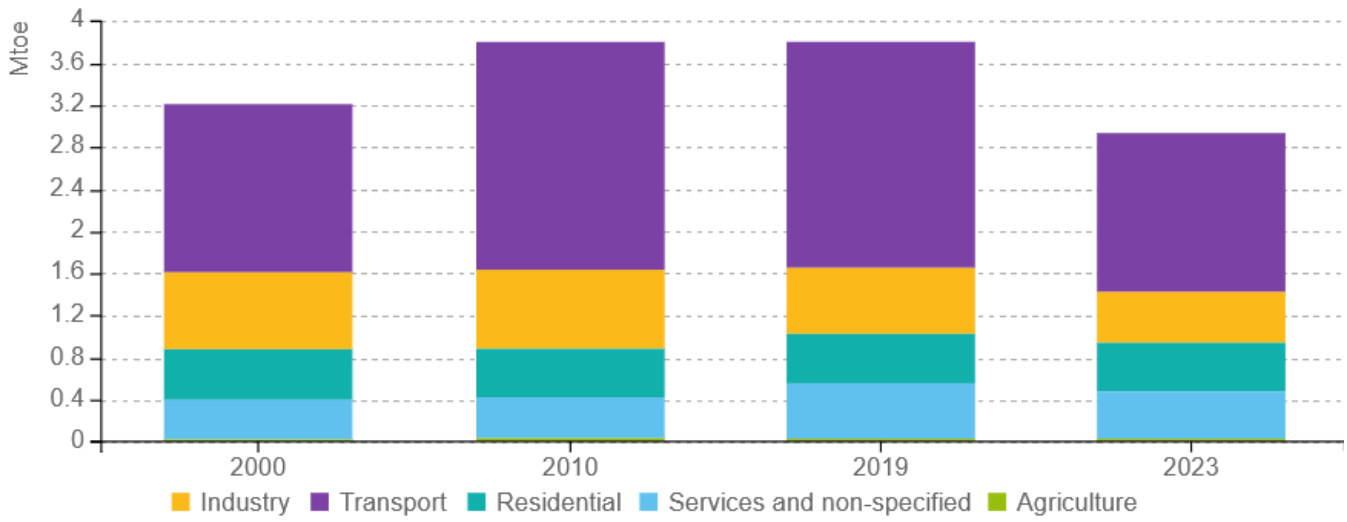
Energy efficiency trends and policies

Overview

Luxembourg's energy balance is strongly shaped by the transport sector, which benefits from the country's central location and favorable fuel prices. In 2023, transport energy consumption reached 1.51 Mtoe, falling back below its 2000 level. The tertiary sector's energy use declined to 0.451 Mtoe in 2023 after rising from 0.377 Mtoe in 2000 to a 0.529 Mtoe peak in 2019, despite ongoing demographic and economic growth. In the residential sector, energy consumption remained relatively stable, shifting slightly from 0.482 to 0.464 Mtoe over the years. Industrial consumption fell more steadily, decreasing from 0.735 in 2000 to 0.487 Mtoe in 2023 due to structural changes and improved efficiency.

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



Source: ODYSSEE

The gradual introduction of efficiency measures has significantly improved Luxembourg's ODEX since 2000. In the residential sector, the 2007 energy performance regulation and the strengthened 2017 requirements, including nZEB standards, drove substantial progress and supported long term efficiency gains across new and renovated buildings. In industry, the long-standing voluntary agreement between the government and Fedil continues to promote efficiency gains through quantified targets and energy management systems for major companies. In transport, fiscal incentives were replaced in 2019 by a support scheme, while the expansion of e-mobility has improved vehicle efficiency despite high overall demand. Finally, the energy efficiency obligation mechanism has generated significant cross-sector savings since 2015 and continues to support national efforts.

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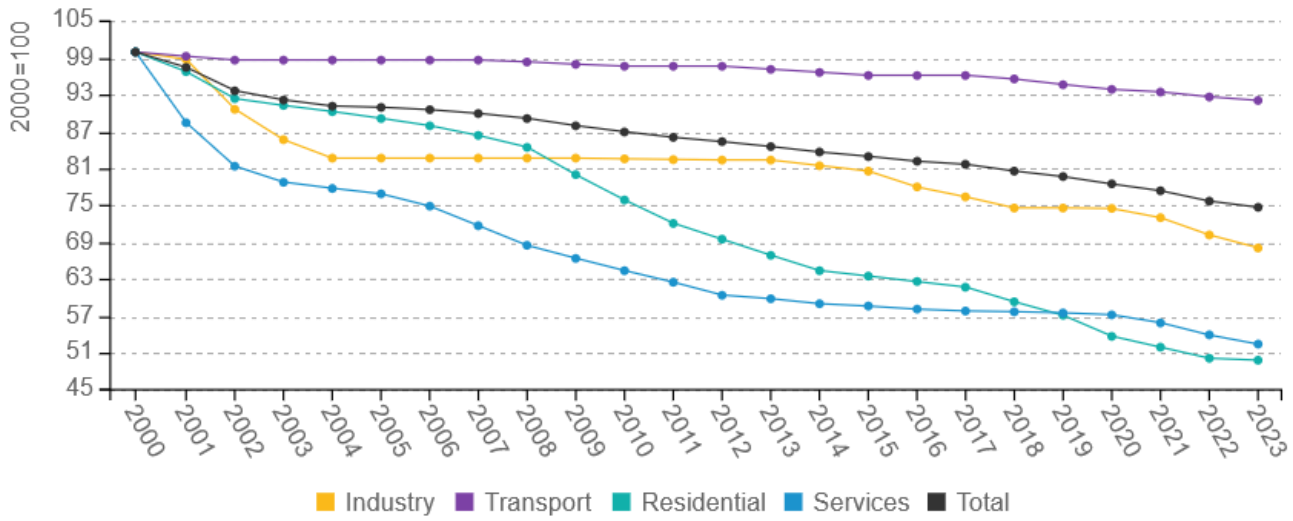
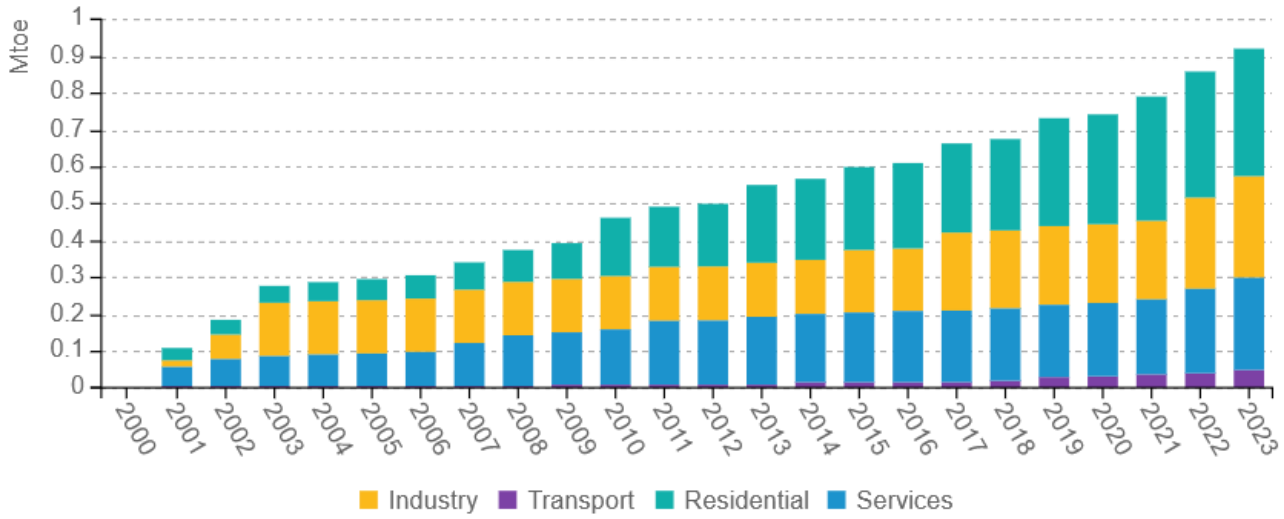
Figure 2: Technical Energy Efficiency Index



Source: ODYSSEE

Overall, Luxembourg shows a consistent upward trend in energy efficiency efforts, with total energy savings reaching 0.92 Mtoe in 2023, equal to 33% of the final consumption that year. Savings increase steadily over time, driven mainly by the residential, service and industry sectors. These gains result from the introduction and later strengthening of the energy performance regulation for residential and service buildings, as well as from the continued efforts of the voluntary agreement in the industry sector. The transport sector shows very slow progress and only begins to contribute notable savings after 2017, mainly due to the promotion of low emission vehicles, zero emission vehicles and improved public transport.

