Analysis of greenhouse gas emissions at the University of Luxembourg

Year 2023

Update and comparison with the reference year 2019

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1. Context

In 2024 and 2025, the University undertook to update its analysis of greenhouse gas emissions for the year 2023. This work constitutes the second analysis on this subject, following the one carried out for the reference year 2019.

Since 2019, the geopolitical, health and societal contexts in which the University operates have changed significantly and have had a major impact on the organisation and functioning of the institution. The health crisis resulting from the COVID-19 pandemic and its economic consequences, the war in Ukraine and its impact on energy supplies and prices, to highlight just two events, have shaken the foundations of our economy and impacted the functioning of the University. The widespread use of homeworking has also, for other reasons, affected the organisation of the institution.

Despite this changing context, the University has continued to grow, welcoming more students, employing more academic staff and requiring more support staff. The portfolio of research projects has expanded, requiring more equipment and office and laboratory space.

2. Overall results and comparison with the reference year

2.1. Revision of 2019 emissions

During the analysis work for 2023, three discrepancies were identified in the calculations of the previous analysis.

Emissions related to home-to-campus mobility had been overestimated during the extrapolation phase of the data collected in the mobility survey of the entire staff population. A difference of -1,064 tCO_2e was calculated.

Emissions relating to the construction of buildings made available or leased to the University had been underestimated when obtaining data on gross internal floor space from the Infrastructure Department. A difference of +125 tCO_2e was calculated.

Finally, emissions related to the construction of University residences had been recognised over an incorrect amortisation period that differed from the assumption used by the emission factor. A difference of -112 tCO_2e was calculated.

The **revised** greenhouse gas emissions from the University's activities for 2019 are therefore set at **43,030 tCO_2e** instead of 44,080 tCO_2e, a difference of -1,050 tCO2e, or -2.38%.

2.2. Emissions for 2023

Greenhouse gas emissions resulting from the University's activities for 2023 amount to **44,617 tCO_2e**. Details and associated uncertainties are presented in the table below.

			Emissions			Uncertainties	
			tCO_2e	Share		%	+/- tCO_2e
Energy	Scope 1	Gas	303			14,4%	44
	Scope 2	Elec/heating/cold	3 945			10,6%	417
		Sub-total	*4 248*	*10%*		*9,9%*	*419*
Mobility	Scope 1	Fuel	13			11,2%	1
	Scope 3	Commuting	8 341			33,1%	2 762
	Scope 3	Inter-campus moves	218			23,5%	51
	Scope 3	UL business travel	3 590			37,7%	1 355
	Scope 3	Visitors' travel	1 650			34,8%	574
		Sub-total	*13 812*	*31%*		*22,7%*	*3 130*
Goods & services	Scope 3	Water	5			5,8%	0
	Scope 3	Goods & services	18 523			27,7%	5 139
		Sub-total	*18 528*	*42%*		*27,7%*	*5 139*
Capital items	Scope 3	Buildings	2 406			52,2%	1 256
	Scope 3	Residences	383			58,3%	223
	Scope 3	Other capital items	5 230			47,3%	2 471
		Sub-total	*8 019*	*18%*		*34,7%*	*2 781*
Waste	Scope 3	Waste water	*10*	*0%*		*8,0%*	*1*
Total emissions			**44 617**			**14,9%**	**6 642**

Table 1 - Details of 2023 emissions and associated uncertainties

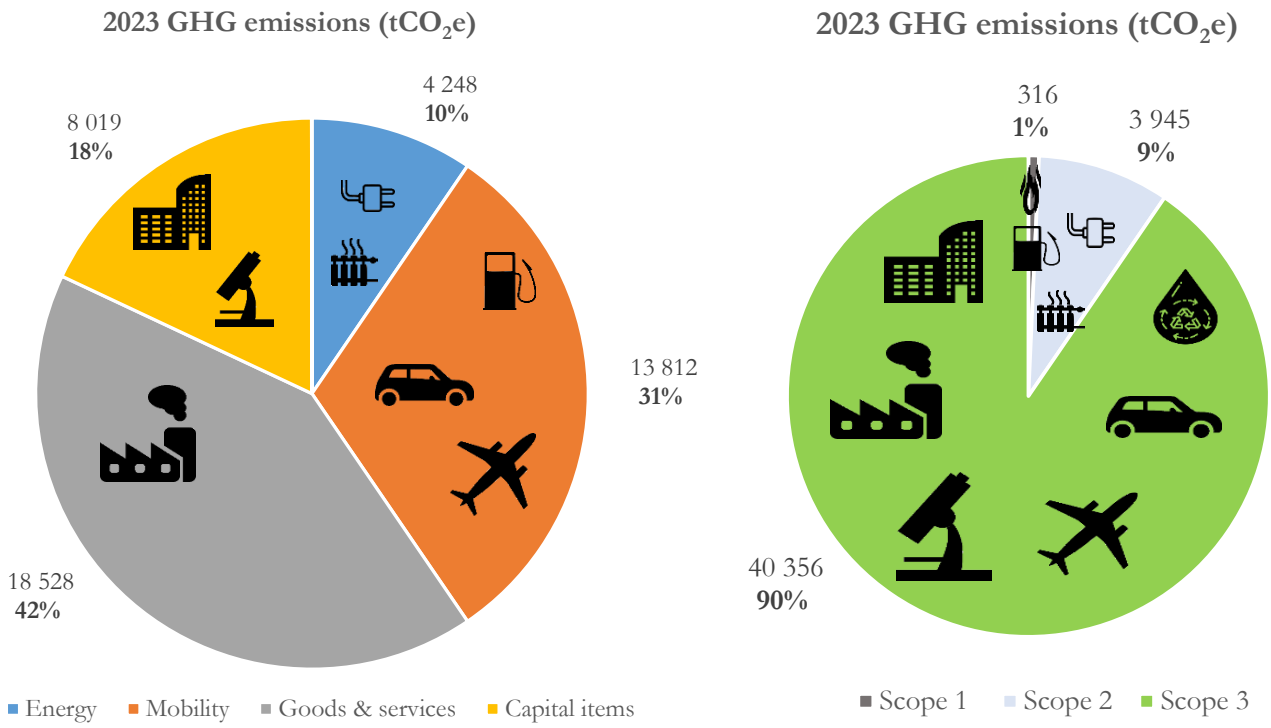


Figure 1 - Emissions in 2023, by category (left) and scope (right)

The main source of greenhouse gas emissions comes from **the purchase of goods and services**, which accounts for 42% of total annual emissions. **Mobility** in the broad sense accounts for 31% of emissions, with a predominance of staff and student commuting between home and campus (19% of the total). This is followed by **capital items** with 18% of emissions and **energy** with 10%.

Most of the University's emissions (90%) fall under **scope 3**[1], i.e. indirect emissions that are not related to energy. The latter (purchases of electricity, heating and cooling), which define scope 2, account for only 9% of emissions. Direct emissions from the on-site combustion of fuels are marginal, accounting for only 1% of the University's emissions.

2.3. Comparison with emissions in 2019, the reference year

The University's greenhouse gas emissions in 2023 are higher overall than those recorded in 2019 (revised), the reference year. The **increase is around 1,587 tCO_2e, or 3.7%**.

			2023 Emissions tCO_2e	Share		2019 (revised) Emissions tCO_2e	Share		2023-2019 Variation
Energy	Scope 1	Gas	303			545			-44,4%
	Scope 2	Elec/heating/cold	3 945			4 558			-13,5%
		Sub-total	*4 248*	*9,5%*		*5 103*	*11,9%*		*-16,8%*
Mobility	Scope 1	Fuel	13			13			0,2%
	Scope 3	Commuting	8 341			8 801			-5,2%
	Scope 3	Inter-campus moves	218			37			489,8%
	Scope 3	UL business travel	3 590			3 643			-1,5%
	Scope 3	Visitors' travel	1 650			1 641			0,5%
		Sub-total	*13 812*	*31,0%*		*14 135*	*32,8%*		*-2,3%*
Goods & services	Scope 3	Water	5			5			-3,4%
	Scope 3	Goods & services	18 523			16 705			10,9%
		Sub-total	*18 528*	*41,5%*		*16 710*	*38,8%*		*10,9%*
Capital items	Scope 3	Buildings	2 406			2 244			7,2%
	Scope 3	Residences	383			417			-8,0%
	Scope 3	Other capital items	5 230			4 410			18,6%
		Sub-total	*8 019*	*18,0%*		*7 071*	*16,4%*		*13,4%*
Waste	Scope 3	Waste water	*10*	*0,0%*		*11*	*0,0%*		*-3,4%*
Total emissions			**44 617**			**43 030**			**3,7%**

Table 2 - Details of 2023 and 2019 emissions

This overall increase in emissions is due to two groups with opposite trends:

- Emissions from the purchase of **goods and services** rose between 2023 and 2019 (1,818 tCO_2e, or +10.9%), as did emissions from the heterogeneous group of **capital items** (949 tCO_2e, or +13.4%). This

[1] Further explanations on the classification of greenhouse gas emissions according to scopes, as well as on the calculation of uncertainties related to emissions, can be found in the appendix to this analysis.

rise in emissions is linked to the University's ongoing development, which consumes more goods and services (either immediately or as fixed assets) and requires more office and laboratory space.

