0.16 Mtoe in total energy consumption (from 0.46 to 0.62 Mtoe). The decomposition analysis showed that the increase in energy consumption was mainly determined by the growth of economic activity (0.47 Mtoe) and less by the climate (0.02 Mtoe) and some other reasons (0.04 Mtoe). The increase in energy consumption was largely but not fully compensated by productivity increase (0.3 Mtoe) and technical energy savings (0.07 Mtoe).

Figure 23: Decomposition of final energy consumption in the service sector from 2000 to 2022



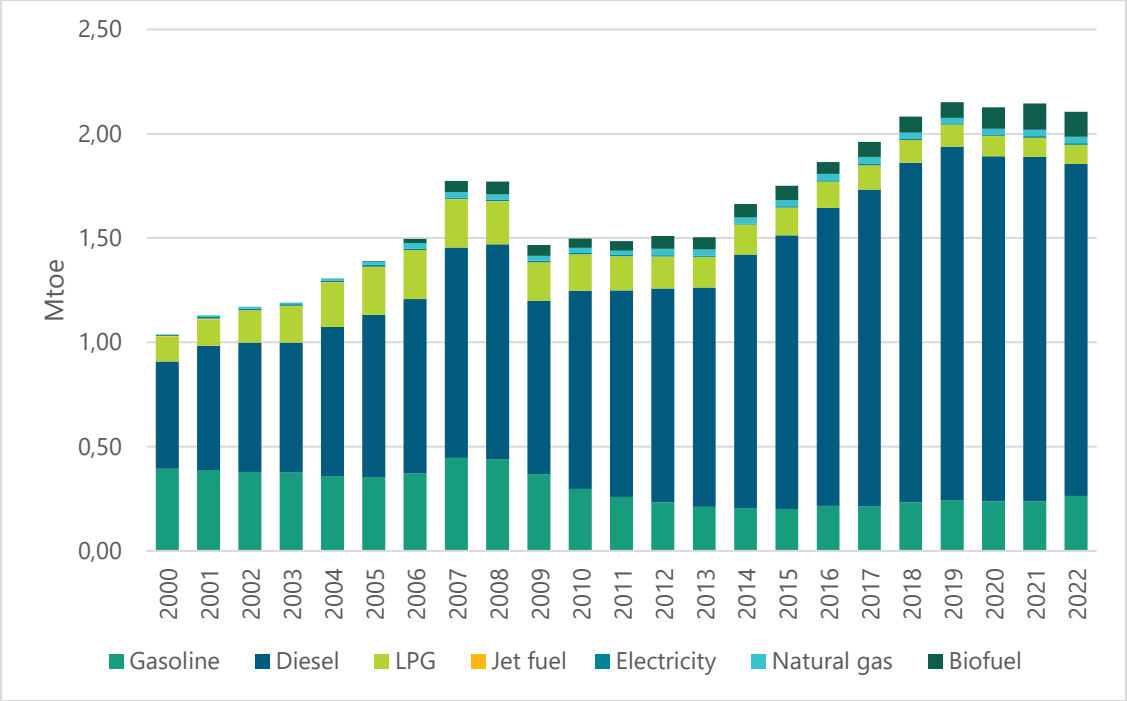
Source: ODYSSEE database

Lithuania intends to increase energy efficiency and implement programs and measures in the service sector. Historically, 11 programs and measures have been implemented in Lithuania. The financial measures were provided for the modernization of public buildings under the Programme for Renovation of Public Buildings at National and Regional Levels, the Modernization Programme for High Schools and Vocational Training Dormitories, the Modernization Programme for Buildings of Educational Institutions Reducing Energy Consumption Costs, the Climate Change Programme, the Programme for Ignalina Public Buildings, the Projects for Municipality Public Buildings. Financial resources from the State, municipal budgets, EU Structural Funds, and others were used to upgrade buildings. Presently, the **EU Structural Funds 2021-2027** are most relevant. They focus on the **Digitalization of building renovation**. The former measure funds the creation and implementation of digital methodological tools for planning green and innovative energy efficiency measures in renovated buildings and for the administration of renovation projects.