Figure 3: Energy savings by sector



Source: Odyssee

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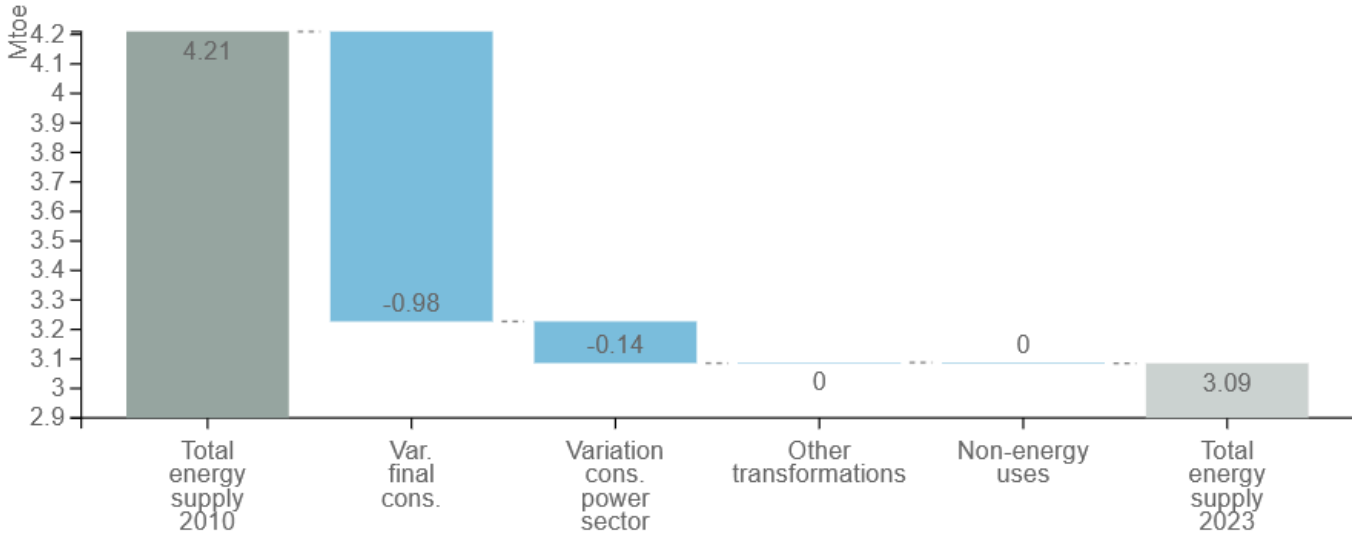
The total energy supply in Luxembourg decreased from 4.21 Mtoe in 2010 to 3.09 Mtoe in 2023, a reduction of 1.12 Mtoe. The primary driver was a 0.98 Mtoe decrease in final energy consumption, driven by efficiency improvements and the growth of renewable energy. Power sector consumption contributed a further 0.14 Mtoe reduction, reflecting increased use of solar and wind power. Changes in "other transformations" and non-energy uses had a negligible impact. This trend highlights Luxembourg's efforts to reduce energy demand and transition to a greener energy mix, while ongoing policy measures continue to encourage sustainable consumption across all major sectors and support long-term national decarbonization objectives.

Figure 4: Main drivers of the total energy supply variation



Source: Odyssee

Final energy consumption in Luxembourg decreased from 3.89 Mtoe in 2010 to 2.94 Mtoe in 2023, a reduction of 0.95 Mtoe. Activity growth increased energy demand by 0.4 Mtoe, reflecting economic and demographic expansion. However, this was more than offset by energy savings of –0.46 Mtoe, indicating substantial efficiency improvements across sectors. Structural changes contributed an additional –0.11 Mtoe, likely due to a continued shift toward less energy-intensive economic activities. Climate effects had a small influence (–0.13 Mtoe), while "Other" factors slightly raised consumption by 0.65 Mtoe. Overall, efficiency gains clearly outweighed growth-related pressures, leading to a moderate but meaningful decline in final energy consumption.

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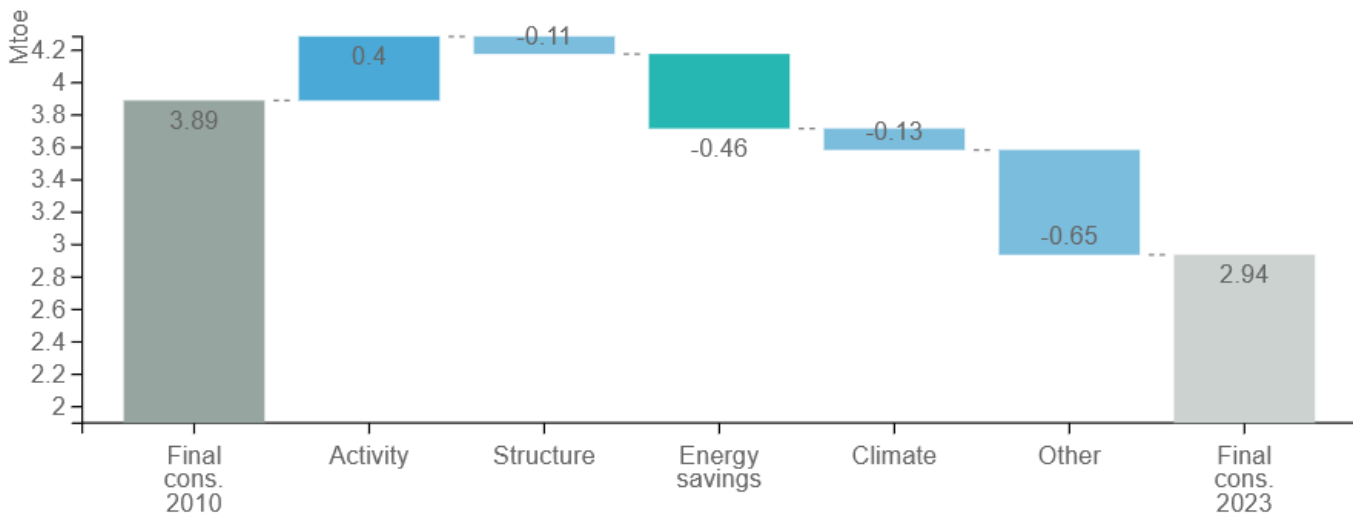
Figure 5: Main drivers of the final energy consumption variation



Source: Odyssee

The CO2-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 CO2 tax. The annual rates of the CO2 tax are set by Grand-Ducal regulation and correspond to €20/t CO2 in 2021 and €25/t CO2 in 2022. From January 1, 2023, the rate will be 30 €/t CO2. The revenues generated by the CO2 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
CO2 tax	Yes	Since 2021, fossil fuels have been subject to the CO2 tax. The CO2 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 CO2 tax are set by Grand-Ducal regulation and correspond to €20/t CO2 in 2021 and €25/t CO2 in 2022. From	15.80 TJ

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		January 1, 2023, the rate will be 30 €/t CO2. The revenues generated by the CO2 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.	
EU-related: Energy Efficiency Directive (EED) - Directive 2012/27/EU - Energy Efficiency Obligation Scheme (revision)	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
Aid scheme for municipalities	Yes	Municipal administrations, associations of municipalities and public establishments under the supervision of municipalities are eligible for financial support for energy efficiency projects (e.g. energy renovation of existing functional municipal buildings, renovation of public lighting, energy optimization studies for municipal planning and urban development projects) and renewable energies (e.g. solar energy, heat pumps, automatic district heating), renovation of public lighting, energy optimization studies for municipal and urban development projects) and renewable energies (e.g. solar energy, heat pumps, wood-fired automatic heating biomass cogeneration plants, district heating networks supplied by energy supplied by renewable energy sources and/or recovered heat). heat). Since 2021, the aid scheme has been financed through the Climate and Energy Fund. The current scheme will be reviewed and strengthened to better support municipalities in their decarbonization efforts.	0.50 TJ

