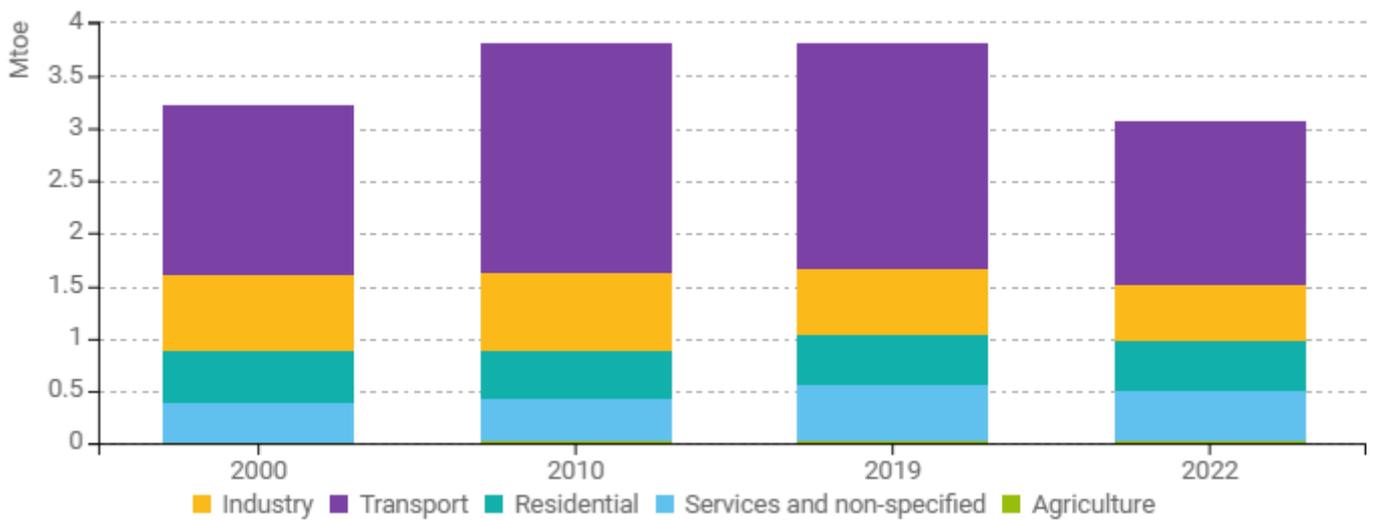


# Energy efficiency trends and policies

## Overview

Luxembourg's energy balance is significantly influenced by the transport sector, which benefits from the country's central location and attractive fuel prices. In 2022, energy consumption in the transport sector reached 1.577 Mtoe, nearly returning to the levels observed in 2000. The tertiary sector also experienced a decline in energy use, moving from 0.377 Mtoe in 2000 to 0.468 Mtoe in 2022, despite steady growth in population and GDP. In the residential sector, energy consumption remained relatively stable, shifting slightly from 0.482 to 0.477 Mtoe over the years. Meanwhile, industrial energy consumption decreased steadily, dropping from 0.735 Mtoe to 0.543 Mtoe in 2022 due to structural changes and improvements in energy efficiency.

Figure 1: Final energy consumption by sector (with climatic corrections)

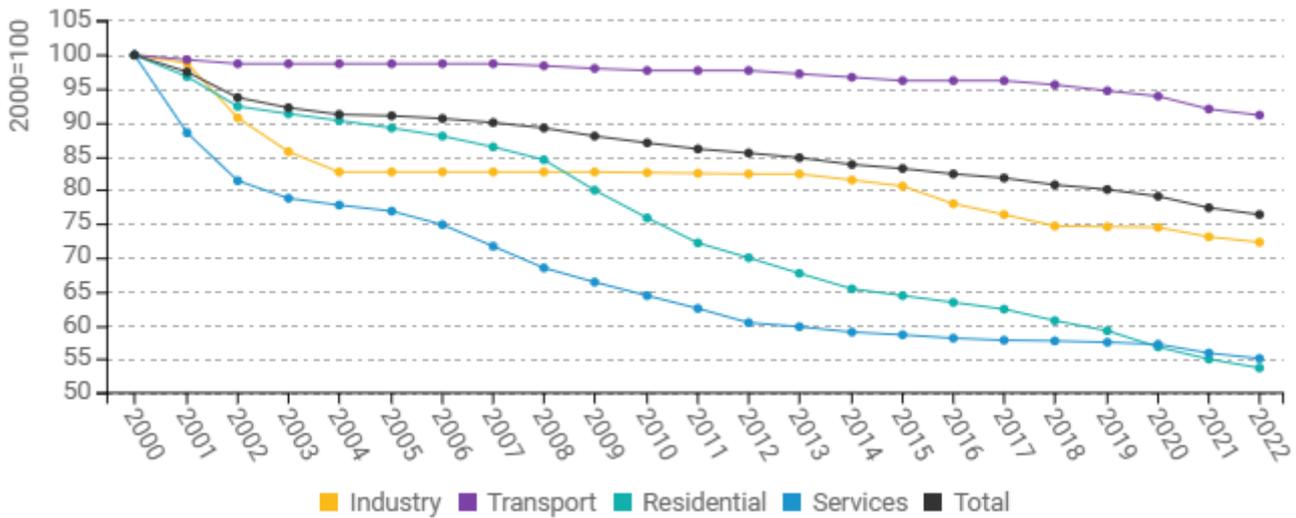


Source: ODYSSEE

The gradual introduction of energy efficiency measures has led to significant improvements in ODEX since 2000: In the residential sector, the introduction of the energy performance regulation in 2007 shows significant improvements, with enhanced minimum requirements for new and existing buildings in 2017 (notably nZEB for new buildings). In industry, the voluntary agreement between the government and Fedil has promoted energy efficiency among major energy consumers through quantified targets and energy management systems since 1996. In the transport sector, the implementation of fiscal measures and the promotion of e-mobility since 2017 has led to improvements in road transport. Finally, the obligation mechanism has enabled significant energy savings since 2015 in all sectors.



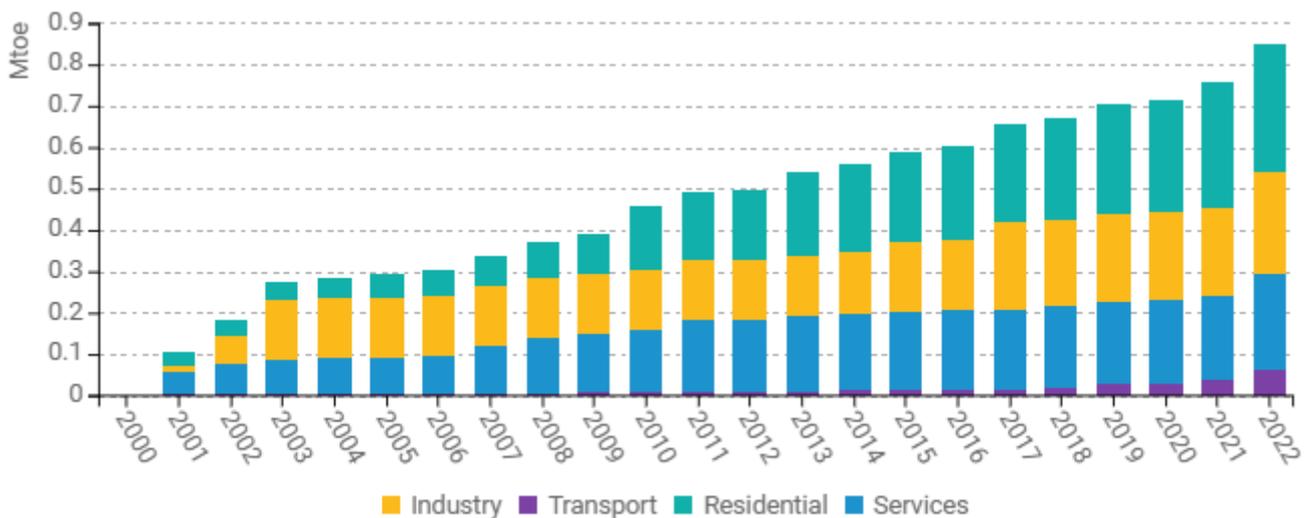
Figure 2: Technical Energy Efficiency Index



Source: ODYSSEE

Overall, Luxembourg shows a consistent upward trend in energy efficiency efforts, with the total energy savings reaching 0.87 Mtoe in 2022, i.e. 30% of the final consumption that year. Total energy savings grow steadily over the years, mostly driven by contributions from the residential, service and industry sectors. These savings can mostly be attributed to the introduction and the strengthening of the energy performance regulation for residential and non-residential buildings and to the efforts of the voluntary agreement in the industry sector. The transport sector exhibits a very slow progress and only really contributes notably energy savings after 2017, due to the promotion of low and zero emission vehicles and public transport.