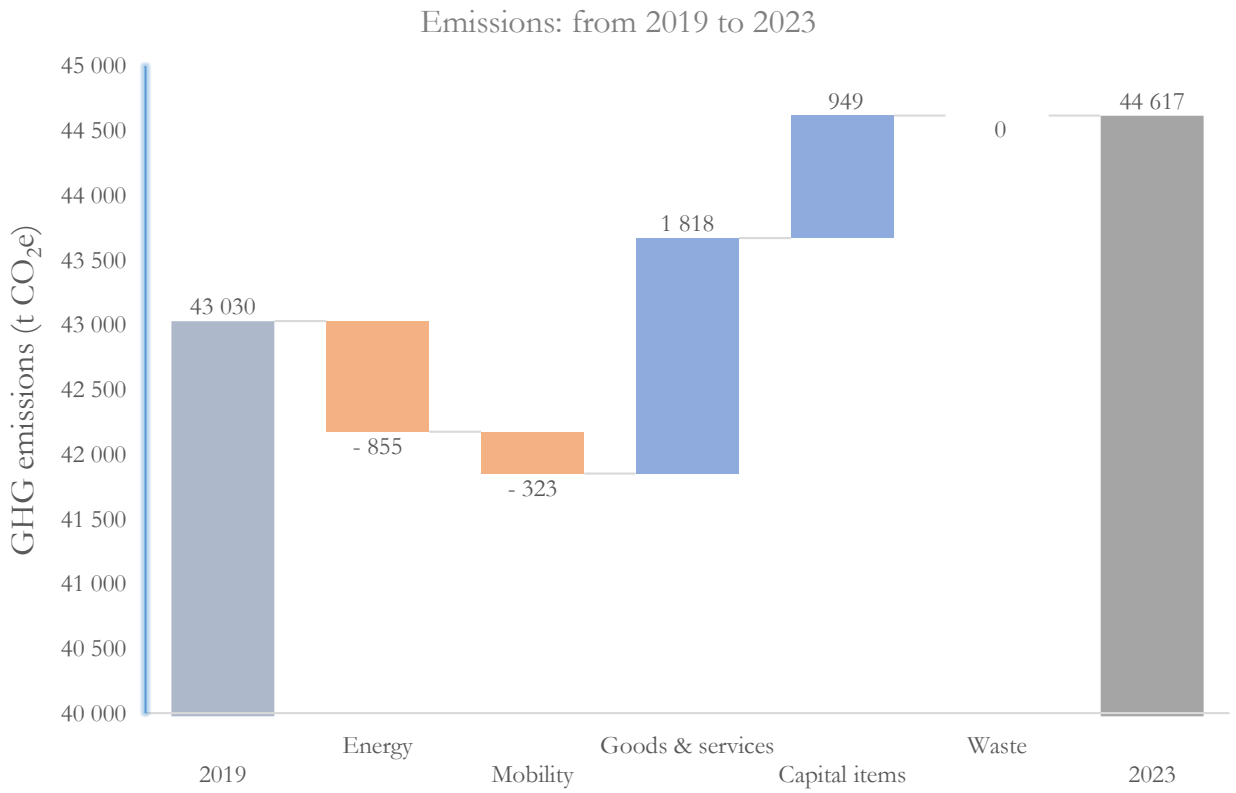


Figure 2 - Change in emissions between 2019 and 2023

- **Energy-related** emissions fell significantly (-855 tCO_2e, or -16.8%), illustrating the efforts to reduce energy consumption undertaken after the outbreak of the war in Ukraine. However, we will see that the impacts are not entirely uniform across energy vectors and university buildings. Emissions from **mobility** fell slightly (-323 tCO_2, or -2.3%), driven by the contraction in emissions from home-to-campus commuting (-460 tCO_2e or -5.2%) and business travel (-53 tCO_2e or -1.5%), despite better accounting for travel between campuses (+ 181 tCO_2e or +490%).

2.4. The University's carbon footprint

As observed, the net increase in greenhouse gas emissions from the University's activities is driven by expanding operations, fuelled by a growing number of staff and students, but partially mitigated by efforts to reduce energy consumption in buildings and mobility journeys.

Although the Paris Agreement's objective of holding "the increase in the global average temperature well below 2°C above pre-industrial levels" and pursuing efforts "to limit the temperature increase to 1,5°C above pre-industrial levels" requires a rapid and absolute reduction in emissions, a positive intermediate development is the observed decrease in the University's carbon footprint between 2019 and 2023.

We define the University's carbon footprint as the impact of its activities in terms of greenhouse gas emissions relative to the number of people comprising the university community (staff and students). To make this calculation more meaningful, we have attempted to link the different categories of the analysis to staff, students or the community as a whole.

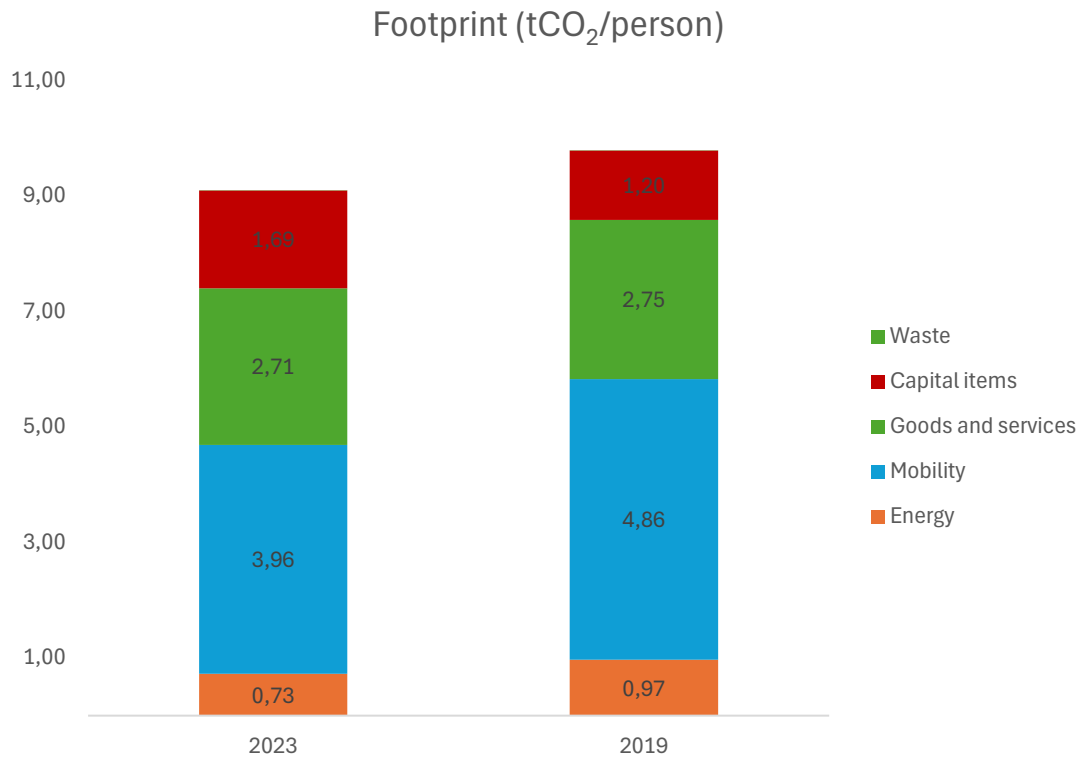


Figure 3 - University's carbon footprint in 2023 and 2019

This indicates that the University's carbon footprint has declined, from 9,78 tCO_2e per person in 2019 to 9,09 tCO_2e per person in 2023 (–7,1%). This demonstrates that, while emissions have not decreased in absolute terms, they are growing more slowly than the University community, indicating a relative decoupling between the two. It also highlights the importance of individual efforts and the role of the community in fostering more sustainable behaviours. The 'carbon content' of the University's activities relative to its community is decreasing, a necessary prerequisite for their stabilisation and subsequent reduction.

The most significant reduction is attributable to mobility, which fell by 0,9 tCO_2/person, followed by energy consumption (-0,24 tCO_2/person). It should be noted that the sharp increase in emissions linked to the purchase of goods and services is offset here, with the footprint of this category remaining stable (2,75 tCO_2/person in 2019, 2,71 tCO_2/person in 2023), whilst capital items, particularly scientific equipment and IT infrastructure, see their footprint increase significantly (+0,49 tCO_2/person).

3. Highlights

From the analysis of greenhouse gas emissions from the University's activities in 2023 and the detailed results further presented in Part 4, we can highlight the following findings:

Where the University has taken action and made efforts to contain its emissions, either directly or indirectly, they have fallen or are under control.

Emissions related to energy consumption in buildings fell importantly between 2019 and 2023 (-17.3% or -855 tCO_2e), following energy-saving efforts in the wake of the outbreak of the war in Ukraine, the sanctions imposed by the European Union and the ensuing market destabilisation. These efforts have been substantial, visible and have resulted in significant reductions in emissions.

Commuting between home and campus for University staff and students has also been positively affected by the measures implemented by the institution, primarily the roll-out of a homeworking policy. Various measures to promote car sharing, public transport and active mobility have also been introduced in recent years. Emissions from this activity fell by 5.2% between 2018 and 2023 (-460 tCO_2e), with homeworking alone producing a reduction of 328 tCO_2e.

Finally, business travel by members of the university community recorded a slight decrease in emissions between 2019 and 2023 (53 tCO_2 or -1.5%), mainly due to the fact that activity in 2023 had not returned to the level seen in 2019. The distance travelled by plane in 2023 represented 89% of the distance travelled in 2019, while the distance travelled by train increased by 29%. The validation of the sustainable travel policy in 2025 and the roll-out of its implementation procedure at the end of the year could accelerate the reduction of emissions related to business travel.

However, the University's continued significant growth in terms of staff (+21.8%), student enrolment (+13.8%) and the development of its activities (purchases up by 15.2%) has had an impact on the University's absolute emissions, which rose by 3.7% over the period.

The strategic priority given by the University to research into digital transformation has enabled the institution to invest in infrastructure supporting research and innovation in digitalisation, ICT, data science and artificial intelligence. Emissions linked to investments in IT infrastructure rose by 51% (+610 tCO_2e), while increased energy consumption (electricity and cooling) at the *centre de calcul* (including HPC) and the newly created DRS contributed to an increase in emissions of 433 tCO_2e.

The development of the University's activities has obviously led to additional office and laboratory space requirements (Rouden Eck and KTT5 only, as the impacts relating to the creation of the LCES and the integration of ULCC have not yet been included as they are post-2023), scientific equipment (capital items) and various purchases (including consumables, repair and maintenance services and small non-capital equipment). These three specific impacts contributed to a specific increase in emissions of around 3,664 tCO_2e[2] (+8.5%) compared to 2019.

The outlook and points for attention are discussed in Section 5. Outlook. Based on an extrapolation of historical growth (2019-2023) in staff and student numbers, we anticipate that the University's greenhouse gas emissions will increase again by 6.1% between 2023 and 2025.

[2] The breakdown of these increases is as follows: 161 tCO_2e for emissions from buildings (capital items), 1,865 tCO_2e for scientific equipment (capital items) and 1,818 tCO_2e for purchases of goods and services.

4. Detailed results

4.1. Energy

4.1.1. Emissions 2023

Emissions related to energy consumption amounted to 4,248 tCO_2e in 2023. Most of these emissions fall within Scope 2, i.e. indirect emissions related to energy purchases (3,945 tCO_2e – 92.9%). Scope 1 includes emissions produced by the combustion of boiler gases, which concerns a small minority of buildings.

All of the University's electricity supply contracts are green and are backed by renewable energy certificates. Based on the market-based principle (for which the GHG Protocol recommends reporting results), emissions related to electricity consumption would be zero and emissions related to energy consumption would then amount to 1,434 tCO_2e in 2023.