Source: MURE

Buildings

Since 2000, residential buildings have consistently accounted for the largest share of energy consumption in the building sector. In 2023, they represented 51% of total building energy use, reflecting a slight majority. While the share for residential buildings remains on a stable level, the energy consumption of the service sectors followed

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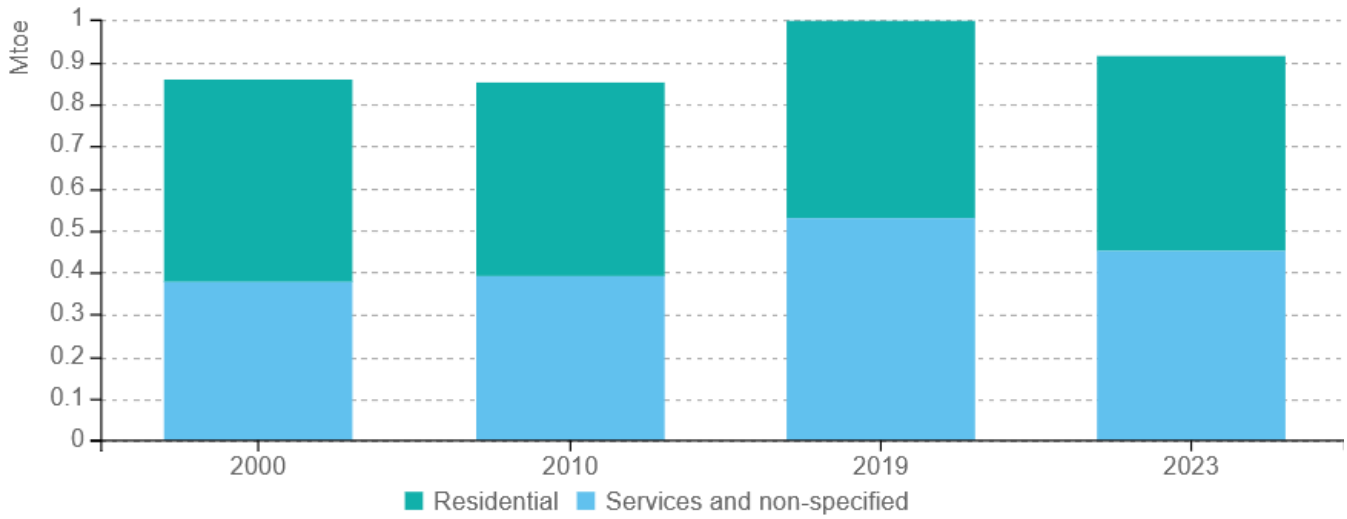
an upward trend between 2010 and 2019 before decreasing again after 2019. Both shares are at a comparable level in 2023.

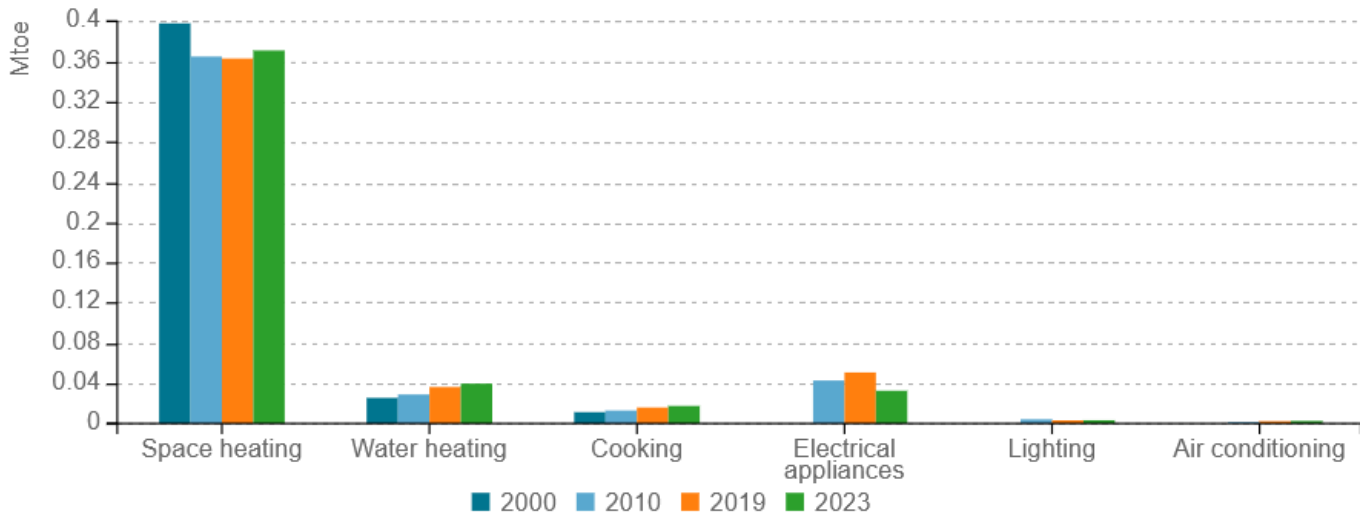
Figure 6: Final energy consumption in buildings (with climatic corrections)



Source: Odyssee

Space heating remains the dominant energy use, declining from 0.398 Mtoe in 2000 to 0.371 Mtoe in 2023. Water heating and cooking steadily increased over the period, reflecting evolving household energy needs. Electrical appliances peaked in 2019 before declining again. Lighting and air-conditioning consumption stayed minimal throughout, showing a slight downward trend and limited overall influence on residential energy demand.

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



Source: Odyssee

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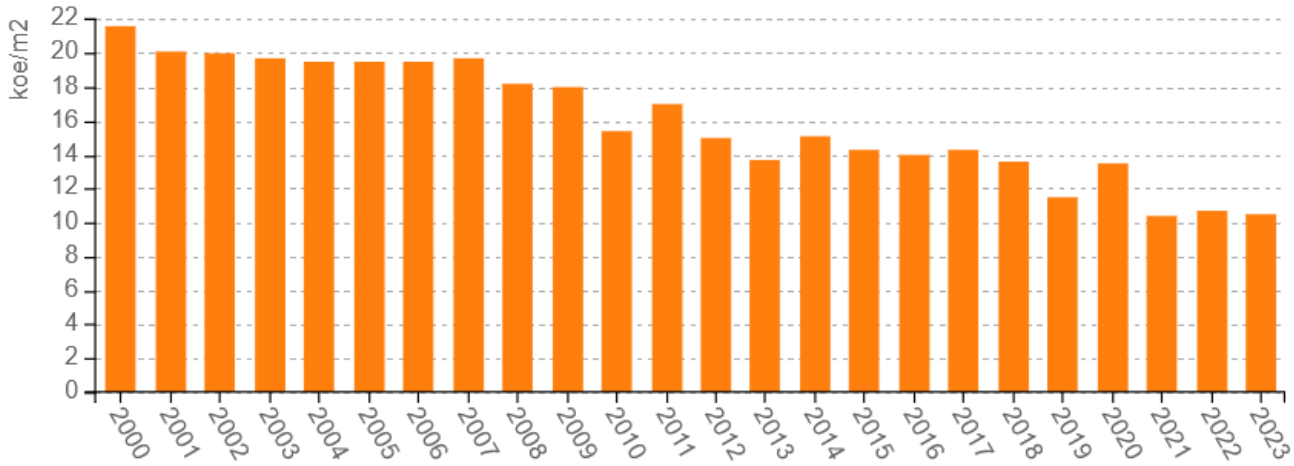
Specific energy consumption for household space heating in Luxembourg has steadily decreased, dropping from 21.6 koe/m² in 2000 to 10.5 koe/m² in 2023. This significant reduction (-51% or 3.1%/year) can be attributed to two key factors. First, introducing stricter building regulations in 2007 played 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. Energy consumption for electrical appliances and lighting has declined steadily since 2014, accounting for 38% of energy consumption (excluding space heating) in 2023. This reduction is primarily driven by the widespread adoption of energy-efficient appliances and broader technological advancements in device efficiency. Meanwhile, water heating has been stable and emerged as the dominant energy end-use, representing 42% of consumption in 2023. Cooking makes a smaller but steady contribution, while air conditioning remains negligible throughout the period.