4.4 Transport sector

In the transport sector, the final energy consumption increased twice from 1.04 Mtoe in 2000 to 2.11 Mtoe in 2022 (Fig. 24). The annual growth rate of final energy consumption in transport was 3.3%. Diesel is the main fuel in transport final energy consumption, its share increased from 49.4% in 2000 to 75.3% in 2022. It has had a yearly increase of 5.3% over the whole period. On the contrary, the highest annual consumption reduction (-1.8%) is attributed to motor gasoline. Motor gasoline accounted for about 12.4%, LPG – 4.4%, and biofuels about 5.7% of the energy consumption in 2022.

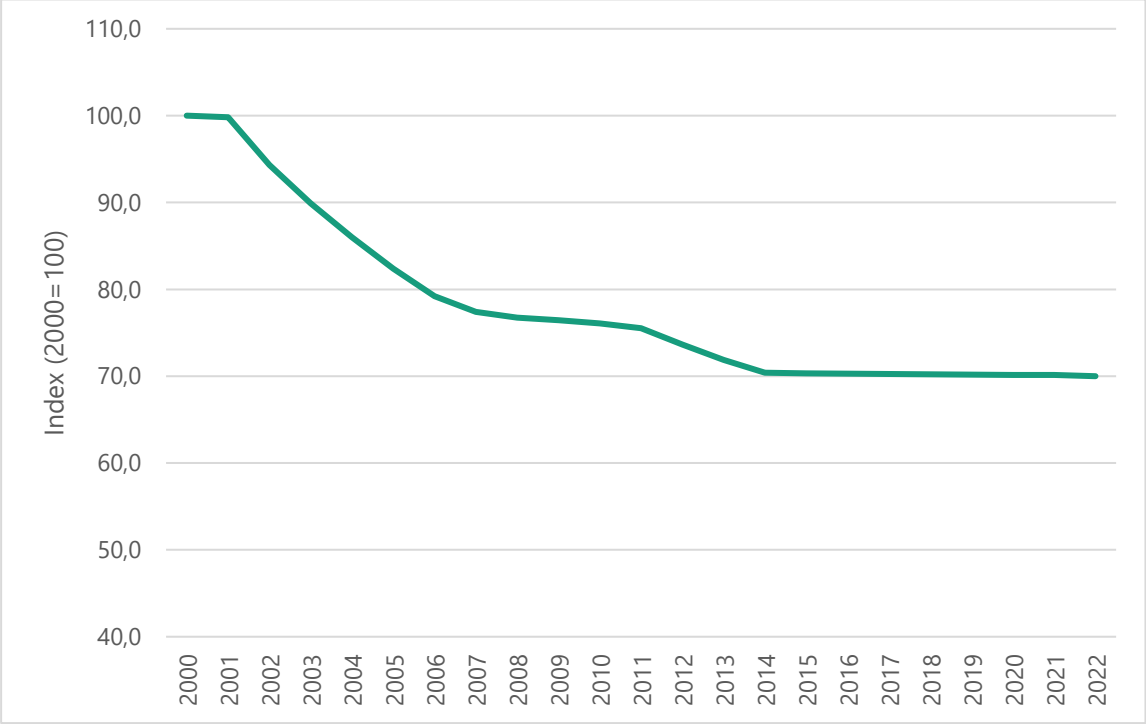
Figure 24: Final energy consumption in the transport sector from 2000 to 2022



Source: ODYSSEE database

In 2022, the technical energy efficiency index (ODEX) amounted to 70.0, which means an energy efficiency improvement of almost 30.0% compared to the base year 2000 in the transport sector (Fig. 25).