Figure 3: Energy savings by sector

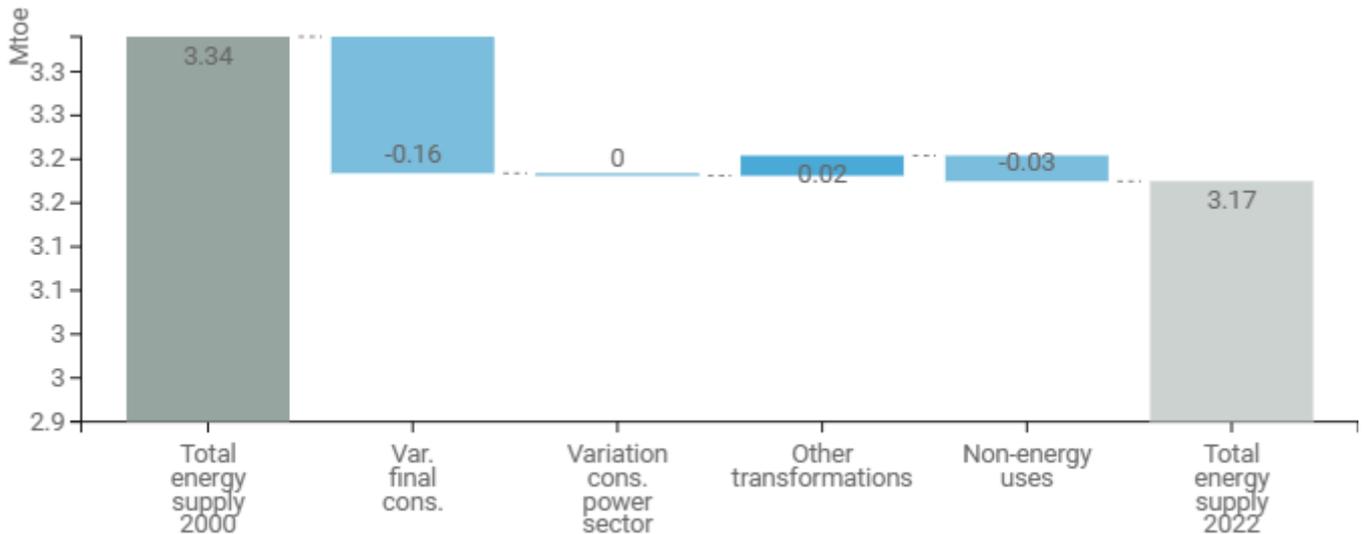


Source: Odyssee



The total energy supply in Luxembourg decreased by 0.17 Mtoe from 3.34 Mtoe in 2000 to 3.17 Mtoe in 2022, reflecting a modest reduction over the period. The primary driver of this decrease is the decline in final energy consumption, which contributed to a reduction of 0.16 Mtoe. Contributions from variations in the power sector consumption were negligible, indicating no significant changes in this area. Non-energy uses also had a minor impact, showing a small decrease of 0.03 Mtoe. On the other hand, "Other transformations" slightly increased the energy supply by 0.02 Mtoe.

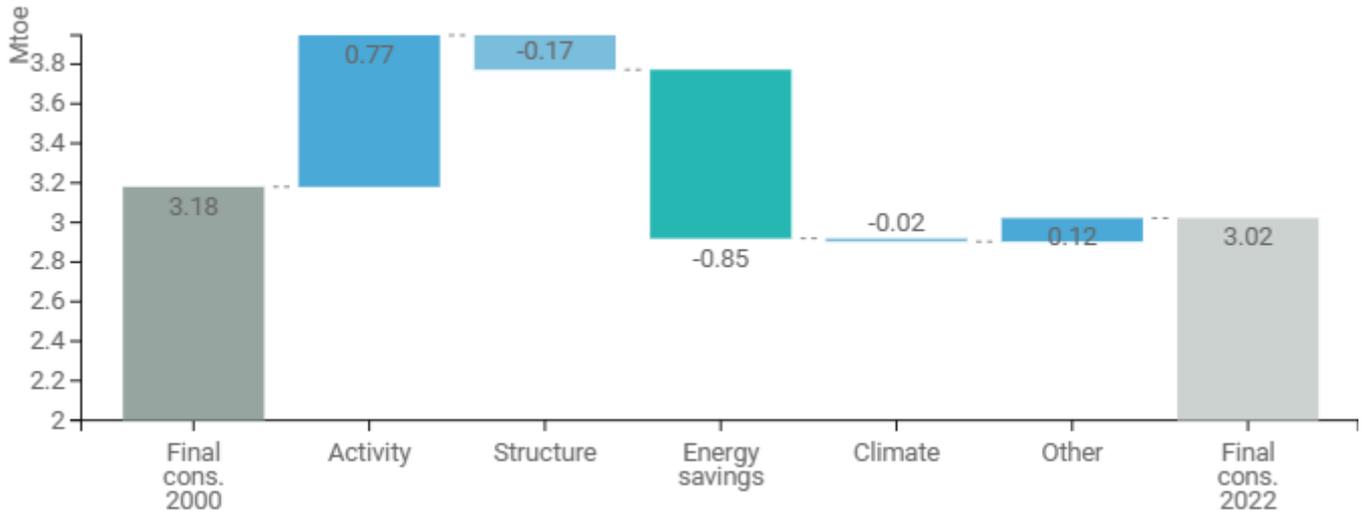
**Figure 4: Main drivers of the total energy supply variation**



Source: Odyssee

Final energy consumption in Luxembourg decreased by 0.16 Mtoe from 3.18 Mtoe in 2000 to 3.02 Mtoe in 2022. The main drivers include an increase in activity (+0.77 Mtoe), indicating economic or population growth that boosted energy demand. However, this was offset by significant energy savings (-0.85 Mtoe), demonstrating improved efficiency across sectors. Structural changes contributed a minor reduction of -0.17 Mtoe, likely reflecting shifts in the economy towards less energy-intensive industries. Climate variations had a negligible impact (-0.02 Mtoe), while "Other" factors slightly increased consumption by +0.12 Mtoe. Overall, energy efficiency efforts outweighed growth-related increases, resulting in a modest decline in final energy consumption over the period.

Figure 5: Main drivers of the final energy consumption variation



Source: Odyssee

The CO<sub>2</sub>-Tax and the Energy Efficiency Obligation Scheme are the most ambitious cross-cutting measures implemented in Luxembourg in the field of energy efficiency. Since 2021, fossil fuels have been subject to the CO<sub>2</sub> tax. The annual rates of the CO<sub>2</sub> tax are set by Grand-Ducal regulation and correspond to €20/t CO<sub>2</sub> in 2021 and €25/t CO<sub>2</sub> in 2022. From January 1, 2023, the rate will be 30 €/t CO<sub>2</sub>. The revenues generated by the CO<sub>2</sub> tax are used equitably to finance climate and energy transition and social compensation measures for low-income households and the increase in the cost-of-living allowance. Activities covered by the EU Emissions Trading Scheme are exempt from the tax. The Energy Efficiency Obligation Scheme was designed according to the article 7 of the Energy Efficiency Directive 2012/27/EC and was introduced in 2015 for a first period covering the years 2015 to 2020. The measure is intended to provide energy savings in every sector (buildings, industry, and some cases in transport) and with every energy vector. The mechanism was revised in 2021 for the second period covering the years 2021 to 2030. Electricity and natural gas suppliers are still the obliged parties in this mechanism.

Table 1: Sample of cross-cutting measures

Measures	NECP measures	Description	Expected savings, impact evaluation
<a href="#">CO<sub>2</sub> tax</a>	Yes	Since 2021, fossil fuels have been subject to the CO <sub>2</sub> tax. The CO <sub>2</sub> tax rate ceilings are set by the amended law of December 17, 2010 on excise duties and similar taxes on energy products, electricity, manufactured tobacco products, alcohol and alcoholic beverages. The annual rates of the CO <sub>2</sub> tax are set by Grand-Ducal regulation and correspond to €20/t CO <sub>2</sub> in 2021	15.80 TJ