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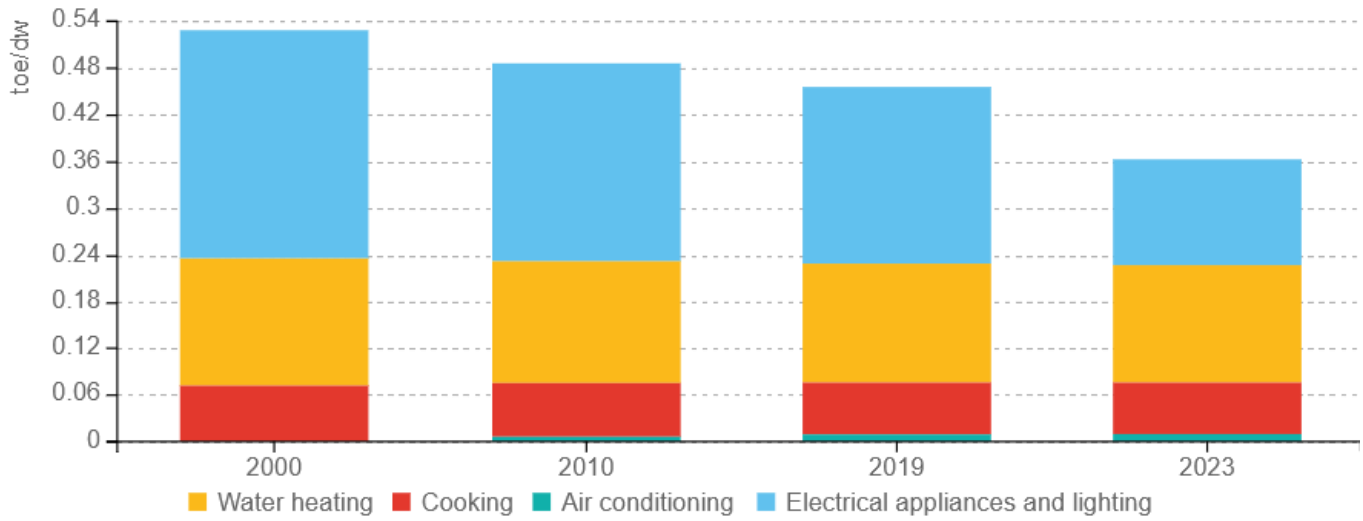
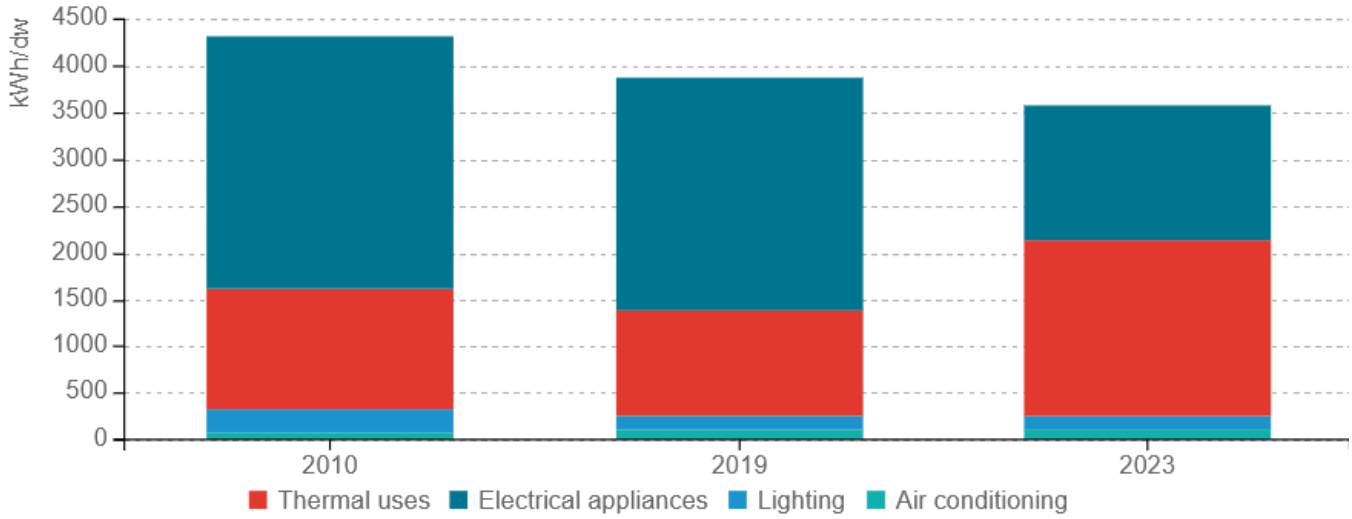
Figure 9: Energy consumption per dwelling by end-use (except space heating)



Source: ODYSSEE

Overall, a gradual reduction in electricity consumption per dwelling is observable, mostly driven by advancements in energy-efficient technologies but partly offset by a heightened demand for thermal uses. Electricity consumption from electrical appliances has declined by 47% since 2010, reflecting significant energy efficiency improvements. Despite this reduction, appliances remained the second-largest contributor to electricity consumption in 2023, though their share fell to 40%. Conversely, thermal uses experienced substantial growth post-2019, becoming the leading contributor to electricity consumption at 53% in 2023. Lighting and air conditioning remain steady but negligible.

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



Source: Odyssee

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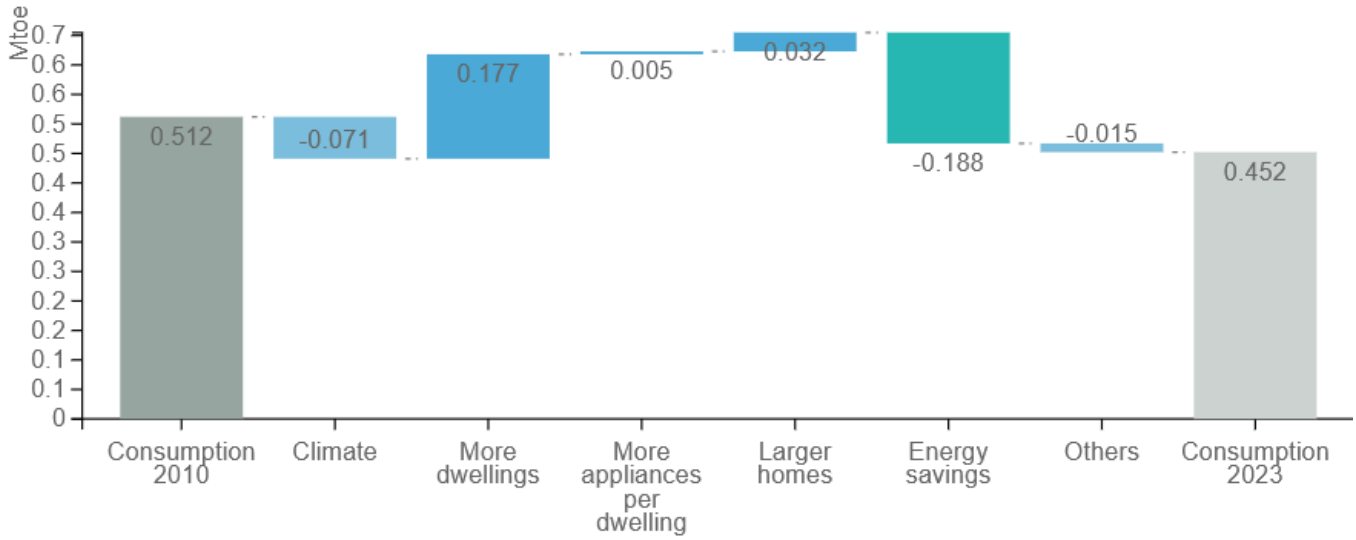
Energy consumption in the residential sector shows a slight decrease (-0.06 Mtoe) from 0.512 Mtoe in 2010 to 0.452 Mtoe in 2023. This decline is attributed to energy savings (-0.188 Mtoe), due to heightened energy efficiency standards, significantly reducing energy demand per unit area, and climate (-0,071 Mtoe).However, this improvement has been offset by an increase in the number of dwellings, driven by a rise in population (+0.177 Mtoe). Additionally, a certain rebound effect has emerged, as larger homes are being built leading to higher overall energy use (+0.032 Mtoe).