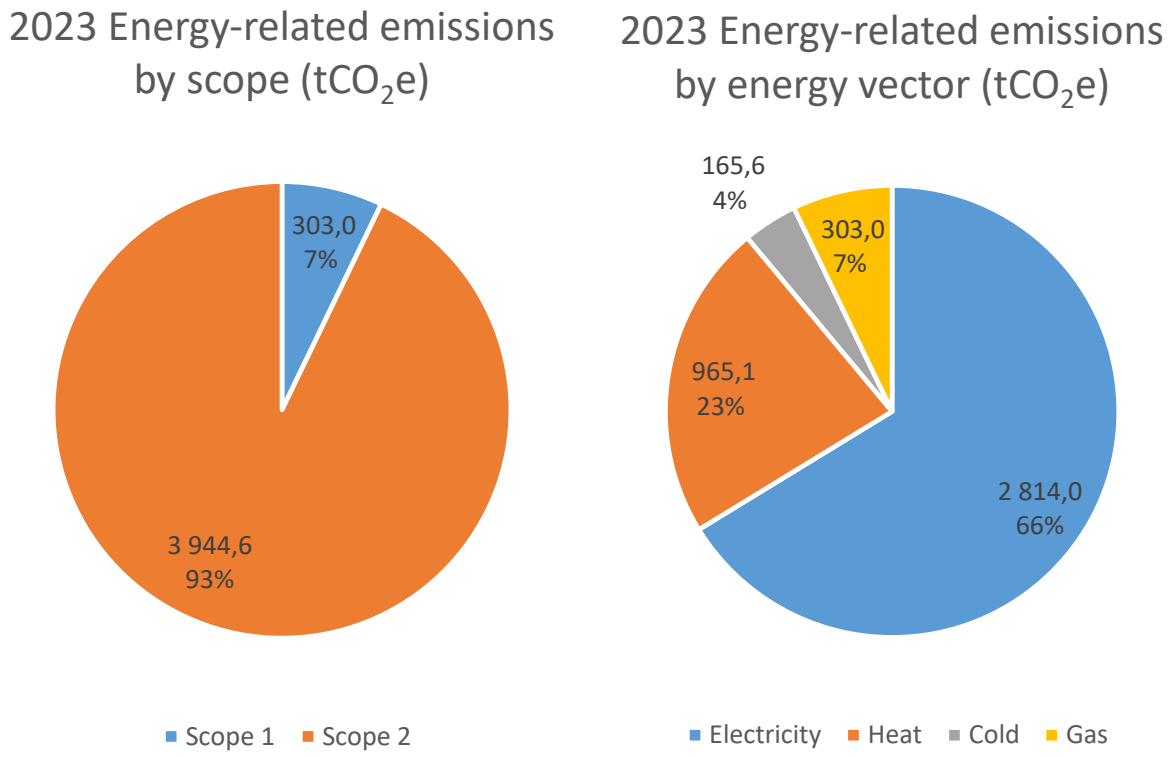


Figure 4 - Emissions (energy) 2023, by scope (left) and category (right)

Two-thirds of emissions are produced by electricity consumption in buildings, with 23% coming from heat purchased from the Belval and Kirchberg networks. Gas combustion accounted for 7% of emissions and cooling energy consumption for only 4%.

The distribution of emissions relating to energy consumption in buildings by building and energy vector shows considerable variation:

- The **Centre de Calcul** (CDC), which houses the University's IT infrastructure, including **HPC**, together with the **DRS** (Disaster Recovery Site), accounts for 23.15% of the University's emissions directly related to energy consumption. These consist of emissions related to electricity consumption and the use of cooling energy.
- The **Limpertsberg** campus (CL), driven by high natural gas consumption, and the **Kirchberg** campus (CK) (excluding the JFK and Weicker (WEI) buildings), with very high heat consumption, are on a par with the Maison du Savoir (MSA). Together, they account for between 10 and 12% of the University's energy-related emissions. In terms of surface area, the carbon intensity of energy consumption is 2.25 times higher for the Kirchberg campus and 4.39 times higher for the Limpertsberg campus than for the Maison du Savoir.
- The **BT2**, undoubtedly due to the energy consumption of the laboratories, accounts for 8.42% of energy-related emissions (and 9.52 times the carbon intensity per m^2 of the MSA). The **BTA** (animal facility) is in a similar situation, due to the temperature and humidity constraints associated with the living conditions of the animals, and accounts for 5.74% of energy-related emissions.
- The Luxembourg Learning Centre (LLC), the Maison des Sciences Humaines (MSH) and the Maison des Arts et Etudiants / Maison du Nombre (MNO/MAE) account for 5.58%, 5.37% and 4.70% of the energy-related emissions respectively. These buildings have a fairly similar energy profile and behave in a similar way to the MSA in terms of carbon intensity per m^2.

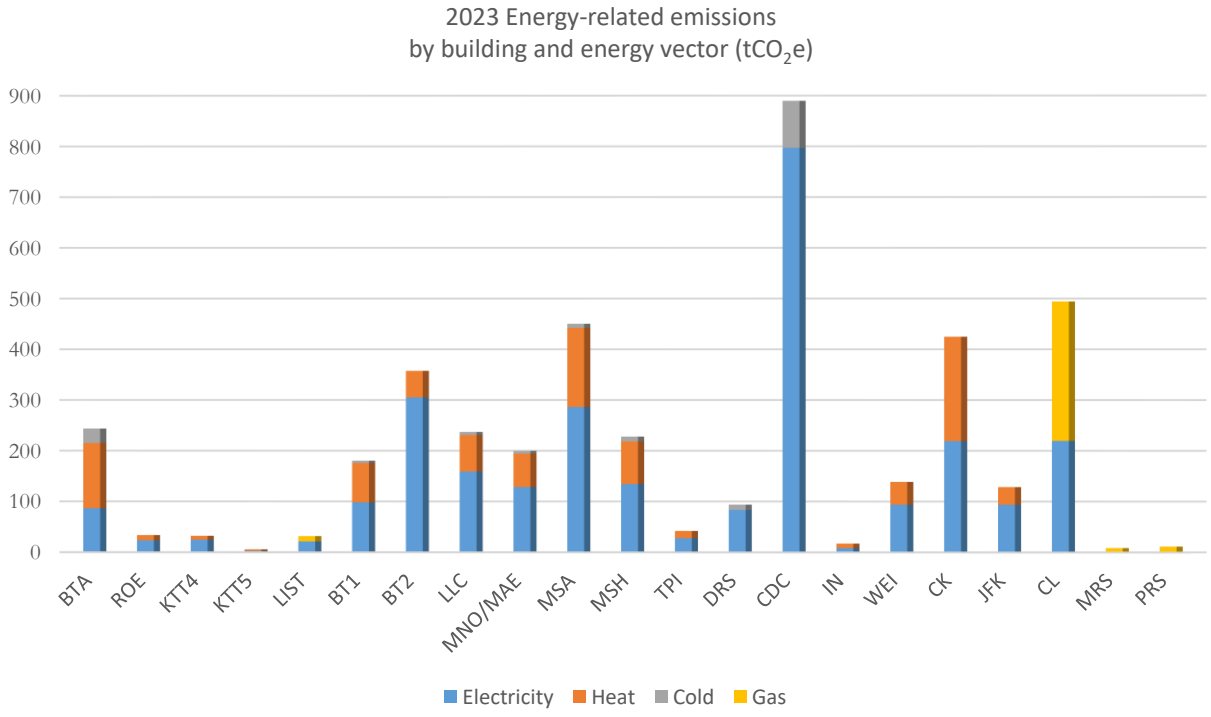


Figure 5 - Emissions (energy) 2023 by building and energy vector

4.1.2. Change since 2019

Energy-related emissions from buildings fell importantly between 2019 and 2023, from 5,103 to 4,248 tCO_2e (- 16.8%).

Although the University rented additional space (Rouden Eck [ROE], Ketterthill 5th floor [KTT 5] and the DRS premises at the MSH) during this period and continued to develop its activities through ongoing growth in staff, purchases, equipment and funding, it significantly reduced its overall energy consumption. This is the result of voluntary and concerted efforts following the outbreak of the war in Ukraine and the destabilisation of gas supplies. At the end of 2021, with the help of the Fonds Belval and its service providers, the University undertook to adjust the technical parameters of its equipment (heating temperatures, ventilation flows, lighting), the organisation and availability of buildings (holiday periods, frost protection mode) and launched an awareness campaign for the University community on energy consumption control measures.

The **reductions in consumption**, especially in heating and gas, were spectacular and continued in 2022 and 2023. Electricity, which accounts for most of the emissions, also saw a drop in consumption, excluding **the centre de calcul and DRS**, which house IT and HPC infrastructure. The latter saw its emissions increase by 433 tCO_2e, or +97% over the period. It should be noted that the emissions related to the CDC and DRS cooling energy consumption decreased, in line with the concerted increase in the temperature of the cooling network provided by the Fonds Belval.