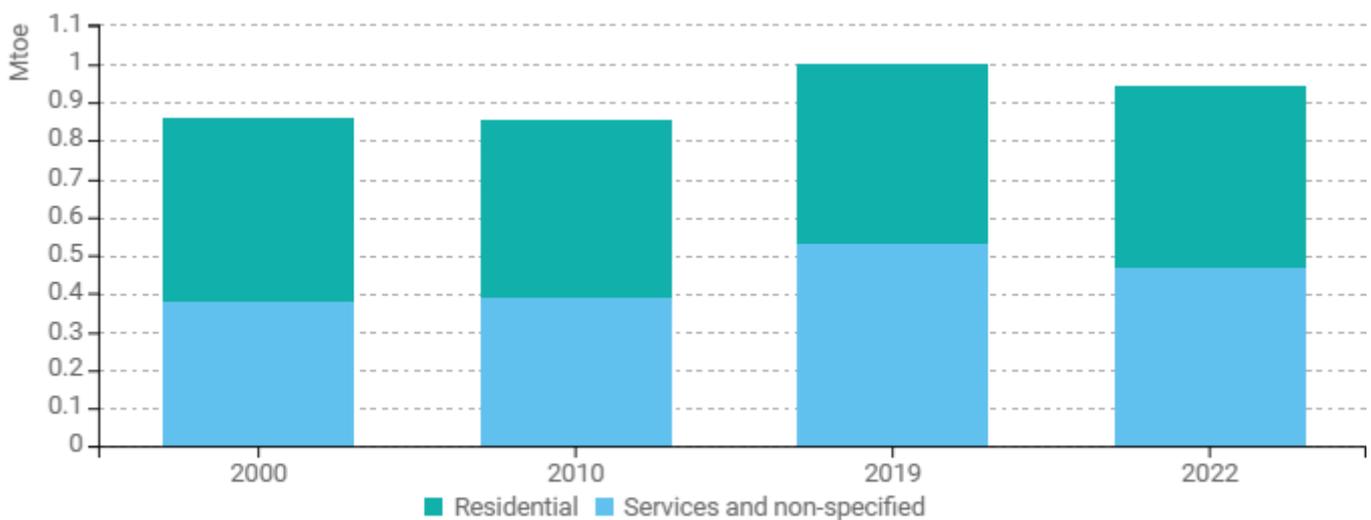
		and €25/t CO <sub>2</sub> in 2022. From January 1, 2023, the rate will be 30 €/t CO <sub>2</sub> . The revenues generated by the CO <sub>2</sub> tax are used equitably to finance climate and energy transition measures and social compensation measures for low-income households, such as the tax credit for the two lowest income quintiles (Q1 and Q2) and the increase in the cost-of-living allowance. Activities covered by the EU Emissions Trading Scheme are exempt from the tax.	
<a href="#">EU-related: Energy Efficiency Directive (EED) - Directive 2012/27/EU - Energy Efficiency Obligation Scheme (revision)</a>	Yes	The energy efficiency obligation mechanism, introduced in 2015 for a first period covering the years 2015 to 2020, is revised in 2021 for the second period covering the years 2021 to 2030. Electricity and natural gas suppliers are still the obliged parties in this mechanism.	7.77 TJ

Source: MURE

### Buildings

Since 2000, the majority of energy consumption in buildings can generally be attributed to residential buildings. While the share for residential buildings remains on a stable level, the energy consumption of the service sectors followed an upward trend between 2010 and 2019 before decreasing again after 2019. Both shares are on a comparable level in 2022.

**Figure 6: Final energy consumption in buildings (with climatic corrections)**

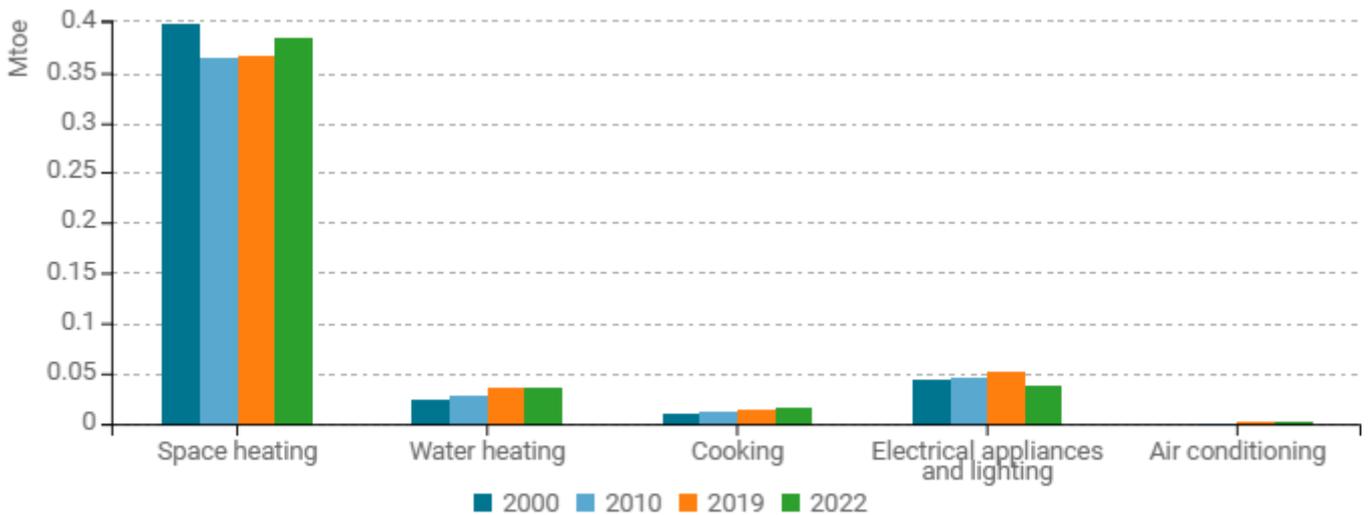


Source: ODYSSEE



Space heating consistently dominates energy consumption, showing only slight fluctuations over the years. Water heating, cooking, and electrical appliances and lighting display relatively minor contributions, though electrical appliances and lighting saw a small increase from 2000 to 2019, followed by stabilization or a slight decline by 2022. Air conditioning consumption remains negligible throughout the observed period.

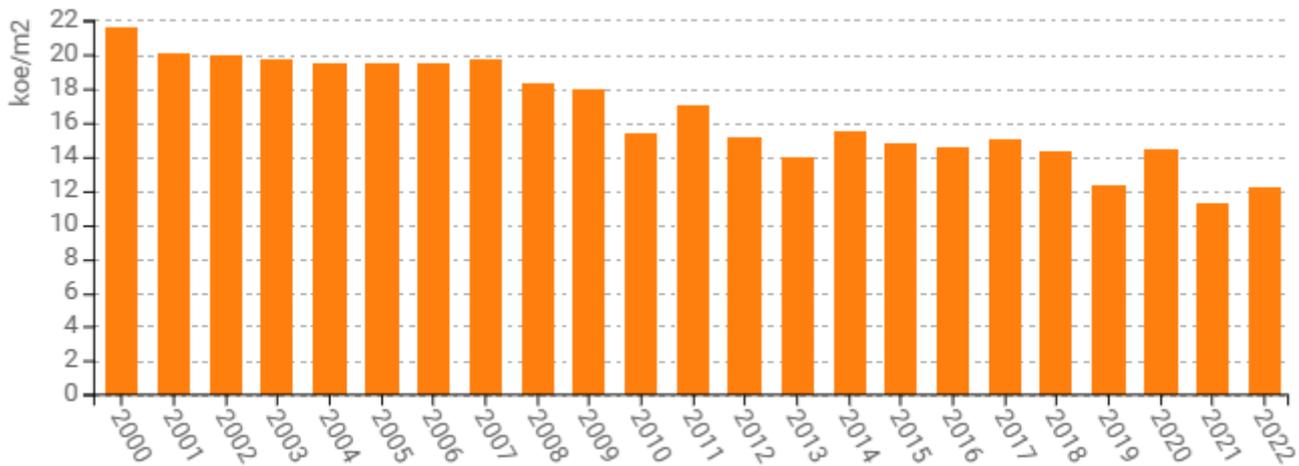
**Figure 7: Energy consumption by end-use of households (with climatic corrections)**



Source: ODYSSEE

Specific energy consumption for household space heating in Luxembourg has steadily decreased, dropping from 21.6 koe/m<sup>2</sup> in 2000 to 12.2 koe/m<sup>2</sup> in 2022. This significant reduction (-44% or -2.6%/year) can be attributed to two key factors. First, introducing stricter building regulations in 2007 played a crucial role by setting higher energy efficiency standards for new constructions. These regulations were further reinforced in 2017, accelerating the shift towards more sustainable building practices. Second, the evolution of the housing stock towards more energy-efficient homes was driven by a generous and ambitious government subsidy program, which incentivized homeowners to adopt energy-saving measures.