Figure 25: Energy efficiency index of the transport sector from 2000 to 2022

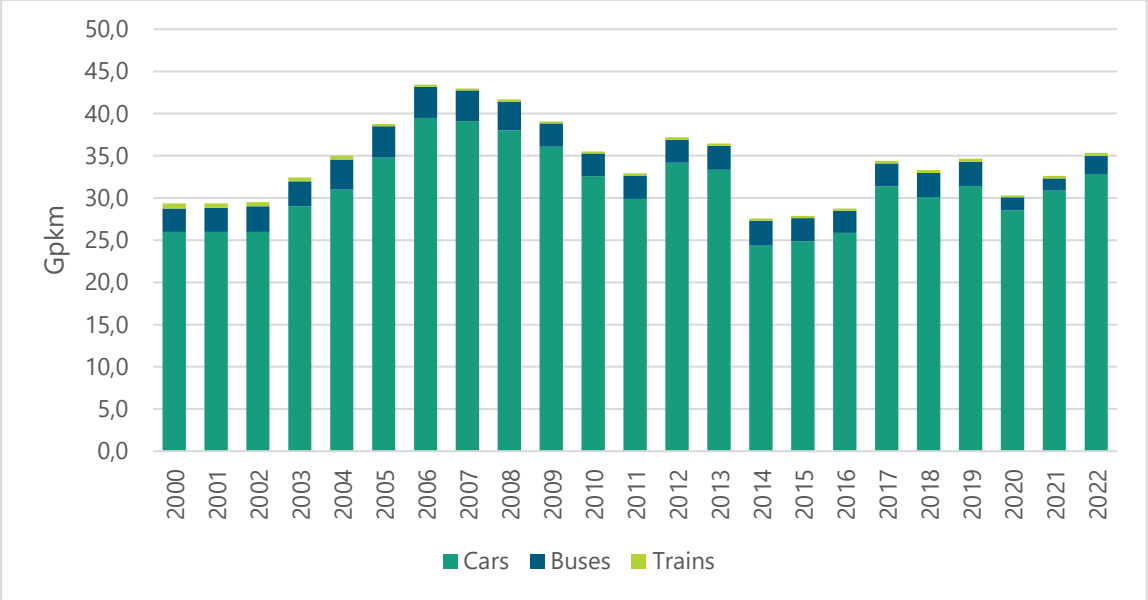


Source: ODYSSEE database

Road transport ensures most of the passenger traffic. In 2022, passenger cars accounted for 93.0%, buses - 6.0%, and trains - 1.0%. These modes of transport have demonstrated different trends since

2000 (Fig. 26). The passenger kilometers traveled by passenger car in Lithuania increased by 26.0% during 2000-2022, while rail travel decreased by around 37.0% and passenger kilometers traveled by bus - by 23.0%.

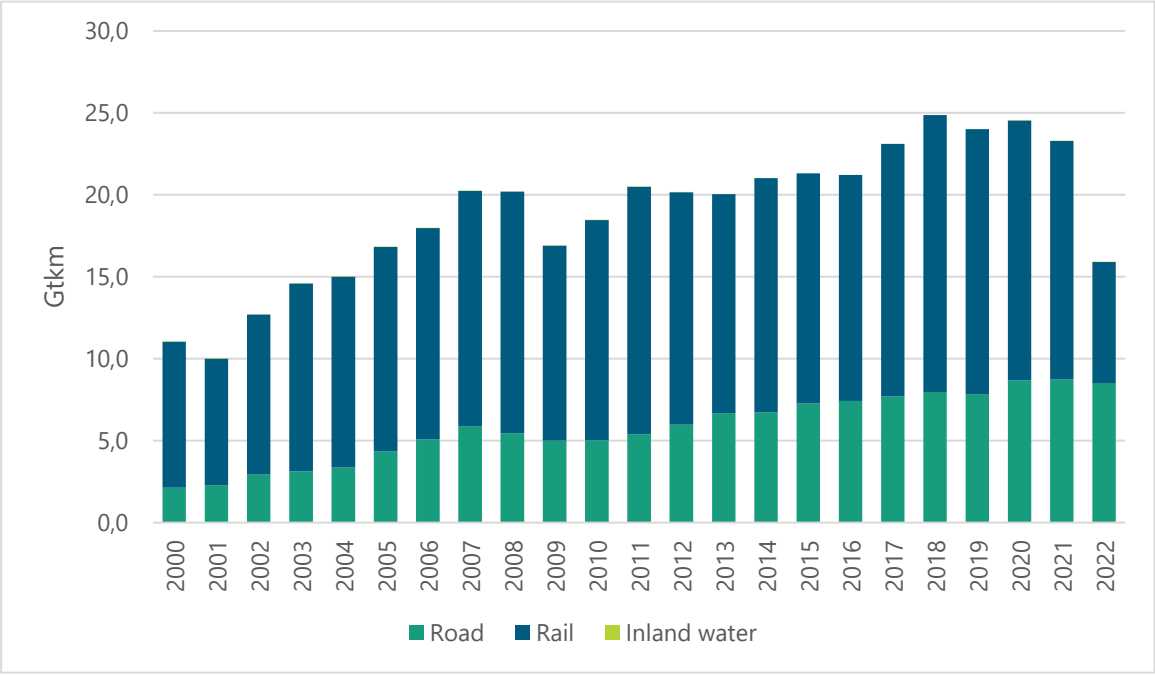
Figure 26: Passenger traffic through transport from 2000 to 2022