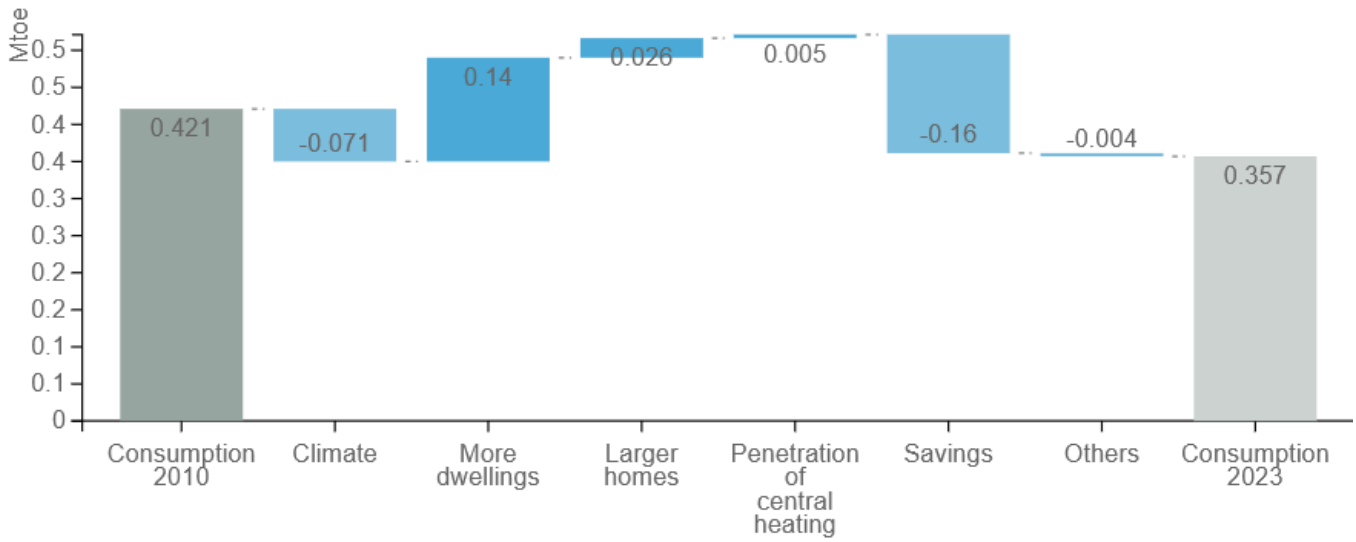
Figure 11: Main drivers of the energy consumption variation in households



Source: ODYSSEE

Space heating consumption for households decreased from 0.421 Mtoe in 2010 to 0.357 Mtoe in 2023 (-0.064 Mtoe). Key drivers include energy savings (-0.16 Mtoe) and climate adaptation (-0.071 Mtoe). This is however offset by an increased number of dwellings (+0.14 Mtoe), and larger homes (+0.026 Mtoe). Central heating penetration (+0.005 Mtoe), and other factors (-0.004 Mtoe) were negligible.

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



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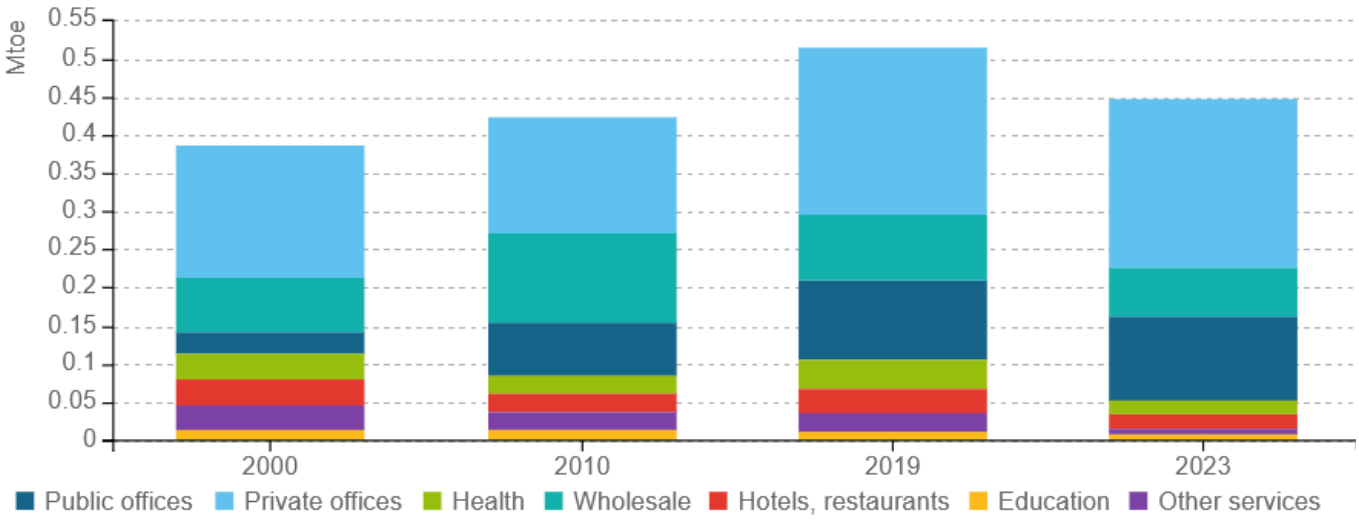
Source: Odyssee

Final energy consumption in the services sector increased from 2000 to 2019, and declined to 0.45 Mtoe in 2023. Private offices dominate services final energy consumption (0.22 Mtoe), followed by public offices (0.11 Mtoe) and wholesale (0.064 Mtoe). Health, hotels/restaurants, and education sectors maintained steady contributions, with minor variations. "Other services" showed stable but smaller shares throughout.

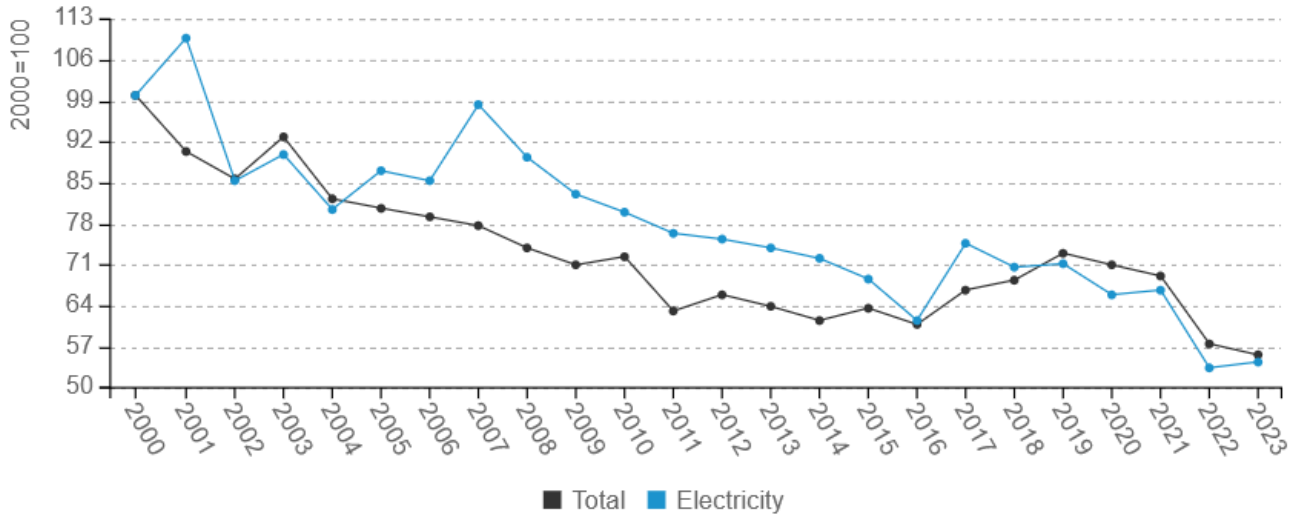
Figure 13: Final energy consumption of services by branch



Source: Odyssee

The specific energy and electricity consumption indexes per employee have steadily decreased since 2000 to 55.6 (energy) and 54.4 (electricity) in 2023. This decrease is linked to the higher headcount of the whole sector (from 188.800 employees in 2000 to 411.350 in 2023) and to the technical progress in installations (HVAC, lighting, computers...).