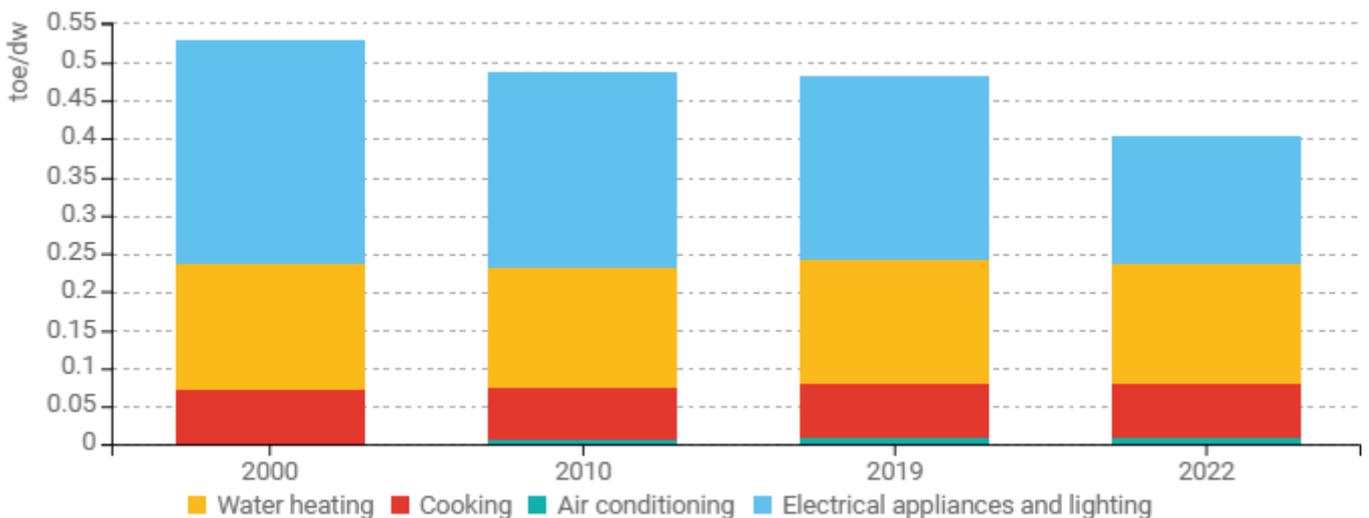
Figure 8: Energy consumption of household space heating per m2 (with climatic corrections)



Source: ODYSSEE

For the other household end-uses, a general decline in energy consumption per dwelling is observable, reflecting improved efficiency and technology advancements. Electrical appliances and lighting consistently account for the largest share of energy consumption, though there is a gradual decline over the years. This decline can mostly be attributed to the replacement of old appliances with more energy efficient ones and a general trend towards more energy efficient devices. Water heating follows as the second-largest contributor, remaining relatively stable. Cooking makes a smaller but steady contribution, while air conditioning remains negligible throughout the period.

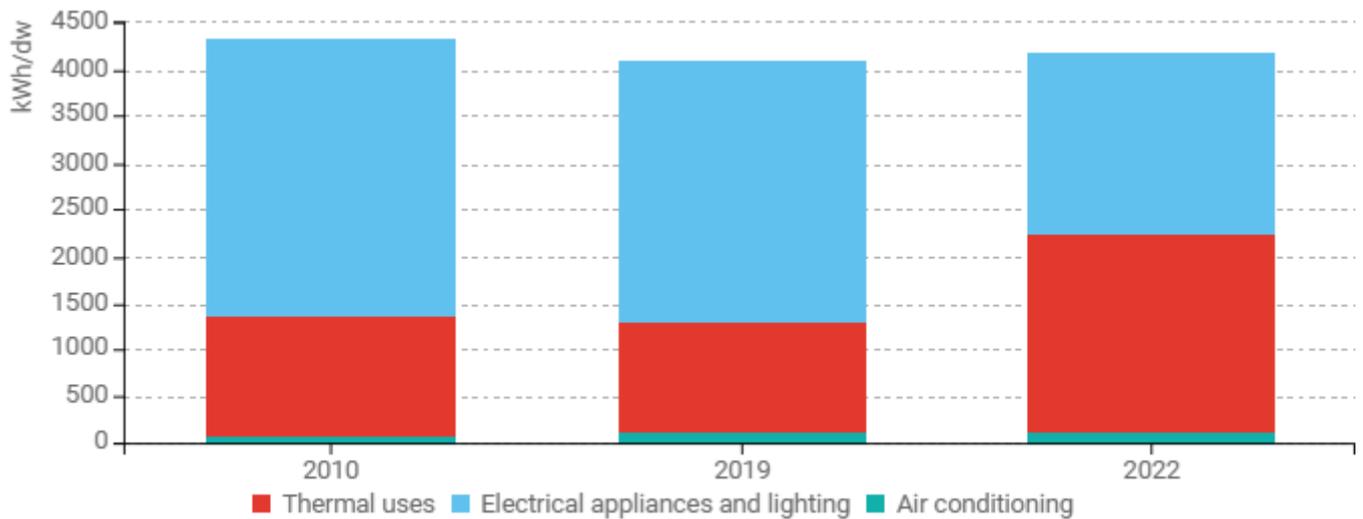
Figure 9: Energy consumption per dwelling by end-use (except space heating)



Source: ODYSSEE

Overall, a gradual reduction in electricity consumption per dwelling is observable, mostly driven by advancements in energy-efficient technologies but slightly offset by a heightened demand for thermal uses. Electrical appliances and lighting represented the largest share, with a decrease from 2019 to 2022, reflecting improvements in energy efficiency. Thermal uses show a significant increase after 2019. Air conditioning remains negligible.

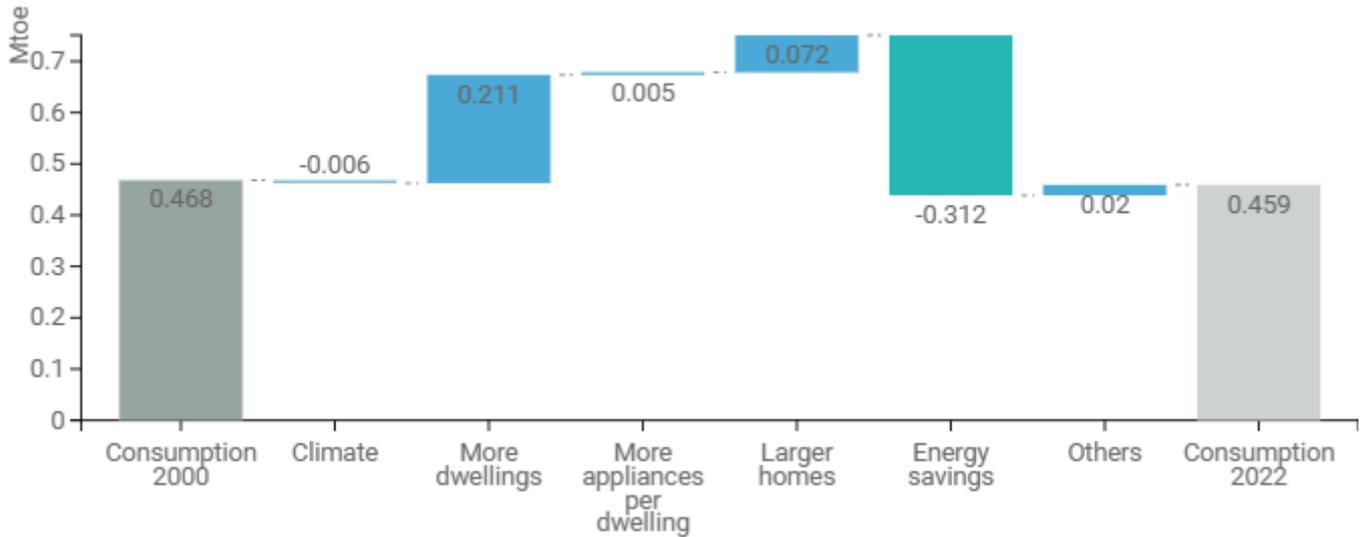
**Figure 10: Electricity consumption per dwelling by end-use (with climatic corrections)**



Source: ODYSSEE

Energy consumption in the residential sector has remained stable, with a slight decrease (-0.009 Mtoe) from 0.468 Mtoe in 2000 to 0.459 Mtoe in 2022. This stability is attributed to energy savings (-0.312 Mtoe), due to heightened energy efficiency standards for new residential buildings, significantly reducing energy demand per unit area and renovation in existing buildings. However, this improvement has been offset by an increase in the number of dwellings, driven by a rise in population (+0.211 Mtoe). Additionally, a rebound effect has emerged, as larger homes are being built—often because they are more energy-efficient—leading to higher overall energy use (+0.072 Mtoe).