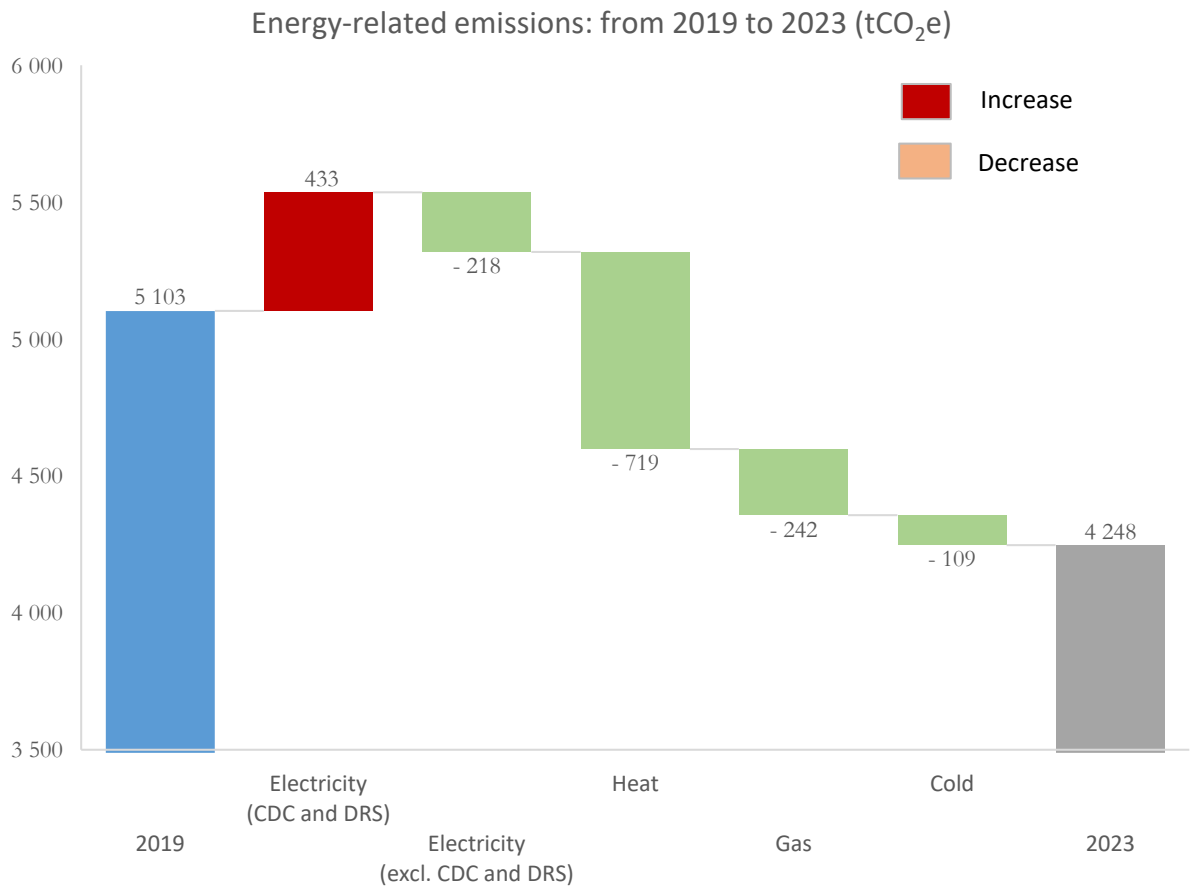


Figure 5 - Change in emissions (energy) between 2019 and 2023

The graph below confirms the considerable reductions in emissions from heat consumption and gas combustion, particularly on the **Kirchberg and Limpertsberg campuses**. This applies to all buildings occupied by the University on various scales.

The extremely rapid increase in emissions linked to electricity consumption is very noticeable, making the **CDC** the University location's biggest emitter in 2023. The development of HPC activities, the expansion of data

hosting capacities and the creation of the DRS, in line with the University's strategic priorities, are the driving forces behind this.

The **BTA**, meanwhile, is seeing its energy emissions increase due to a significant development of its activities (+200% in active animal cages), with sterilisation and autoclaving requiring enormous amounts of electricity. The need to maintain a constant temperature also has an impact on consumption and emissions related to cooling.

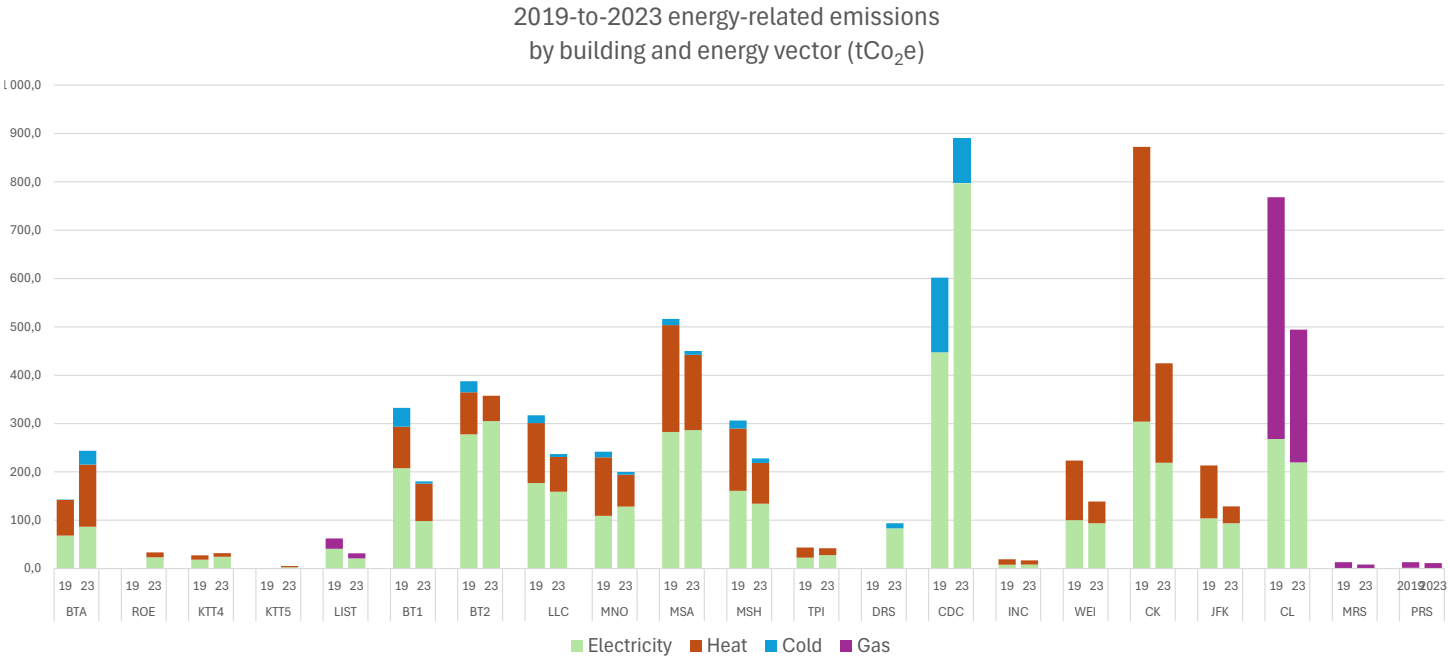


Figure 6 - Emissions (energy) in 2019 and 2023, by building and energy vector

4.2. Mobility

4.2.1. Emissions in 2023

Mobility operations, including staff and student commuting, travel between campuses, business travel and visitors' travel, emitted **12,162 tCO_2e in 2023**, representing **31.0% of the University's total emissions**.

Most of these emissions (60%) come from commuting between home and campus by the University community, followed by business travel (26%) and visits to the University (12%). It should be noted that emissions from commuting between home and campus are almost twice as high as those related to energy and alone account for 18.7% of the University's total emissions.

Car travel, which accounts for the majority of local travel, accounts for 42% of mobility-related emissions, or 5,855 tCO_2e. These are relatively less significant for student travel, which also shifts to trains and buses. **Air travel** is the most polluting mode of transport for business travel and visitors, accounting for 24% (3,279 tCO_2e) of mobility-related emissions.

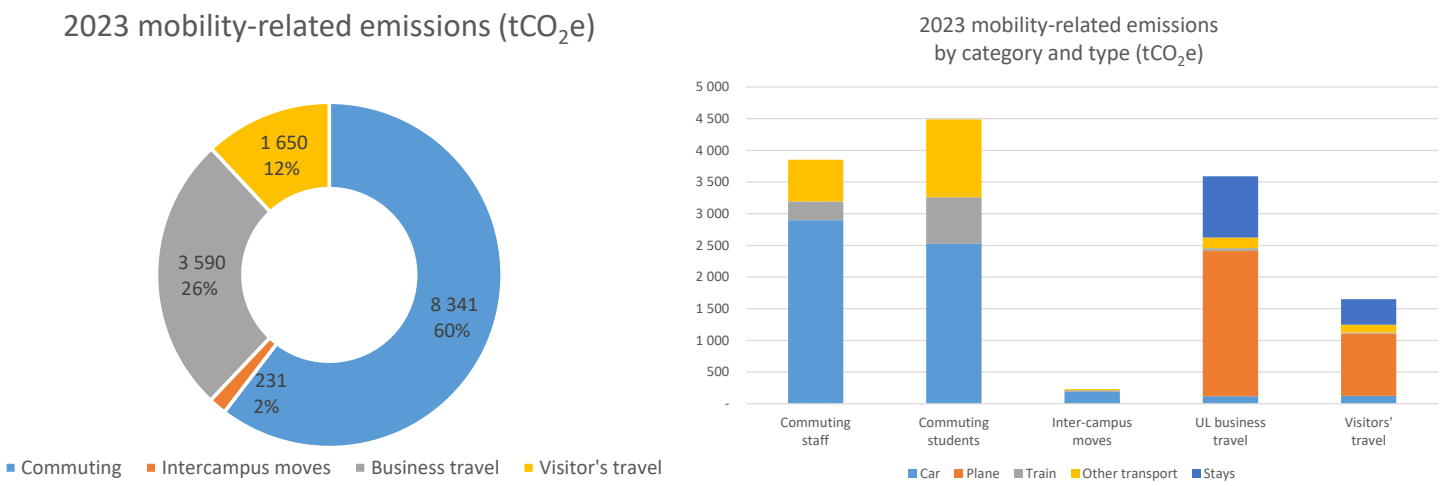


Figure 7 - Emissions (mobility) 2023, by sub-category (left) and by type of travel (right)

In 2023, members of the University community travelled more than 72 million km **between home and campus**. Trains accounted for 36% of the distance travelled but only 12% of emissions. In contrast, private cars accounted for nearly 61% of emissions for 31% of the distance travelled. Other modes of public transport accounted for 25% of the distance travelled, making public transport the preferred mode of transport for the University community (61% of the distance travelled and 35% of emissions).

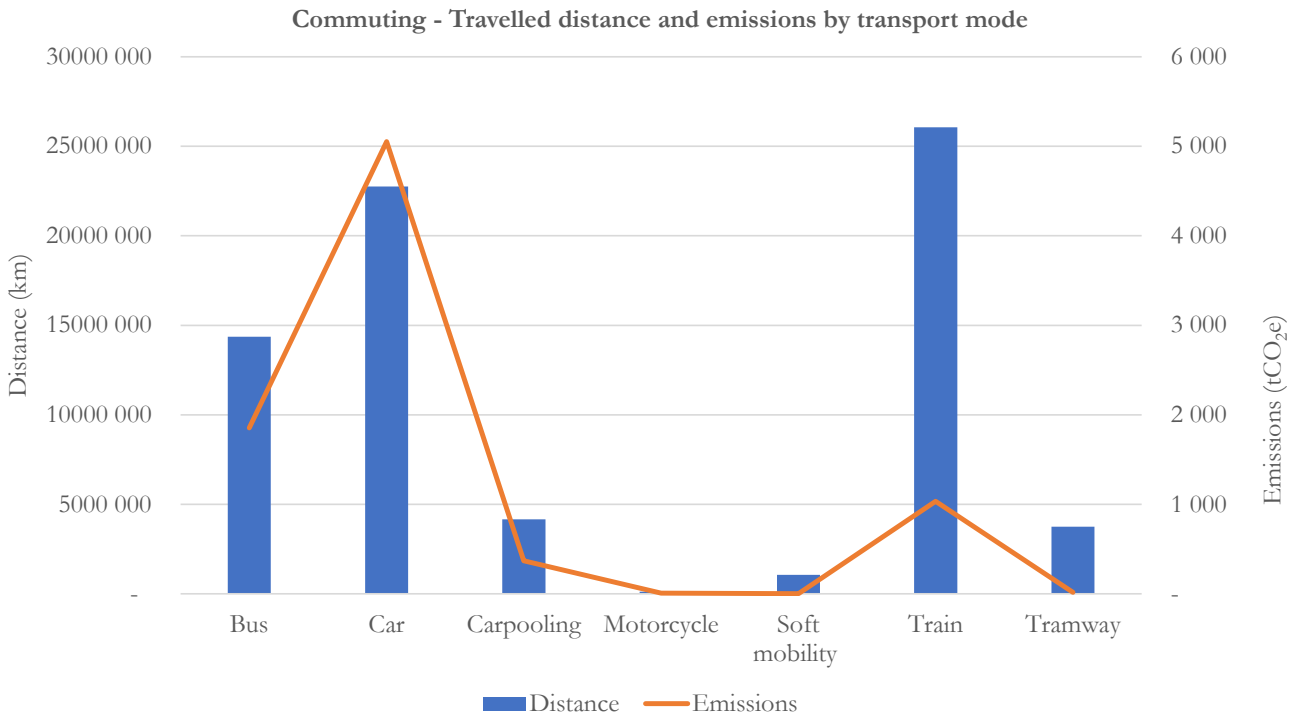


Figure 8 - Emissions and distances travelled (home-campus journeys) 2023

As for **business travel** by University members and visitors, the most common modes of transport (car, plane and train) account for just under 22 million km travelled and 3,580 tCO_2e. Air travel is, of course, the main mode of