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



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Source: ODYSSEE

The policy measures implemented in the buildings sector are crucial to triggering 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
"Klimabonus Wunnen", Grant scheme for sustainable housing, sustainable energy renovations an installation of renewable systems (2022-2025)	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
Individual housing assistance scheme	Yes	The bill on individual housing subsidies (no. 7938) provides for income-tested individual housing subsidies: - energy retrofit premium as a supplement to financial assistance under the "Klimabonus Wunnen" scheme (eligible households up to income corresponding to the median standard of living (decile 5); maximum premium: 100% of Klimabonus Wunnen assistance) ("social top-up") - climate loans - in this case a state guarantee and a climate loan interest subsidy - in connection with the energy renovation of a home; these provisions will take over the "climate loans" aid scheme.	0.80 TJ

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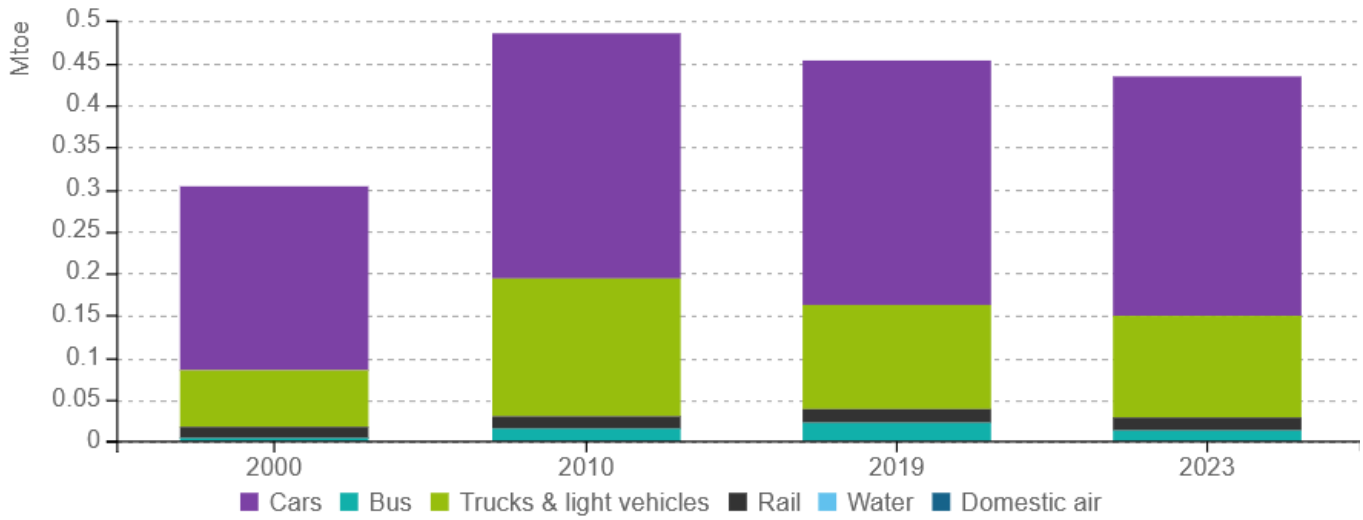
Tax incentives for energy-efficient home renovation	Yes	To promote energy-efficiency renovation, a depreciation rate of 6% for 10 years is granted for all investments in sustainable energy-efficiency renovation of rental properties qualifying for financial assistance under the "Klimabonus Wunnen" scheme. In addition renovation work (not limited to energy renovation) benefits from the capped capped application of the super-reduced 3% vat rate.	0.70 TJ

Source: MURE

Transport

Road transport dominates Luxembourg's transport sector energy consumption, with passenger cars representing the largest share at 66% in 2023, a 6-percentage-point rise since 2010. Trucks and commercial vehicles followed as the second-largest contributor, accounting for 28% of the sector's energy use. Rail transport and buses remain stable.

Figure 15: Transport energy consumption by mode



Source: ODYSSEE

The modal split is dominated by cars with a share of 81% in 2023, remaining on a high level since 2000. Regarding public transport, buses accounted for 13.3% of the modal split in 2023, and trains represented 6%, both showing a slight increase.

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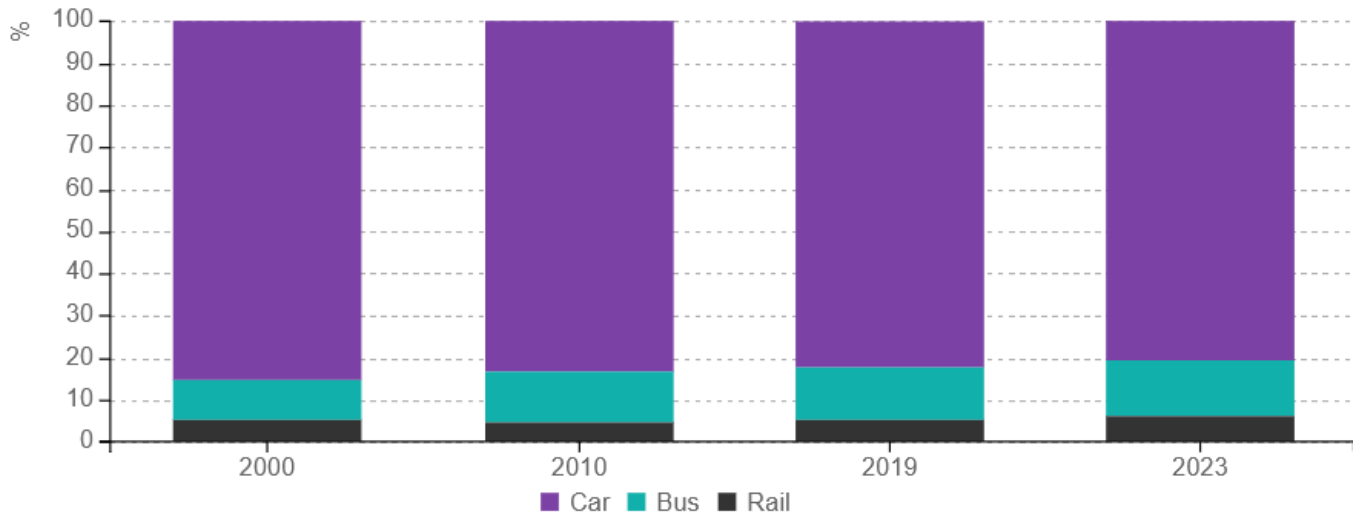
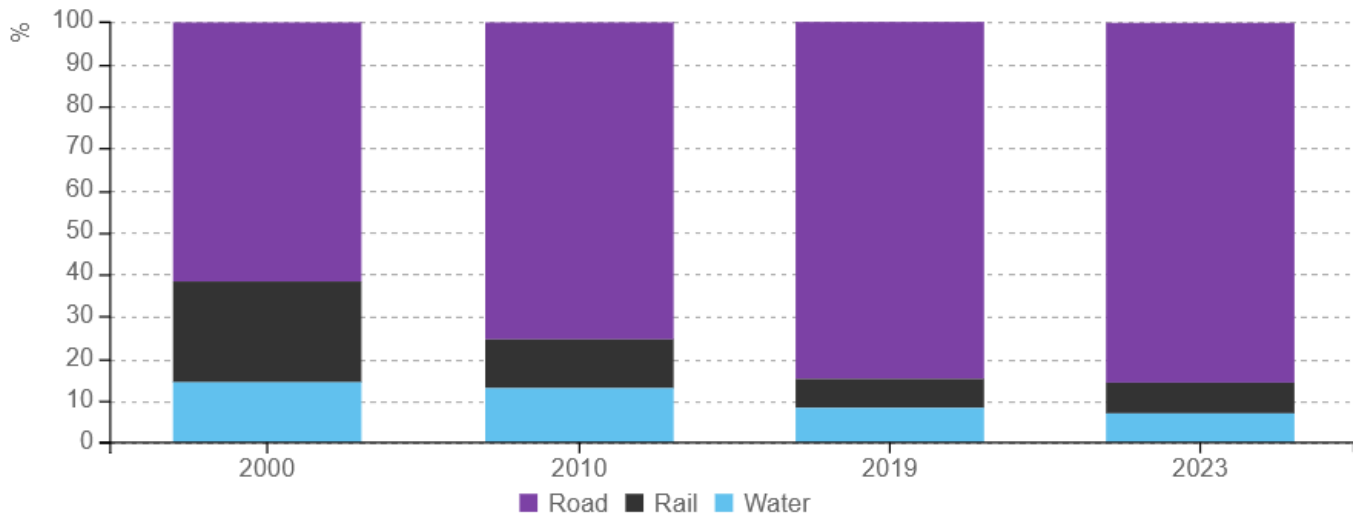
Figure 16: Modal split of inland passenger traffic



Source: ODYSSEE

The share of road freight transport has increased over time, reaching 85.7% in 2023. However, this has been at the expense of rail freight traffic, which has fallen sharply by 73% since 2000, resulting in a share of 7.3% in the modal split. Waterway traffic similarly fell by 56% over the same period, resulting in a share of 6.9%.