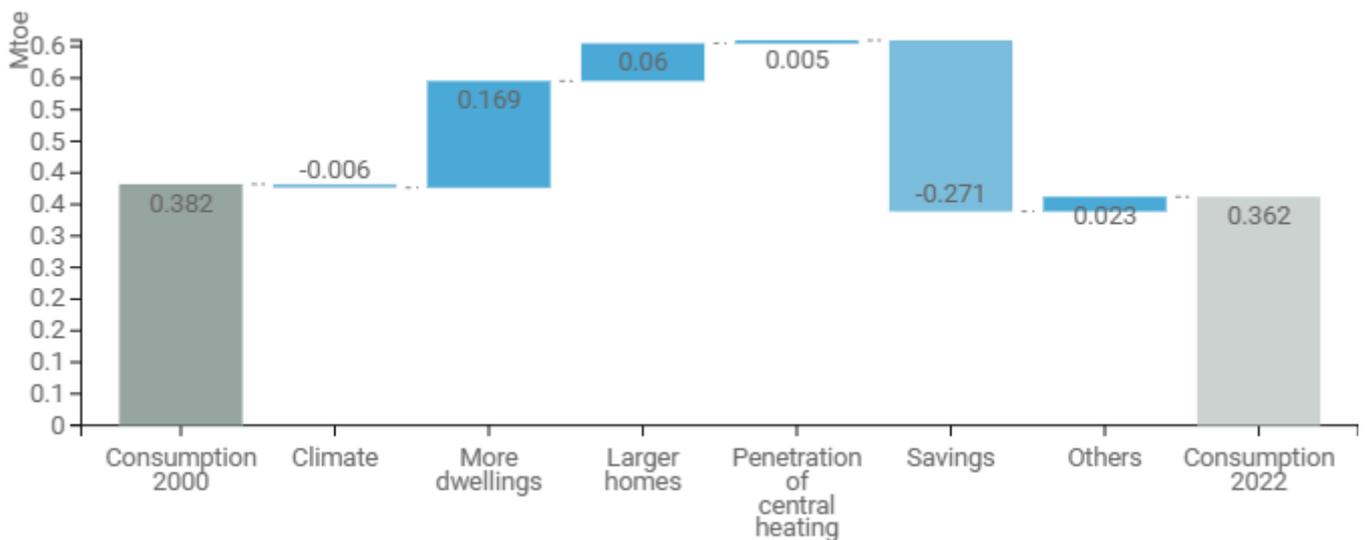
Figure 11: Main drivers of the energy consumption variation in households



Source: ODYSSEE

Space heating consumption for households decreased from 0.382 Mtoe in 2000 to 0.362 Mtoe in 2022 (0.02 Mtoe). Key drivers include energy savings (-0.271 Mtoe), offset by increased activity (+0.169 Mtoe), and larger homes (+0.06 Mtoe). Other effects were negligible: central heating penetration (+0.005 Mtoe), climate changes (-0.006 Mtoe) and other factors (-0.023 Mtoe).

Figure 12: Main drivers of the space heating consumption variation of households

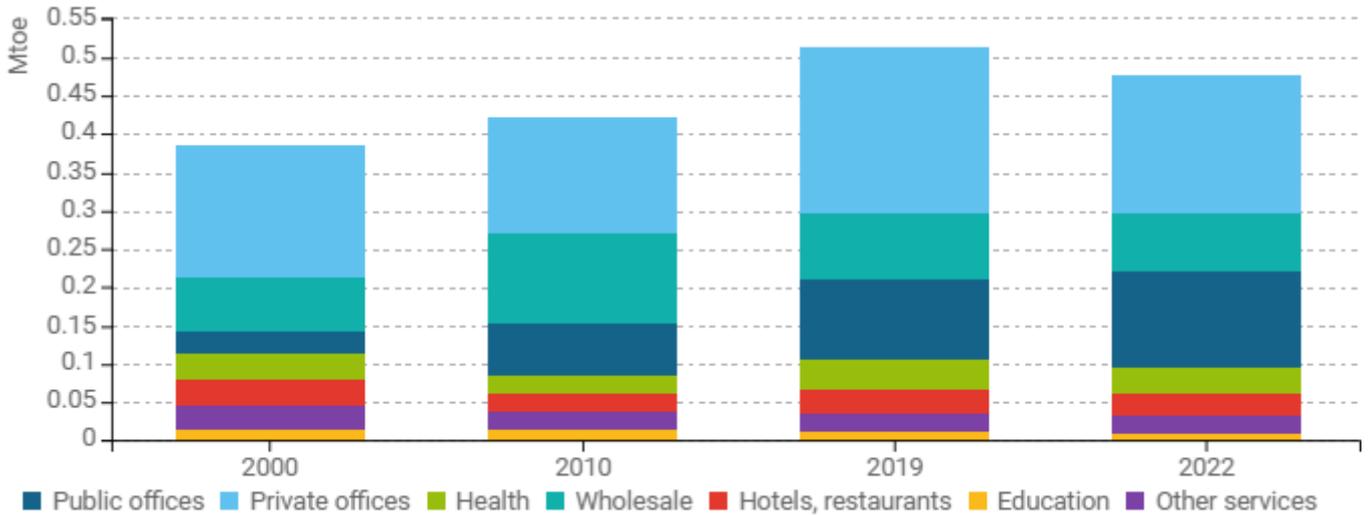


Source: ODYSSEE

Final energy consumption in the services sector increased from 2000 to 2019, followed by a decline by 2022. Private offices consistently contributed the most, followed by wholesale and public offices. Health, hotels/restaurants, and education sectors maintained steady contributions, with minor variations. "Other

services" showed stable but smaller shares throughout. The chart highlights the dominant role of private offices in total consumption trends.

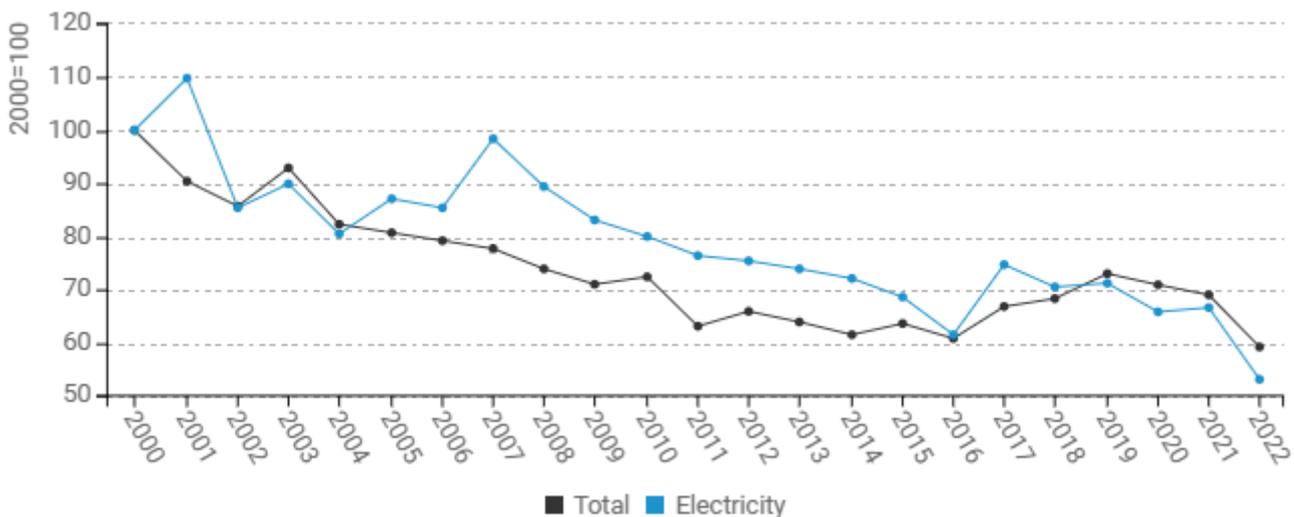
**Figure 13: Final energy consumption of services by branch**



Source: ODYSSEE

The specific energy and electricity consumption indexes per employee strongly decreased from 100 in 2000 to 59 (energy) and 53 (electricity) in 2022. This decrease is linked to the higher headcount of the whole sector (from 188.800 employees in 2000 to 401.270 in 2022) and to the technical progress in installations (HVAC, lighting, computers...).

**Figure 14: Energy and electricity consumption per employee in services (with climatic corrections)**



Source: ODYSSEE



The policy measures implemented in the buildings sector are crucial to trigger the introduction of significant energy efficiency improvements in households and non-residential buildings. The Energy Performance of Buildings Regulation, first introduced in 2007 and supplemented by a regulation for non-residential buildings in 2010, and the subsequent tightening of building standards have set an ambitious improvement trajectory, culminating in 2017 with the nZEB building standard for new residential buildings. In 2021, both regulations were combined into one legislative text, with the standards for residential buildings being further tightened and a target path for the nZEB standard for non-residential buildings being introduced. The ordinance has always been accompanied by generous subsidy programs to promote energy-efficient refurbishment of existing buildings, which are regularly revised and reformed.