transport, accounting for 88% of the distance travelled and 92% of emissions linked to these three modes of transport. By way of comparison, rail is used for 8% of the distance travelled and accounts for only 2% of emissions.

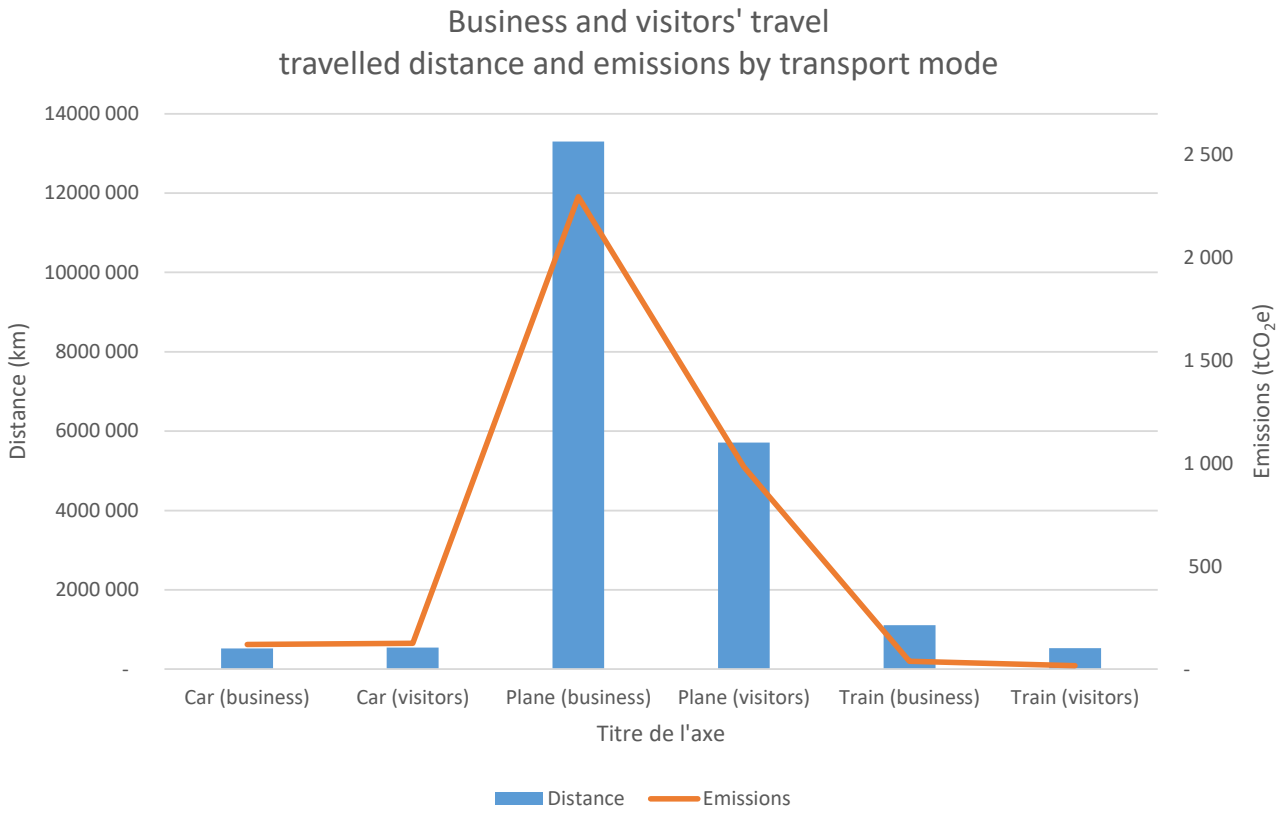


Figure 9 - Emissions and distances travelled (business and visitor travel), by main mode of transport

Accommodation is also a focus of attention in terms of emissions (emitting, for example, 15 times more than train travel, i.e. 859 tCO_2e). Together with meals and other *per diem* allowances, accommodation accounts for the emissions associated with business travel (abroad and in Luxembourg): These emissions amount to 1,659 tCO_2e, or 26.1% of emissions from business travel and visitors. By way of comparison, air travel accounts for 3,279 tCO_2e (62.6%) of these emissions, while cars account for 246 tCO_2e (4.7%).

It should also be noted that the University has committed to converting points from its corporate mileage programme into purchases of sustainable aircraft fuel (SAF). According to the airline, these purchases have resulted in a reduction in emissions (compared to conventional fuels) of 5.6 tCO_2e.

4.2.2. Changes since 2019

Emissions related to mobility at the University fell moderately between 2019 and 2023, from 14,135 to 13,812 tCO_2e (-2.3%).

Most of this change is due to the significant drop in emissions from staff **commuting between home and campus** (-367 tCO_2e, or -8.7%), confirmed by the more moderate decrease in student travel (-92 tCO_2e, or -2.0%). **Travel**

between campuses was studied in greater detail, based on the mobility survey conducted in spring 2024, leading to a more accurate assessment of these journeys (+181 tCO_2e).

Emissions **from business travel and visitors' travel and stays** remained stable in 2023 (-0.8%). While the distances travelled and corresponding emissions by car, plane and train show significant decreases between 2019 and 2023 (-9.2% and -10.7% respectively), emissions related to stays have increased significantly, driven by inflation and the revaluation of subsistence allowances (*per diem*, "forfaits"), these emissions being strictly correlated with the expenses incurred (monetary method).

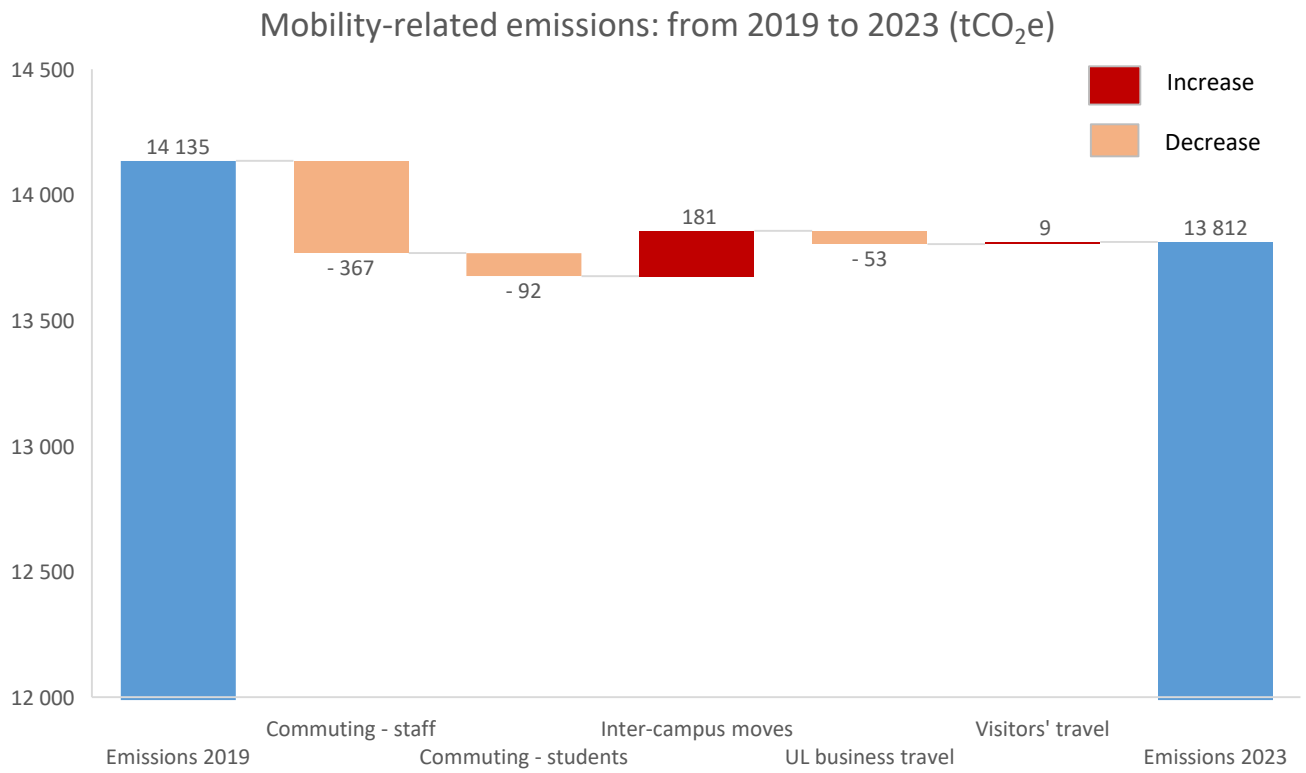


Figure 10 – Change in emissions (mobility) between 2019 and 2023

The breakdown of emissions from **home-to-campus commuting** shows the impact of the University's continued growth on both staff and students, reflected in the growth of the University community (+21.5% for staff and 9.3% for students between 2019 and 2023). Another phenomenon highlighted by the spring 2024 mobility surveys is the increase in distance of the daily journeys between home and the main place of work/study (+3.7 km at 28.5 km, respectively +4.3 km at 23.1 km).