Figure 17: Modal split of inland freight traffic



Source: ODYSSEE

Since 2017, Luxembourg has intensified its efforts to promote low-emission mobility through a combination of information campaigns, financial incentives and infrastructure development. These measures have led to a marked rise in electric and hybrid vehicle registrations. While efficiency improvements in conventional vehicles remained an important driver of declining energy use per passenger-kilometer, the increasing penetration of electric vehicles in recent years has begun to exert a measurable downward effect on this indicator. A significant

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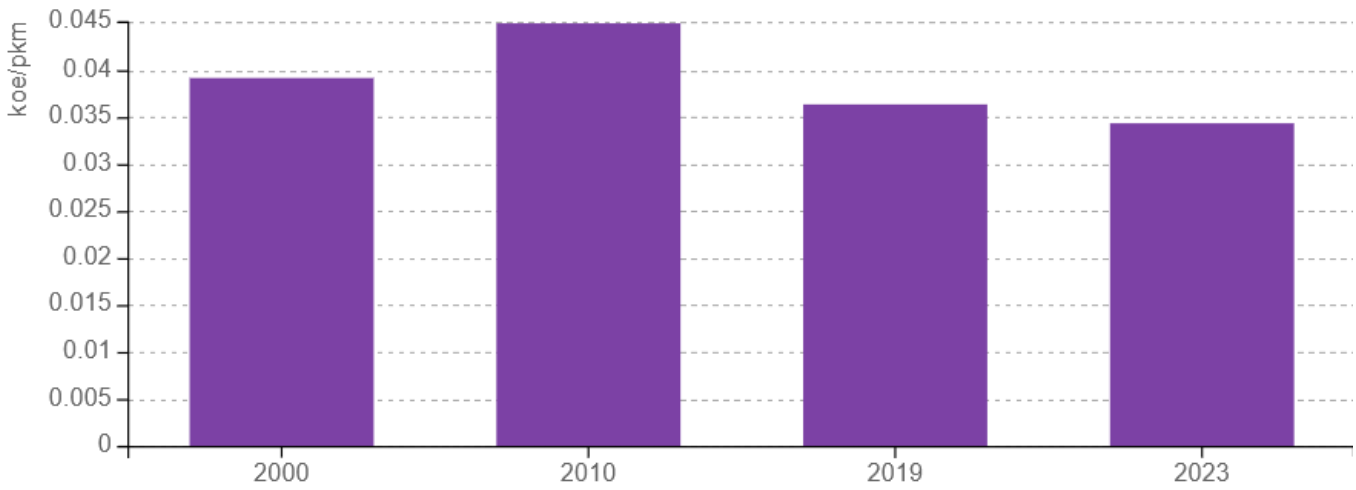
milestone was reached in March 2020, when all public transport in Luxembourg became completely free. This initiative likely shifted a portion of the population from private car use to more sustainable transportation options, further reducing energy consumption per passenger-kilometer. In addition, recent 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 2023.

Figure 18: Energy consumption of cars per passenger-km



Source: ODYSSEE

Assessing Luxembourg's energy use proves difficult because of the impact of foreign vehicles. Shifts in energy demand are largely driven by variations in transit traffic and fuel purchases by foreign vehicles, sectors over which Luxembourg has little control. Nevertheless, as the gap in fuel prices fades, fuel buying by foreign vehicles decreases steadily. The other effects like increased transport activity, energy savings from improved fuel efficiency and a shift to public transport exist but only play a minor role.

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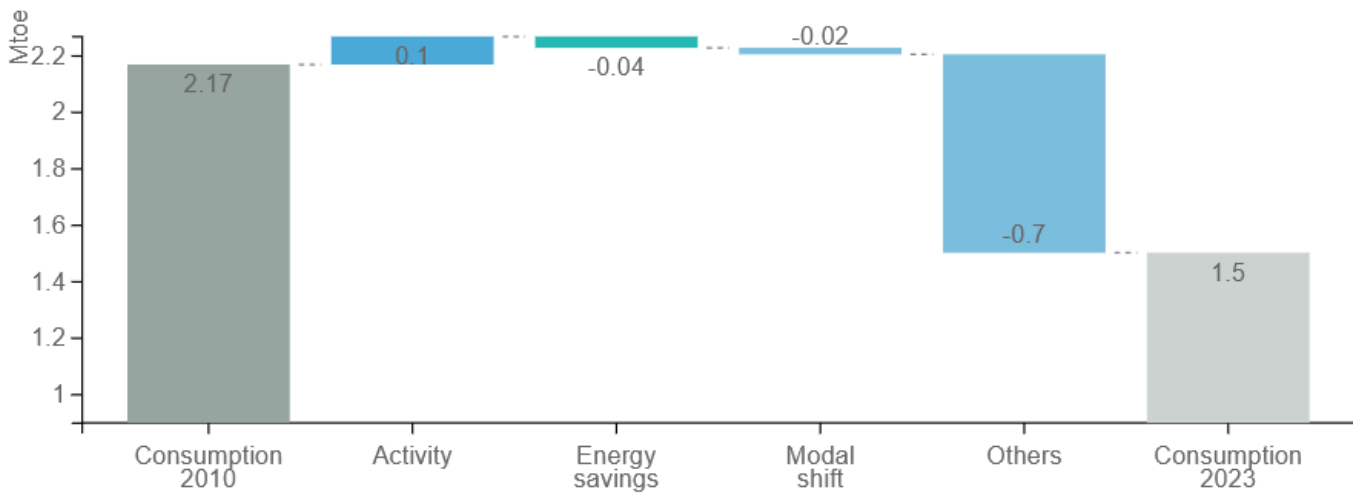
Figure 19: Main drivers of the energy consumption variation in transport



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 than a CO2-linked vehicle tax, which applies only to resident vehicle owners, and is therefore less significant. Luxembourg has implemented measures to promote zero-emission vehicles, including tax rebates and grants for private individuals and enterprises, alongside the expansion of public transport and the introduction of free public transport. While these policies have already begun to reshape mobility patterns, their most lasting impact may lie in the long-term transformation of the vehicle fleet.

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

Measures	NECP measures	Description	Expected savings, impact evaluation
Promoting the electrification of the vehicle fleet registered in Luxembourg	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 basic public charging infrastructure Chargy; - 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	3.00 TJ

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		electric vehicles (cars and vans) vans); - extensive 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 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 category B license; - 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.	
Promotion of public transport	Yes	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. 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.	2.50 TJ
Grant scheme for low CO2 emission cars and electric cars (2019)	Yes	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.	1.70 TJ

Source: MURE

Industry

Between 2000 and 2023, the energy consumption of the industrial sector has decreased by 34%. Energy consumption in the non-metallic minerals industry has plummeted by 62% since 2018, representing the most significant sectoral declines. The consumption of the steel industry also declined sharply since 2018 (-32%).