Source: ODYSSEE database

Figure 27 shows that freight traffic doubled by 2021, but the outbreak of war in Ukraine in 2022 significantly reduced rail freight traffic from 14.6 Gtkm in 2021 to 7.4 Gtkm in 2022. From 2000 to 2022, the annual growth rate of road freight transport was 6.5%; in 2022, it accounted for 8.5 Gtkm.

Figure 27: Freight traffic through transport from 2000 to 2022



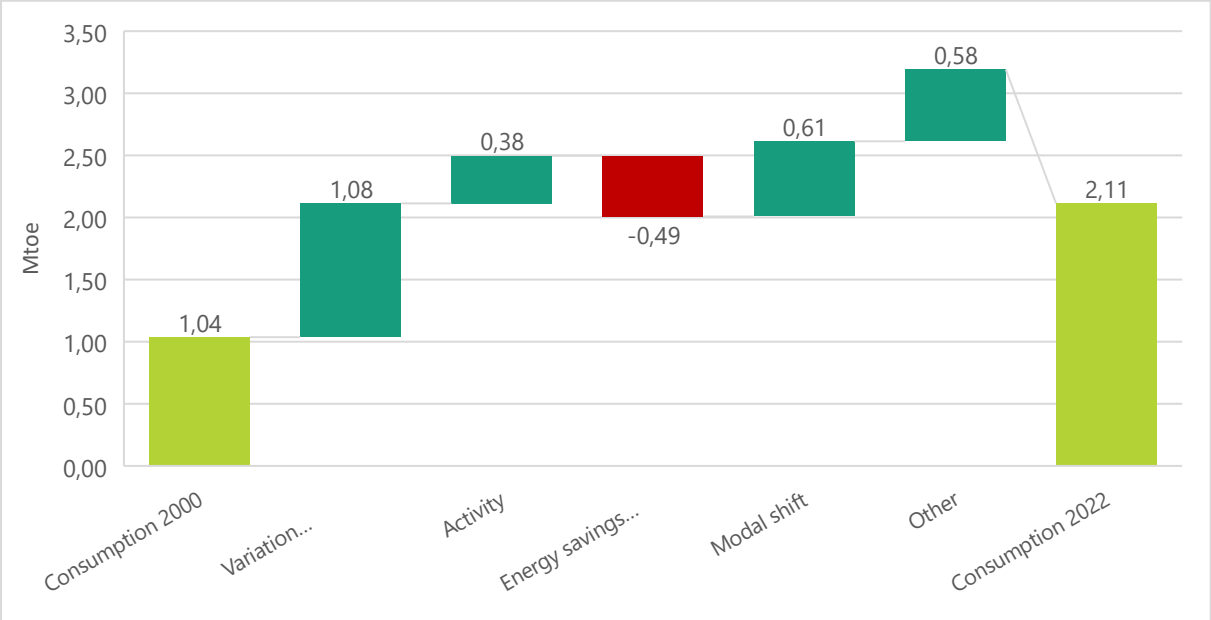
Source: ODYSSEE database

Figure 23 shows a decomposition analysis in the transport sector from 2000 to 2022. The variation of the transport energy consumption is changing under the influence of:

- Change in domestic passenger traffic and traffic of goods ("activity effect");
- Technical energy savings (i.e. change in the efficiency of cars, trucks, airplanes, etc.);
- Modal shift for domestic transport, i.e. change in the share of each transport mode in the total traffic.
- Other effects, i.e., behavioral effects and "negative savings" in freight transport due to low-capacity utilization.