These negative trends in emissions are offset by the highly visible decarbonisation of transport. While mobility surveys show little change in preferred modes of transport, except for a visible but insignificant increase in carpooling, the emergence of electric mobility via private cars and buses has contributed significantly to a very large reduction in emissions linked to transport choices, which fully offsets the impacts of the University's number expansion and longer daily journeys.

Finally, the introduction and continuation of homeworking has had a visible and beneficial impact on staff commuting emissions, contributing to a reduction of 328t CO_2e (-7.8%)[3].

[3] However, it should be noted that part of this reduction may be offset to varying degrees by additional impacts at the employee's home (heating, electricity, food, etc.).

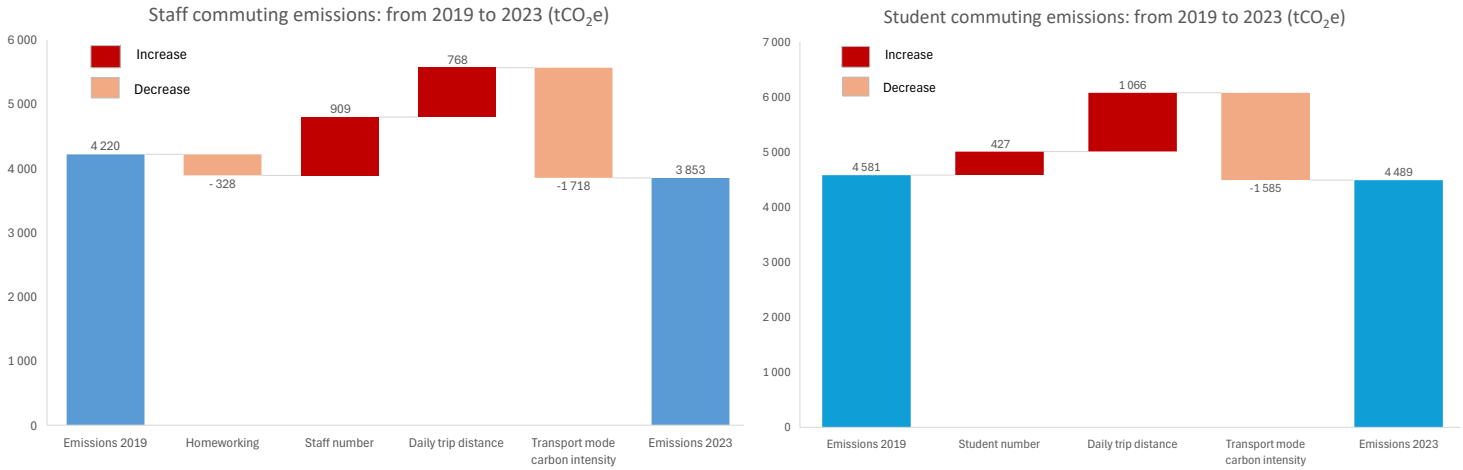


Figure 11 - Change in emissions (home-campus travel) between 2019 and 2023 - staff (left) and students (right)

4.3. Purchase of goods and services

4.3.1. Emissions in 2023

In 2023, purchases of goods and services generated emissions of around 18,528 tCO_2e. As in 2019, this is the **largest source of greenhouse gas emissions** within the University, accounting for **41.5% of total emissions**.

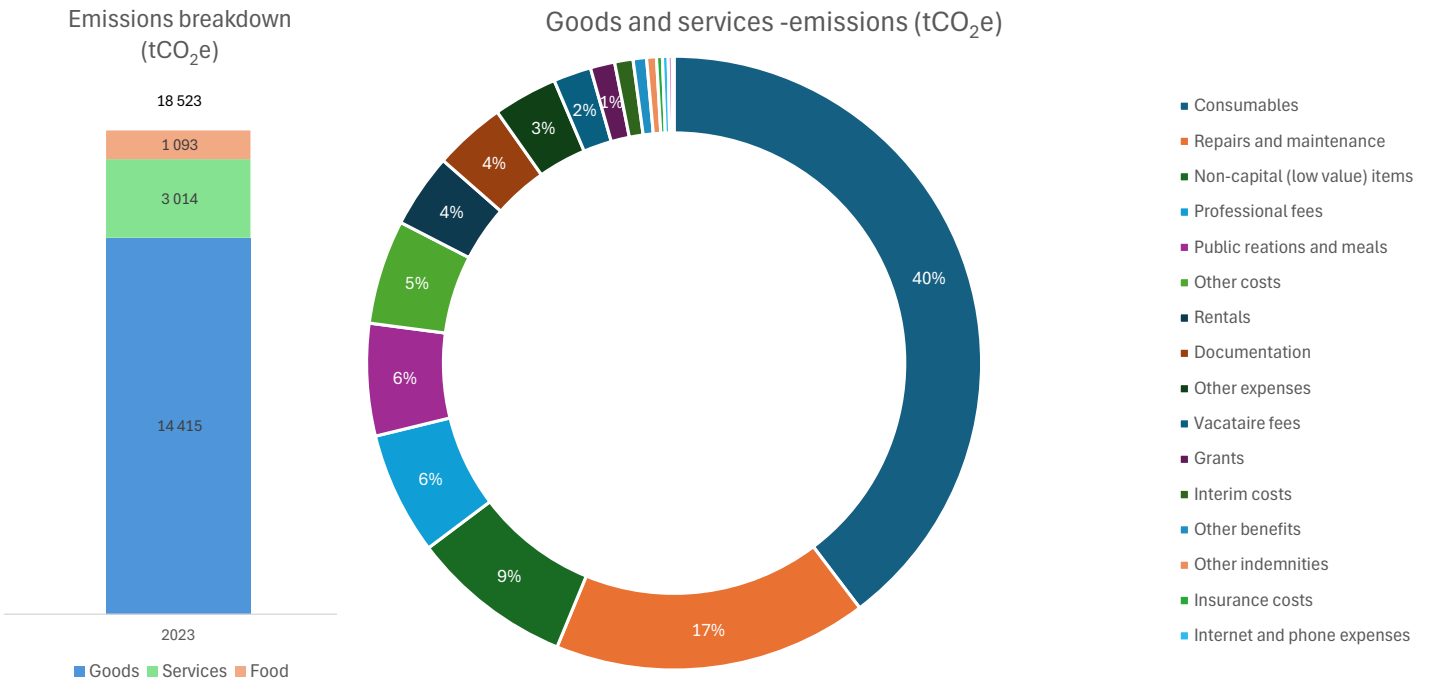


Figure 12 - Emissions (purchases of goods and services) in 2023, by category (left) and type (right)

The type of emissions has changed little and remains dominated by **consumables** (liquid gas, cleaning products, office equipment, packaging, small equipment), which continue to be the main source of emissions (40%) among the purchases of goods and services, as they are high emitters in relation to purchase values. **Repair and maintenance** activities on machinery, vehicles or buildings account for 17% of these emissions. The purchase of **small and no-capital equipment**, such as small IT equipment, small office furniture, small equipment or low-value licences, accounts for 9% of emissions from the purchases of goods and services, followed by **professional services** (lawyers, architects, communication agencies, audit or consultancy firms) provided in 2023, which generated emissions representing 6% of emissions from purchases of goods and services, as did **food** (food and related services).

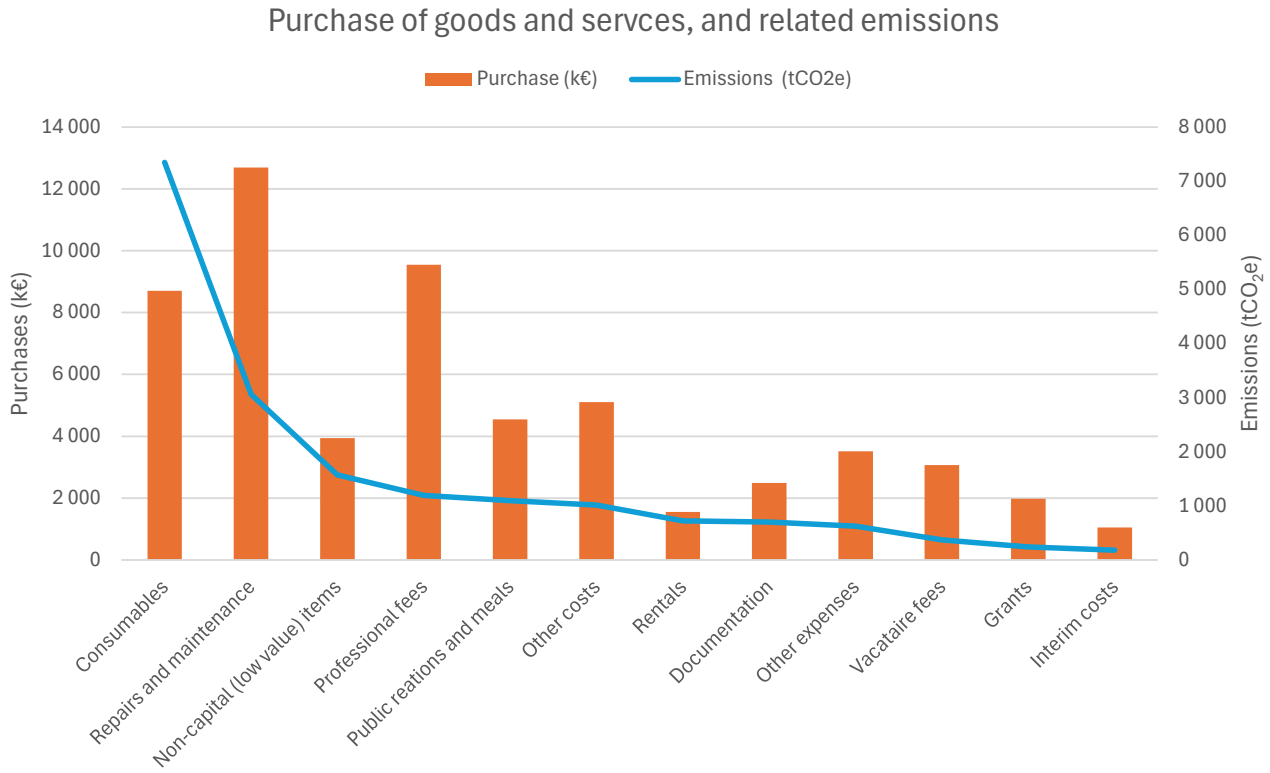


Figure 13 - Emissions and purchase values (goods and services), by category

When we compare the expenditure on these goods and services (€60.95 million excluding VAT in 2023) with the emissions generated by these purchases, we can see the discordant impact of consumables purchases. These purchases represent the third largest item of expenditure on goods and services (14% of expenditure) but are by far the category with the highest greenhouse gas emissions (40% of emissions). Conversely, professional fees and expenses are the second largest item of expenditure (16% of the total) but account for only 6% of emissions within the same scope. These services are highly intellectual and therefore low-emitting, whereas consumables, although of various kinds, contain chemicals whose production is extremely greenhouse gas-intensive.