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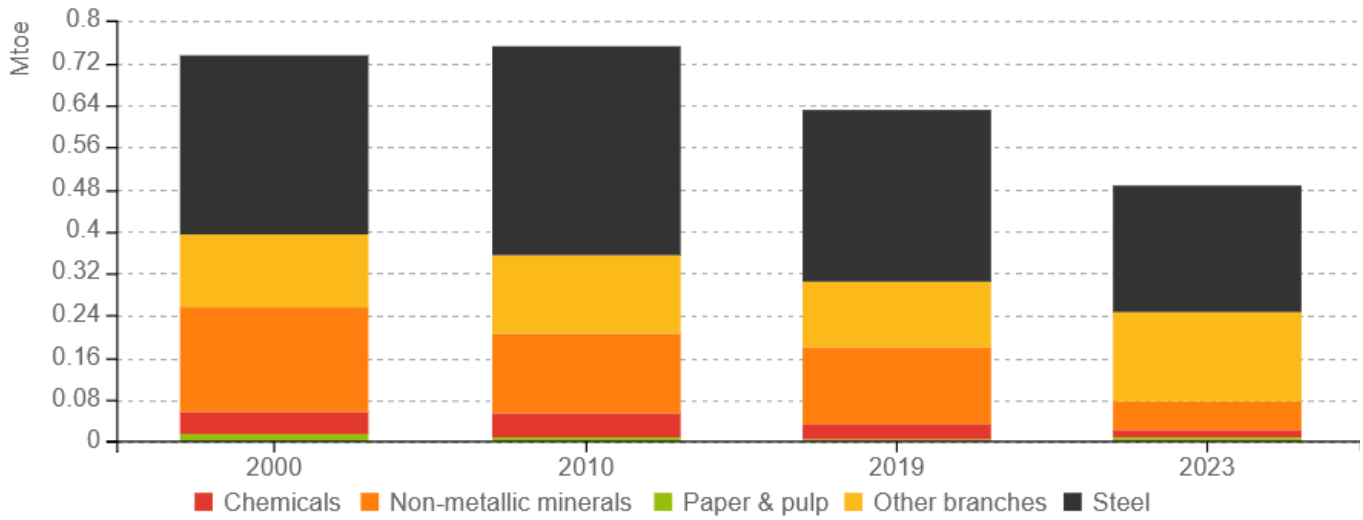
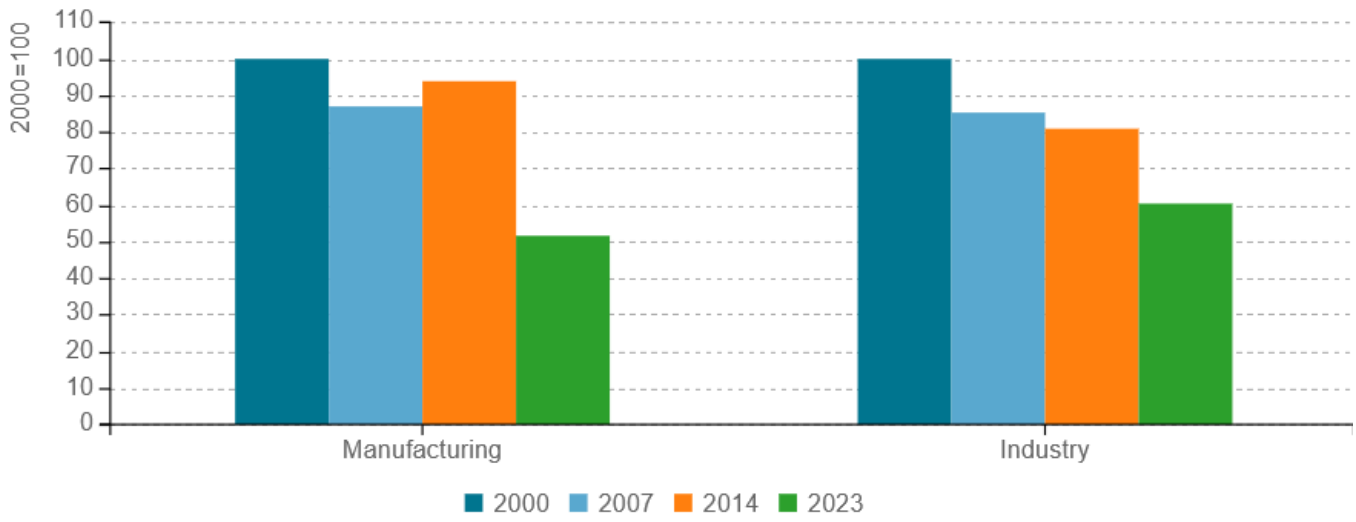
Figure 20: Final energy consumption of industry by branch



Source: ODYSSEE

The industrial sector shows a steady decline in energy intensity over the past 20 years, largely driven by developments in the manufacturing industry. This can be explained by the developments in the steel industry: major mill refurbishments, post-crisis partial operation, and voluntary agreements improving efficiency.

Figure 21: Energy intensity of industry (at purchasing power parities)



Source: ODYSSEE

The 34% reduction in industrial energy consumption between 2000 and 2023 (-0.24 Mtoe) can be attributed to a combination of factors. Energy savings from successive voluntary agreements with industry represent the largest share, amounting to -0.132 Mtoe. Structural changes within the sector, including evolving production structures, contributed -0.088 Mtoe. Smaller contributions arise from reduced activity levels (-0.014 Mtoe) and other minor effects (-0.005 Mtoe).

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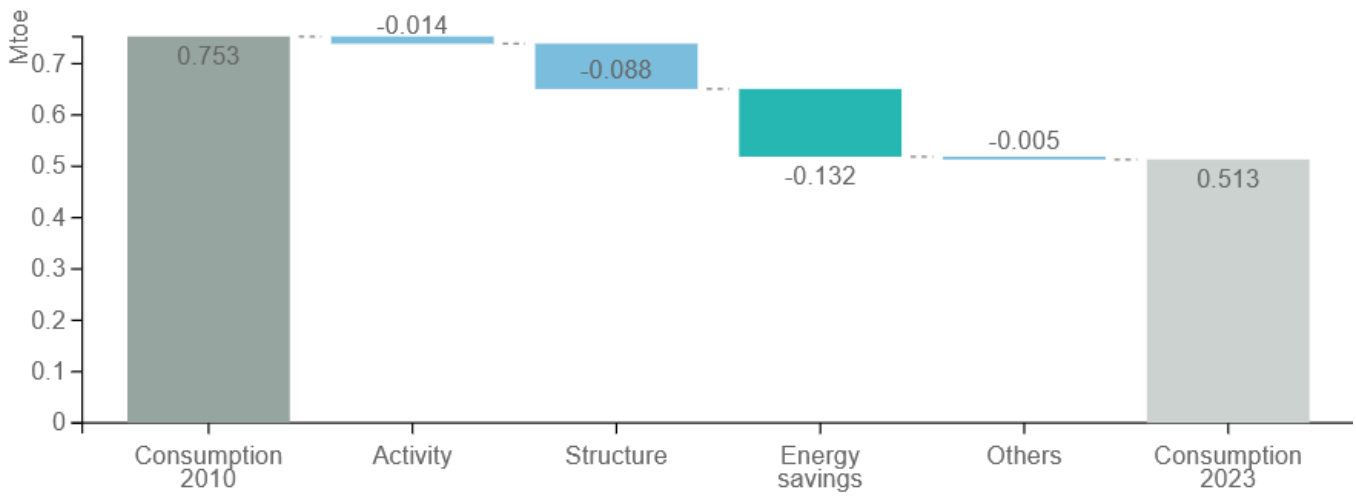
Figure 22: Main drivers of the energy consumption variation in industry



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
Voluntary Agreement (2024 - 2030)	Yes	The voluntary agreement (VA) with industry will be revised and renewed for the period 2024 to 2030. The scope will be extended to include the dimension of decarbonization in addition to energy efficiency. Companies will be asked to commit to a combined objective of reducing their greenhouse gas emissions, improving their energy efficiency and producing or even consuming renewable energy.	0.08 TJ
Mandatory energy audits for companies (Revision EED 2023)	Yes	The obligation to carry out an energy audit for companies meeting certain criteria will be revised on the basis of the revision of the Energy Efficiency Directive (EED) scheduled for 2023. The eligibility criterion will no longer be the company's size classification (SME or non-SME), but the level of annual energy consumption. If the level	0.13 TJ

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		exceeds 10 TJ (2.78 GWh), an audit is mandatory, and if it exceeds 85 TJ (23.6 GWh), an energy management system is required. EPCs (Energy Performance Contracting) will be taken into consideration.	

Source: MURE

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