The final energy consumption in the transport sector was 1.08 Mtoe higher in 2022 than in 2000. The split in modal shift (0.61 Mtoe), the growth in activity (0.38 Mtoe), and other effects (0.58 Mtoe) pushed up transport consumption. This significant increase in energy consumption was not counterbalanced by energy savings (0.49 Mtoe).

Figure 28: Decomposition of final energy consumption in the transport sector from 2000 to 2022



Source: ODYSSEE database

Lithuania intends to increase energy efficiency, implements programmes and measures in the transport sector. Historically, 16 programmes and measures have been implemented in Lithuania. In the transport sector, measures were focused on developing road infrastructure, upgrading public transport fleets, and informational/educational purposes like ecological driving or a day without a car. EU Structural funds, State budget funds, and financial resources from the Special Programme for Climate Change were used. Increased value-added tax is applied to fuels and excise tax on some fuels, including gasoline, LPG, and diesel. Great attention is paid to the implementation of energy efficiency tasks in the transport sector to develop sustainable mobility in cities, to improve traffic safety, to implement intelligent transport systems, for the introduction of more efficient means of transport, and for the development of environmentally friendly transport. During 2014-2020, the financial support measures for Renovation of the city's public transport fleet and Local transport were implemented to renew the public transport fleet. The form of funding for the measures was a non-refundable subsidy. During 2018-2019 public transport vehicles were renewed in the cities of

Radviliškis, Šiauliai, Klaipėda, Vilnius, Panevėžys, Kaunas. Presently, the **EU Structural Funds 2021-2027** are most relevant. They focus on increased installation of electric vehicle charging access points, use of alternative fuels in the transport sector, and development of sustainable urban mobility. The measures support installation and development charging infrastructure for electric cars both public and private property, installation and development of publicly available electric vehicle charging infrastructure in designated sections, promoting the purchase of clean vehicles for the public sector, installation and development of publicly available electric vehicle charging infrastructure in cities with sustainable mobility in municipalities that have not prepared plans, installation of public compressed biogas filling stations (suitable for filling with biomethane), installation of electric car charging stations in sustainable mobility cities, creation of a network of bicycle and pedestrian paths, integrating non-motorized transport into the general transport system, creation of a continuous bicycle path network by integrating non-motorized transport into the general transport system, installation of pedestrian and bicycle paths in the streets, improving the infrastructure of bicycle and pedestrian paths and implementing sustainable mobility measures, creation and implementation of the information system of public vehicles Lithuanian cities.

5 Special focus: Energy poverty policies

To tackle energy poverty, **the National Progress Programme** for 2021-2030 sets the target to reduce energy poverty in the population and identifies three national targets for 2025 and 2030. Firstly, it aims to reduce the share of the population unable to keep their home adequately warm due to lack of funds from 28% (2018) to 23% (2025) and 17% (2030). Secondly, it seeks to reduce the share of households that spend a significant share of their income on energy expenditure from 17.1% (2016) to 15% (2025) and 10% (2030). Lithuania takes cross-cutting measures, covering the areas of energy efficiency, household income, energy prices, and consumer information, to decrease energy poverty. Seeking to reduce energy poverty issues in the country, mainly monetary and social support is provided to indigent residents in accordance with the Law on Monetary Social Support for Indigent Residents. Indigent residents receive compensation for heating, drinking water, and hot water costs. Further, residents participating in the renovation of an apartment building, following the procedure established by the Law, are paid the monthly credit taken for the implementation of the renovation (modernization) project of an apartment building and the interest payments due to the apartment owner of an apartment building who is entitled to compensation for heating costs. Next, in 2022, indigent persons had opportunity to receive support to use RES (solar up to 10 kW) for electricity needs and/or replace heating devices using fossil fuels. In Lithuania, the EU-funded Horizon 2020 project "STEP – Solutions to Tackle Energy Poverty" was launched in 2019. The main objective of STEP was to alleviate energy poverty by encouraging changes in consumer behavior.

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