4.3.2. Changes since 2019

Emissions related to the purchase of goods and services at the University increased significantly between 2019 and 2023, rising from 16,705 to 18,523 tCO_2e (+10.9%).

These emissions are calculated and analysed using a monetary approach, which means that the emission factors for each type of goods and services are based exclusively (except for water consumption) on the value of purchases (expressed in k€ excl. VAT). Not only are purchases that are better in social, environmental and sustainability terms ignored, or even considered counterproductive because they are potentially more expensive to buy, but this method is also particularly susceptible to price fluctuations. Based on the consumer price index published by Statec, cumulative **inflation** in Luxembourg between 31 December 2019 and 31 December 2023 stood at 13.9%, and even 20.4% in the European Union (according to Eurostat), while the value of the University's purchases excluding VAT and fixed assets used as the basis for these calculations rose from 15.2% to 60.95 million euros.

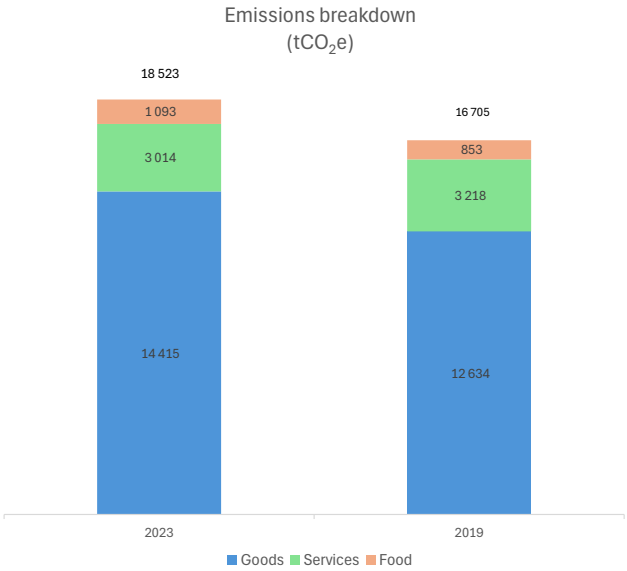


Figure14 - Structure of emissions (purchases of goods and services) in 2013 and 2019

With this important clarification on the impact of inflation, it is noteworthy that emissions linked to **the purchases of services** decreased between 2019 and 2013 (-6.1%), while the value of purchases remained stable (+0.8%), particularly in connection with the contraction in professional services, fees and emoluments of experts and lecturers.

Emissions related to the purchase of goods and consumables rose sharply by 1,781 tCO_2e, or 14.1% over the period. This increase was driven by **consumables**, which accounted for nearly three-quarters of the increase. This category, which is a major source of emissions due to its chemical and plastic components, also rose sharply in value. **Repairs and maintenance** category accounted for more than 37% of the increase in emissions: this category grew significantly in value to become the University's largest purchase item (excluding capital items), mainly relating to work on the University's IT infrastructure and software. **Other costs,** particularly those related to conference registration and the organisation of on-site conferences, have also increased.

Finally, **food costs** (receptions, catering, meals) rose by 31.9% in value and 28.2% in terms of emissions. Food purchases were particularly affected by inflation over the 2019-2023 period but are also to be put in relation with the development of public relations activities, event organisation and participation in academic and scientific conferences, as mentioned above.

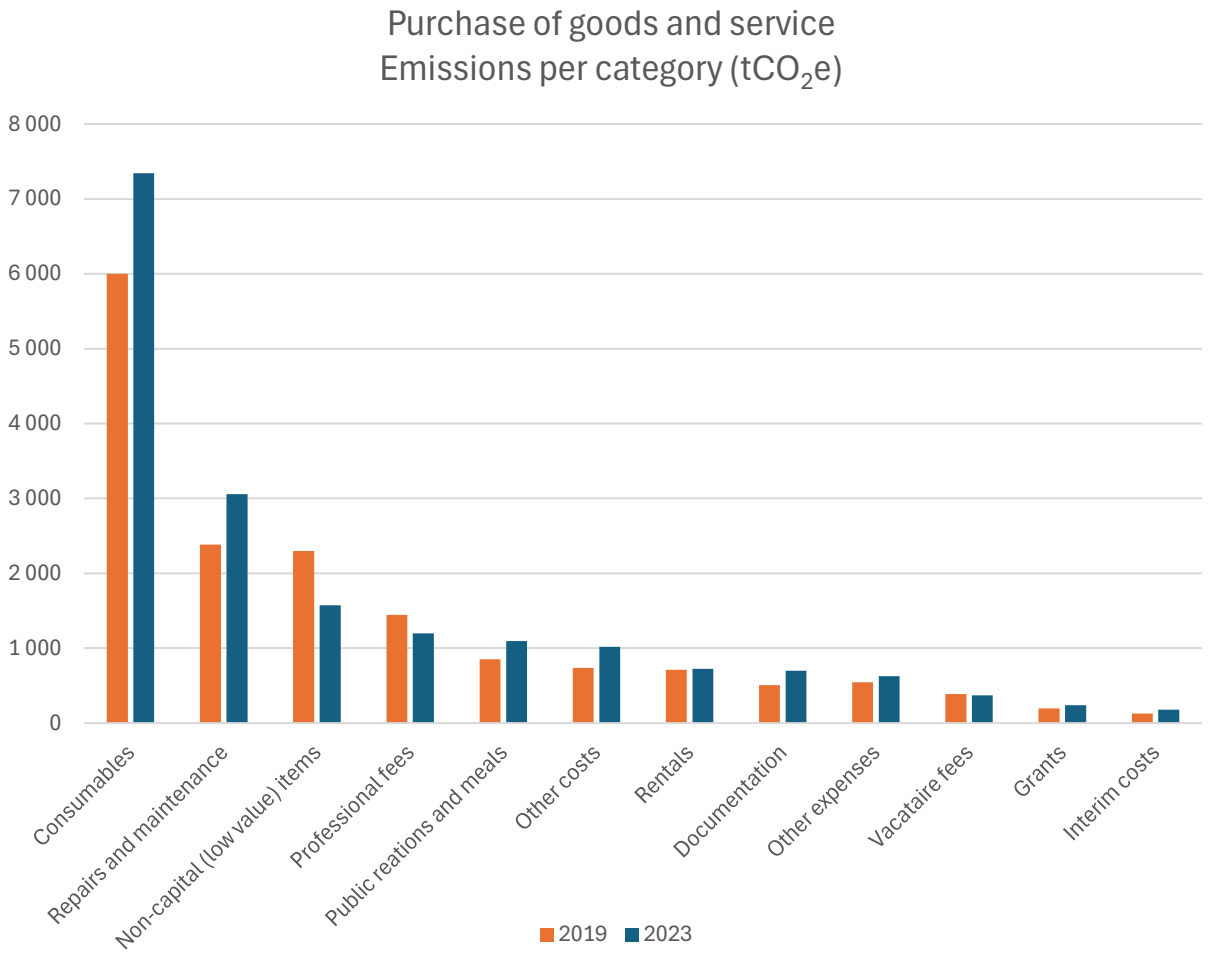


Figure 15 - Emissions (purchases of goods and services) in 2019 and 2023

4.4. Capital items

4.4.1. Emissions in 2023

Capital items (long-term assets used by the University for more than one year, with a unit value of more than €5,000 excluding VAT) are a source of greenhouse gas emissions **amounting to 8,019 tCO_2e, or 18% of the University's total emissions**.

There are three categories of capital items analysed: office buildings and laboratories made available to the University, University residences intended mainly for students but also for visiting researchers, and other tangible assets (scientific and IT equipment, furniture and vehicles) and intangible assets (licences and software).

Emissions from **buildings** total 2,406 tCO_2e, representing 30% of capital items emissions. These emissions are based on a net floor area of 185,109 m^2 and a 50-year depreciation period for emissions generated during construction. The Belval area accounts for 71% of emissions, Kirchberg (including Weicker) 21% and the Limpertsberg campus more than 8%.

The surface area considered in 2023 for calculating emissions from **University residences** is estimated at 36,494 m², spread over 35 residences (one closing in 2023). Emissions are valued at 383 tCO_2e (5% of emissions

relating to capital items), over a depreciation period of 50 years, and are concentrated in Esch-sur-Alzette (51%), Belvaux (19%) and Luxembourg City (15%).

Other capital items account for most of capital items emissions with 5,230 tCO_2e (65%). Based on annual depreciation values, emissions from scientific machinery and equipment are the most significant (45% of the total), followed by those from large IT equipment (34%). Emissions relating to building renovation work complete the top three with a 12% share.

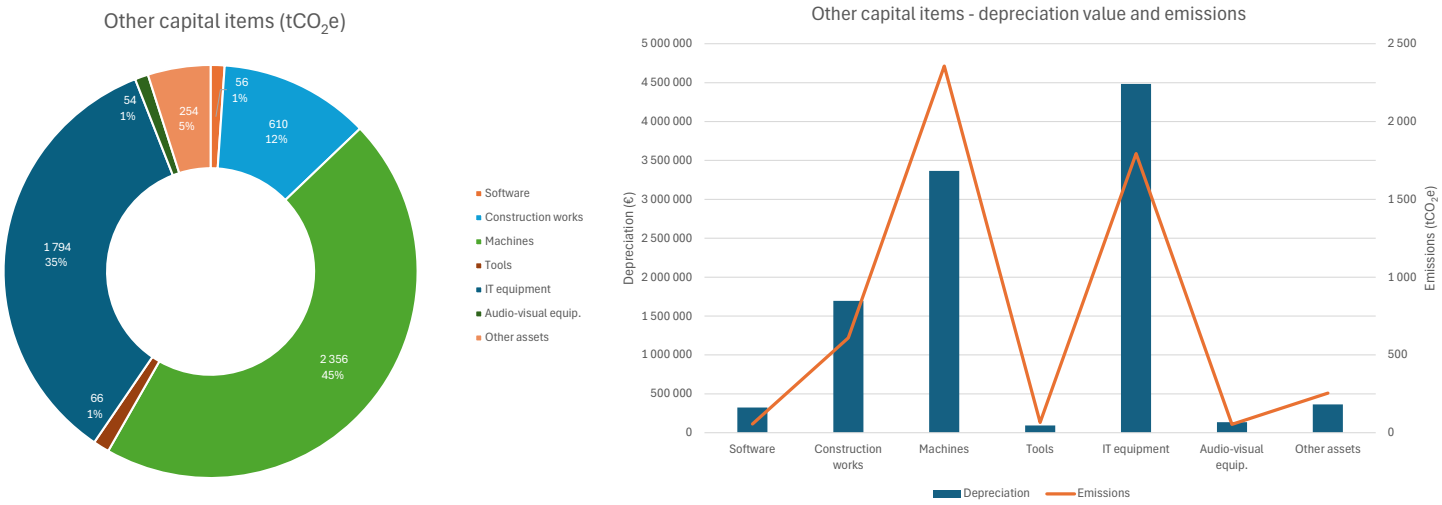


Figure 16 - Other capital items; type of emissions in 2023 (left) - Emissions and depreciation values in 2023 (right)

These emissions reflect the University's significant investments in **scientific and laboratory equipment**, as well as in **IT infrastructure** (centre de calcul, creation of the DRS, expansion and renewal of HPC capacities). The **set-up and arrangement work** related to the University's new premises (Rouden Eck, KTT5) should also be taken into account.