**Table 2: Sample of policies and measures implemented in the building sector**

Measures	NECP measures	Description	Expected savings, impact evaluation
<a href="#">"Klimabonus Wunnen", Grant scheme for sustainable housing, sustainable energy renovations and installation of renewable systems (2022-2025)</a>	Yes	Since 2022, the "Klimabonus Wunnen" subsidy scheme has been boosting for the construction of sustainable housing, sustainable energy renovation renovations, the installation of technical systems that use renewable energy sources renewable energy sources, and energy consulting. The current scheme covers projects initiated between 2022 and 2025.	1.50 TJ
<a href="#">EU-related: Energy Performance of Buildings EPBD Amendment (Directive (EU) 2018/844) - Regulation on the energy performance of buildings (revision 2021)</a>	Yes	In 2021, the regulatory framework concerning the energy performance of residential and functional buildings has been adapted with the aim of integrating the various provisions for residential and functional buildings into a single Grand Ducal regulation. In particular, this regulation defines the reference building model that is used to define the energy efficiency requirements for individual buildings.	

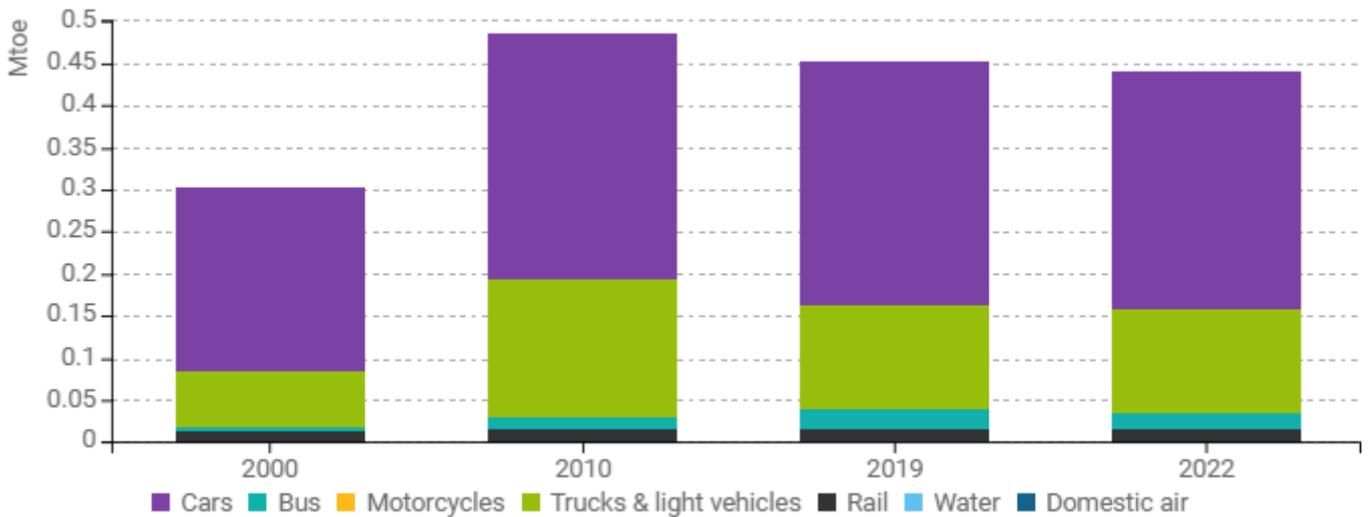
<a href="#">EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Regulation on the energy performance of residential buildings</a>	Yes	<p>The Ordinance of the Grand Duchy of 30 November 2007 on improving the overall energy efficiency of buildings (dwellings) (WD2008) aims at the improvement of the cavity wall insulation compared to the 1996 pre-standard. Hence, it is an update of the Ordinance on thermal insulation from 1996 and sets forth higher standards for insulation of buildings. It is in compliance with the European Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.</p>	
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Source: MURE

### Transport

In Luxembourg, 71% of energy consumption in the transport sector in 2022 is from foreign vehicles. Since 2000, road transport has dominated domestic energy consumption, with passenger cars having the largest share, followed by trucks and commercial vehicles. Public transport remains stable, with a shift toward buses.

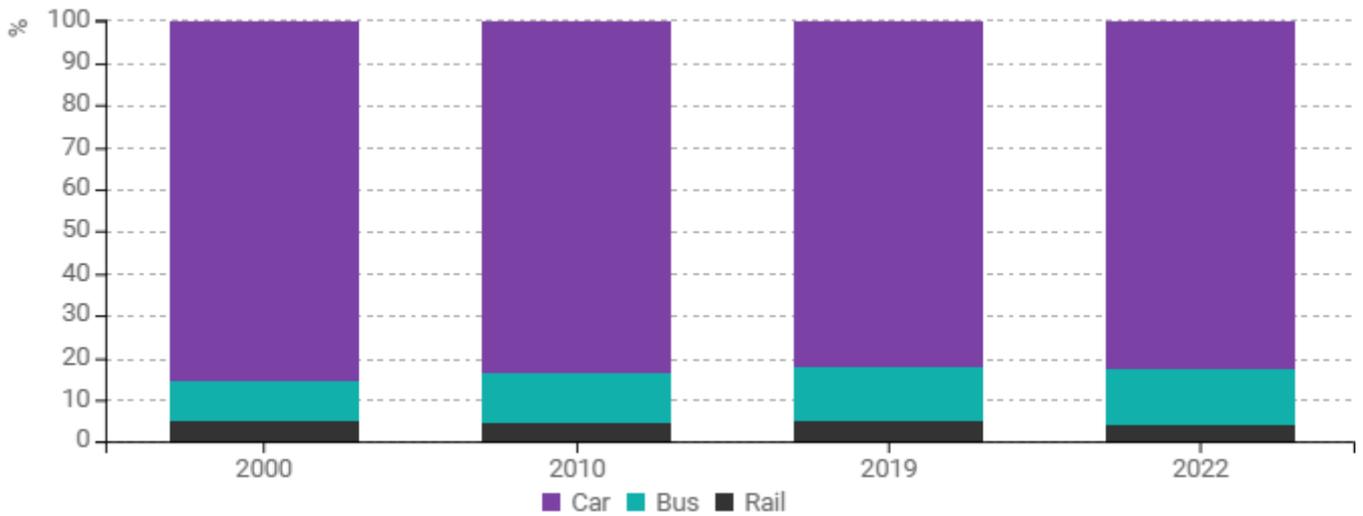
Figure 15: Transport energy consumption by mode



Source: ODYSSEE; consumption for domestic transport (i.e.

The share of passenger transport has remained stable over the years. Cars still account for the largest share at 83%. For public transport, the share of buses in the modal split has increased slightly, while that of trains has decreased.

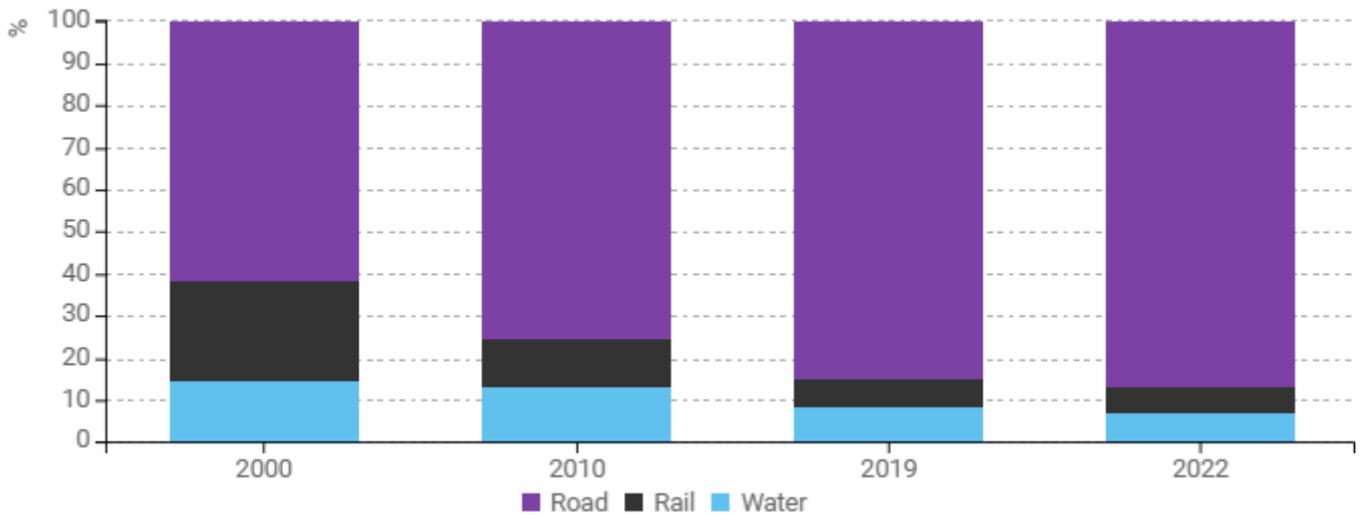
Figure 16: Modal split of inland passenger traffic



Source: ODYSSEE

The share of road freight transport has increased over time, reaching 87.1% in 2022. However, this has been at the expense of rail freight traffic, which has fallen sharply by 72%. The absolute value of waterway traffic fell by 43% over the same period.

Figure 17: Modal split of inland freight traffic

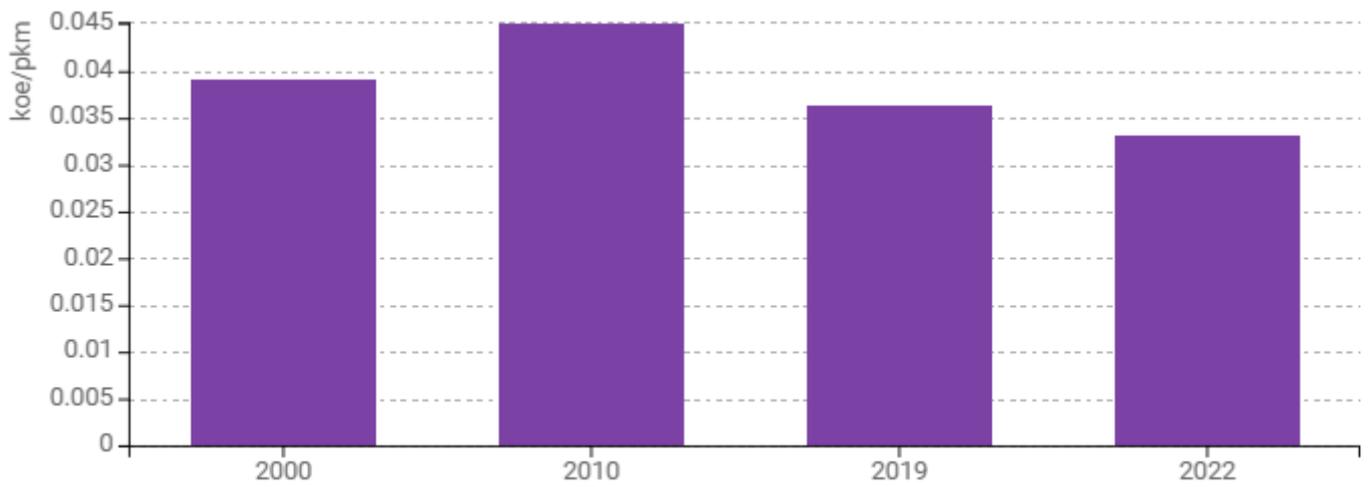


Source: ODYSSEE

Since 2017, Luxembourg has intensified efforts to promote low-emission mobility through targeted information campaigns and incentives. These measures have encouraged the adoption of electric and hybrid vehicles, contributing to the reduction of energy consumption per passenger-kilometer for cars. A significant milestone was reached in March 2020, when all public transport in Luxembourg became completely free. This initiative likely shifted a portion of the population from private car use to more sustainable transportation options, further

reducing energy consumption per passenger-kilometer. In addition, recent years have seen increased promotion of carpooling and active mobility, such as cycling and walking. These efforts aim to decrease reliance on individual car travel and foster more efficient and environmentally friendly modes of transport. The combination of these measures—advancing vehicle efficiency, making public transport universally accessible, and promoting alternatives to car usage—has played a crucial role in the observed decline in energy consumption per passenger-kilometer for cars, particularly between 2019 and 2022. These trends highlight Luxembourg's commitment to creating a more sustainable and energy-efficient transportation system.

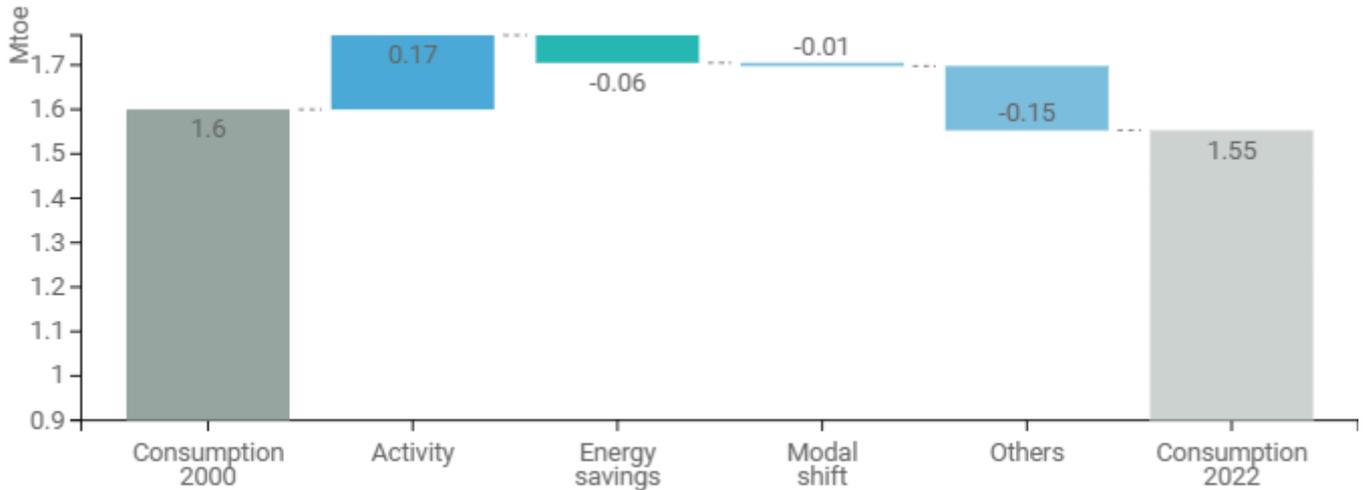
**Figure 18: Energy consumption of cars per passenger-km**



Source: ODYSSEE

Analyzing Luxembourg's energy consumption is challenging due to the influence of foreign vehicles. The main driver is increased transport activity, particularly passenger road traffic. Energy savings stem from improved fuel efficiency in private cars. While a shift to public transport exists, it doesn't significantly affect trends. "Other effects" refer to consumption variations from transit traffic and fuel purchased by foreign vehicles, areas over which Luxembourg has limited control.

Figure 19: Main drivers of the energy consumption variation in transport



Source: ODYSSEE

The situation regarding energy consumption in the transport sector is rather difficult to address. The recently introduced or renewed measures have effects that apply to different types of consumers: an increase in fuel taxes, which applies to all fuel consumers and is therefore likely to result in greater energy savings, a CO<sub>2</sub>-linked vehicle tax, which applies only to resident vehicle owners, and is therefore less significant. The promotion of zero-emission vehicles, including tax rebates and grants for private individuals and enterprises, the promotion of public transport and introduction of free public transport. Nevertheless, its effect has the potential to last in the medium term, because it has triggered changes in the vehicle fleet.

Table 3: Sample of policies and measures implemented in the transport sector

Measures	NECP measures	Description	Expected savings, impact evaluation
<a href="#">Promoting the electrification of the vehicle fleet registered in Luxembourg</a>	No	To accelerate the electrification of Luxembourg's vehicle fleet, a series of measures have been introduced, such as - the implementation and operation of the Chargy basic public charging infrastructure Chargy public charging infrastructure; - promotion of the private charging station network through financial support and through the introduction of minimum requirements as part of the energy performance regulations for buildings; - the introduction of a subsidy scheme for companies investing in public or private public or private charging infrastructure, either through a call for projects or by simple application (SMEs only); - the introduction of financial aid for electric vehicles (cars and vans) vans); - extensive	3.00 TJ

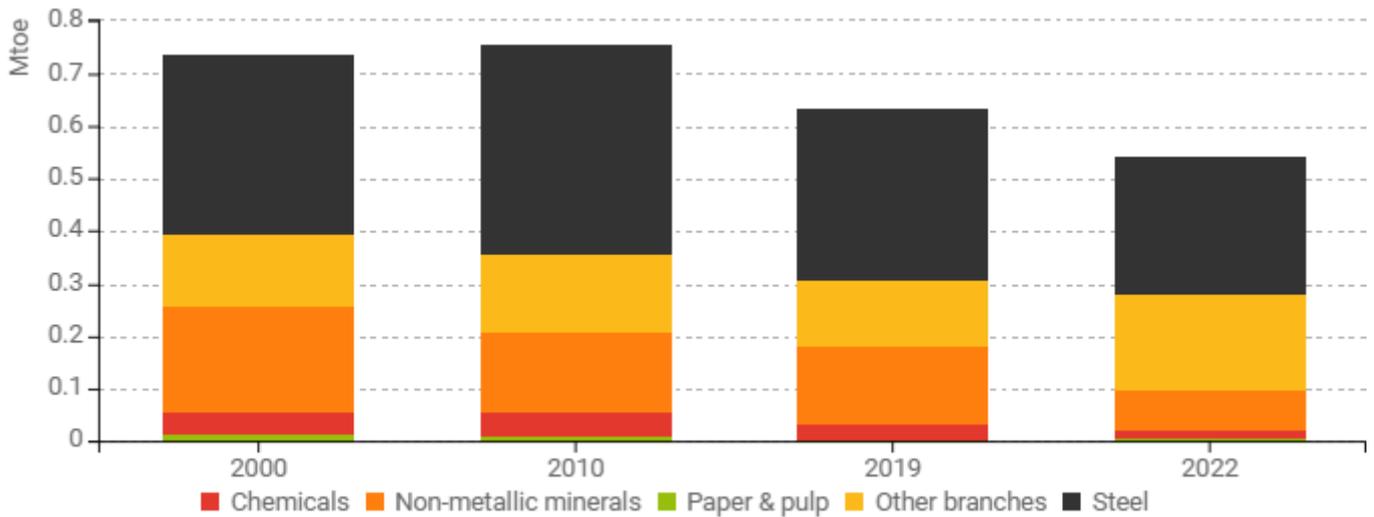
		<p>electrification of public vehicle fleets; - the introduction of complementary promotional measures such as the "Stroum beweegt" initiative; - support for local authorities in setting up charging infrastructure; - expansion of the Klima-Agence advisory service; - adapting the highway code to allow the driving of non-thermal N1 vehicles in excess of 3,500 kg (but no more than 4,250 kg) with a category B licence; - and authorization in the Benelux countries to exceed the maximum of commercial vehicles and zero-emission cars to compensate for the weight to compensate for the additional weight of batteries.</p>	
<a href="#">Promotion of public transport</a>	Yes	<p>Between 2018 and 2027, the Luxembourgish government will invest 3.9 billion euros in rail infrastructure development. Capacity will be substantially increased (PNM 2035). In addition, the reinforcement of direct rail links and the creation of new links to cities in neighboring countries are being planned or studied in partnership with the authorities of neighboring countries. The extension of the streetcar network in Luxembourg City continues. The RGTR bus network is regularly optimized. The bus network in the canton of Esch-sur-Alzette will be reorganized with the arrival of the high-speed streetcar at a new hub in the south of the country. Buses will be prioritized on three high-service corridors until 2035 (PNM 2035). The exchange of information between modes of transport will be improved to offer better quality of service. Since March 2020, public transport has been free in Luxembourg. An extension of free public transport to a 5 km radius around the borders is currently being analyzed.</p>	2.50 TJ
<a href="#">Grant scheme for low CO2 emission cars and electric cars (2019)</a>	Yes	<p>To speed up the transition to zero-emission mobility, a maximum bonus of €8,000 is available for zero-emission CO2 vehicles, including 100% electric cars (BEVs), hydrogen fuel cell cars (FCEVs) and 100% electric vans and hydrogen fuel cell vans.</p>	1.70 TJ

Source: MURE

### Industry

Between 2000 and 2022, the energy consumption of the industrial sector has decreased by 17%. The consumption of the steel industry remained however at a constant level, while all other branches have declined over the years.

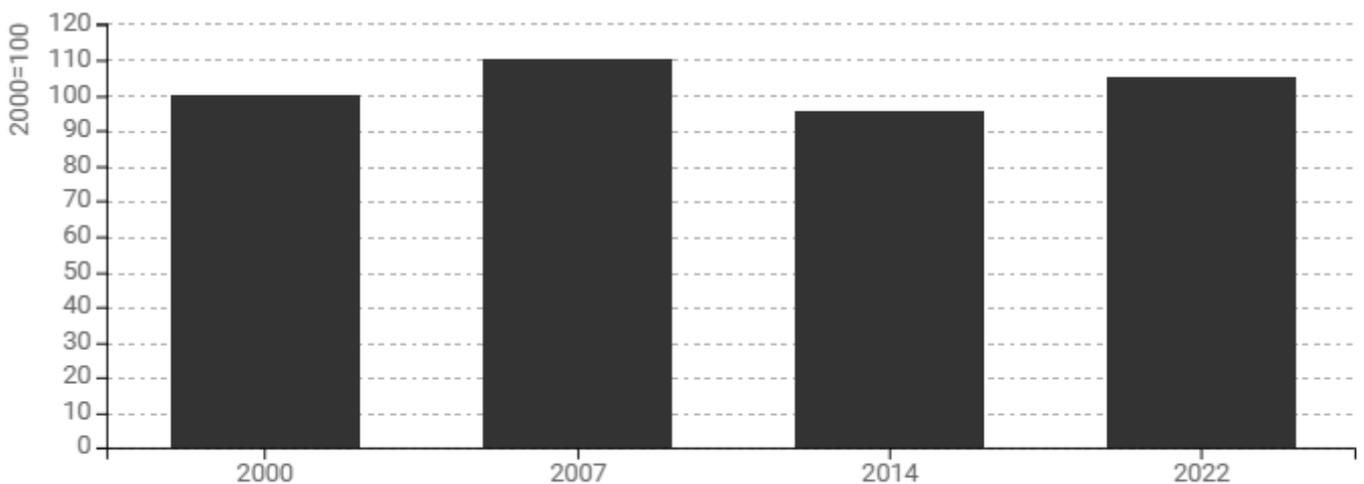
Figure 20: Final energy consumption of industry by branch



Source: ODYSSEE

The steel industry has undergone a number of distinct events that explain the evolution of its energy performance: the refurbishment of its large steel mills; the post-crisis years requiring partial charging; and voluntary agreements enabling greater energy efficiency. Recent years, however, have been marked by insecurity, notably linked to CO2 taxes and high production costs.

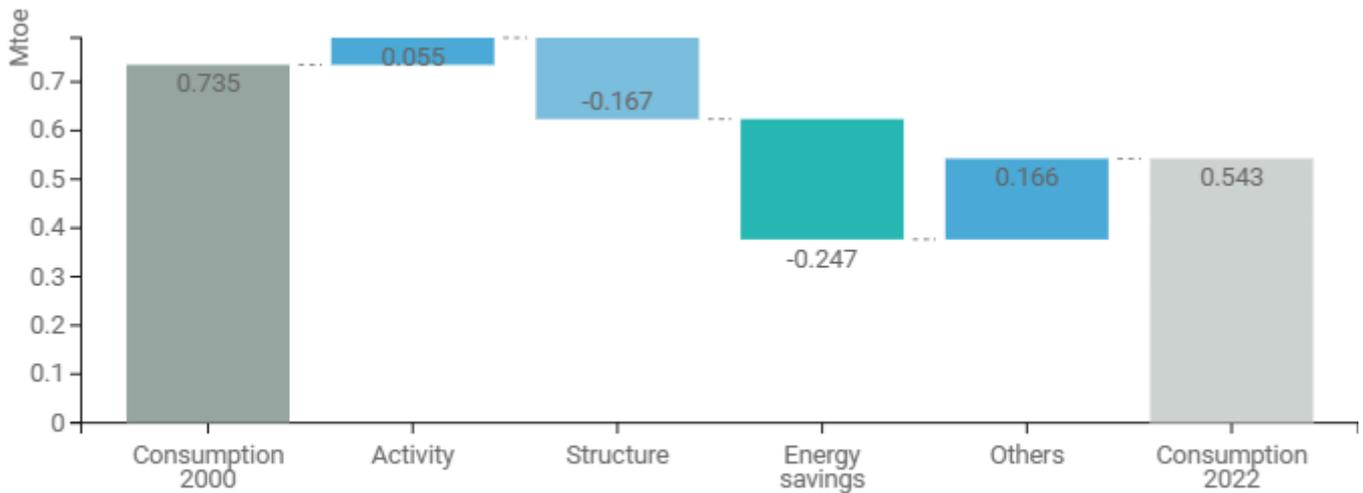
Figure 21: Unit consumption of steel (toe/t)



Source: ODYSSEE

The 17% reduction in industrial sector energy consumption between 2000 and 2022 (0.192 Mtoe) can be explained by energy savings generated mainly by successive voluntary agreements with industry and by competitive forces (0.247 Mtoe) and by structural changes (-0.167 Mtoe) that have more than offset the slight increase in energy consumption due to activity levels (0.055 Mtoe) and to other effects (0.166 Mtoe), the latter reflecting structural changes within branches toward more intensive products.

**Figure 22: Main drivers of the energy consumption variation in industry**



Source: ODYSSEE

The most effective measure for industry is the voluntary agreement, which began in 1996 and covers most of the energy consumption of industrial consumers. The most recent agreement ended in 2023 and achieved significant energy efficiency gains, following the trend of the previous editions. Since 2015, the Energy Efficiency Obligation system has complemented the voluntary agreement by involving obliged parties to play an active role in industrial energy efficiency improvement plans.

**Table 4: Sample of policies and measures implemented in the industry sector**

Measures	NECP measures	Description	Expected savings, impact evaluation
<a href="#">Voluntary Agreements (2021-2023)</a>	Yes		0.08 TJ

Source: MURE