It should be noted that scientific and laboratory equipment emissions are relatively high compared to annual depreciation due to their composition, mass and complexity, while IT equipment has a much lower carbon intensity per euro of depreciation: although IT infrastructure accounts for 42% of the annual depreciation in question, it only accounts for 34% of emissions.

4.4.2. Changes since 2019

Between 2019 and 2023, emissions from capital items increased significantly from 7,071 to 8,019 tCO_2e, representing an increase of 13.4%.

While emissions linked to University residences fell by 8% (-34 tCO_2e) due to a reduction in the available stock (-3,180 m^2, or -9.40% in terms of available floor space) and the closure of six residences, emissions linked to **buildings** made available or rented by the University increased by 7.2% (+162 tCO_2e – 17% of the increase in capital items). While net internal floor space also decreased due to the return of the Central Building and Research Building A of the Limpertsberg Campus to the ABP (-8,442 m^2), partly offset by the acquisition of space

at Rouden Eck and Ketterthill 5 (2,119 m²), the update of the emission factors led to an increase in the total assessment of emissions relating to the construction of these buildings.

The vast majority of the increase in emissions related to capital items is attributable to the **other capital items**. These account for 86.5% of this increase, up by 820 tCO_2e (+18.6%).

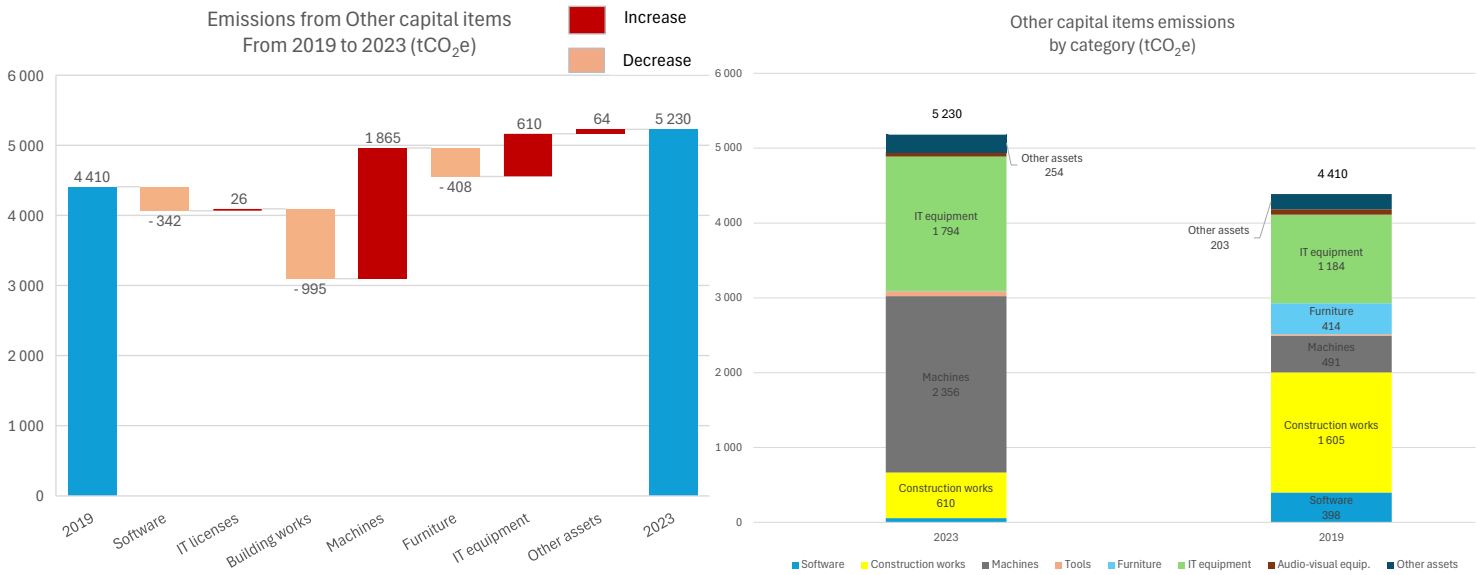


Figure 17 - Change in emissions (other capital items) between 2019 and 2023

The impact of the **scientific equipment** (machines) and **IT infrastructure** two categories is clearly visible. Their annual depreciation has increased significantly compared to 2019: as previously indicated, investments in scientific equipment (depreciable over 5 years) have grown significantly, particularly at the LCSB and recently at the FSTM. Emissions then increased by 380%, from 491 to 2,356 tCO_2e.

IT infrastructure, through investments in the creation of the DRS and the expansion of the CDC and HPC, also saw a sharp increase in annual depreciation, with emissions rising by 51%, from 1,184 to 1,794 tCO_2e.

Emissions related to building renovations and the associated purchase of furniture fell sharply once the impact of the University's gradual move to Belval had dissipated. Work related to current space requirements is not significant, but this should change once ANAS and BT3 have had an impact on the University's accounts. In 2023, emissions related to SAP and the deployment of the MM module also disappeared (amortised over three years).

5. Outlook

Since 2023, the year covered by this analysis, the University has continued to grow, notably by increasing its academic and administrative staff and welcoming more students. We note a significant influence, or even correlation, between staff numbers and emissions linked to the purchase of goods and services, other fixed assets, and office space. To a lesser extent, business travel and commuting between home and campus by the university community as a whole are also affected.

An extrapolation of 2023 emissions based on the average growth rate of staff and students between 2019 and 2023 results in greenhouse gas emissions at the end of 2025 of around 47,350 tCO_2e, an estimated increase of 6.1% compared to 2023. To counterbalance this underlying trend, it is therefore necessary to take action, as demonstrated by this analysis, on the following specific and concrete prospects:

5.1. Energy

The prospects for the redevelopment of **the Kirchberg campus** must take into account the campus's energy considerations, both in the short term to limit heat loss from the central building and in the long term by including energy consumption reduction targets in the renovation of buildings. The provisions relating to the transposition of EU Directive 2023/1791 on energy efficiency and the exemplary role assigned to the public sector should help the University to position itself in this regard.

Emissions linked to energy consumption by **the centre de calcul, the DRS and the HPC infrastructure** (University's share) increased by 63% between 2019 and 2023, bucking the trend for University buildings. It would be extremely useful to support any project aimed at reducing the energy consumption of IT equipment and making emissions reduction a pillar of the University's digital strategy.

5.2. Mobility

In 2025, the University adopted a **sustainable travel policy** setting out principles of moderation, low-emission transport choices and the integration of environmental considerations into business travel. The possibility of creating a low-carbon mobility fund has also been opened up, making high-emission modes of transport more expensive and redirecting the funds collected towards sustainable mobility initiatives. These tools should help to strengthen efforts to reduce emissions from business travel.

The University's contribution to the revision of **the Belval mobility plan**, in agreement with other organisations in the area, could help assess the adequacy of transport options for commuting from home to campus and the reality of travel flows. This initiative could improve public transport links between the campus and staff and student residences, thereby further decarbonising the daily journeys of the university community.

The 2023 analysis highlighted the impact of **travel between campuses**, particularly between Kirchberg and Belval. Car-sharing solutions and the electrification of this mode of transport (given the short distance between campuses) are complementary to the use of public transport. A sustained effort in terms of electric charging facilities will therefore be necessary, in collaboration with the owners and managers of our buildings.

5.3. Purchases

As in 2019, the analysis of greenhouse gas emissions reveals the significant weight of this activity, which remains the category with the highest emissions (42% of total emissions) and the one with the highest increase in emissions in value terms (+1,818 tCO_2e).
The entire analysis is based on a monetary approach, with emissions calculated on the basis of the purchase cost of goods and services. Not only are the specific sustainable characteristics of certain purchases ignored, but this approach was particularly influenced between 2019 and 2023 by the high inflation experienced by the global economy from 2022 onwards.

It is therefore necessary to **develop a methodology** in collaboration with the Procurement Office to obtain comprehensive emissions data for the most significant purchase categories and, within these, the most important suppliers. This data will then enable us to:

- Promote existing purchases of sustainable goods and services,
- Encourage the development of an integrated approach that values the carbon impact of products (purchasing criteria, selection criteria, carbon value),
- Move away gradually but quickly from monetary analysis to obtain a much more accurate picture of the emissions associated with the purchase of goods and services.

5.4. Capital items

Capital items are another category that saw a sharp increase in emissions between 2019 and 2023 (+13.4%). The main reason for this growth is the continued expansion of the University's activities, which is welcoming more students, recruiting more staff and managing a larger budget and project portfolio. The University should commit to developing solutions that **decouple growth in activities from impacts on space and equipment requirements,** in particular through the sharing of workspaces, the pooling of scientific infrastructure and equipment, and extending their useful life. The big equipment initiative may address some of these points.

5.5. Waste

Emissions related to waste management and treatment are not included in the greenhouse gas emissions analysis due to a lack of data on volumes, the diversity of actors involved (University, Belval Fund, building managers, external service providers) and the complexity of operations.

A project to collect the relevant information would ultimately enable the calculation and integration of emissions linked to waste generated by the University's activities, thereby highlighting the University's efforts in terms of waste sorting and recovery, as well as waste reduction, particularly through donations of furniture and IT and scientific equipment. This would also serve as a basis for monitoring waste volumes and categories, providing information to reduce waste and promote recycling.

5.6. Trajectory

The University has every interest in taking advantage of this new analysis to better **integrate the reality of its greenhouse gas emissions into its strategic and operational objectives**. It is a tool that offers a complementary perspective to the institution's traditional indicators.

Firstly, the University must **contribute to national and European emission reduction targets** and thus define its own targets, the trajectory for achieving them and, consequently, develop a solid and measurable roadmap.

It is also possible **to integrate the carbon element into decision-making criteria and underlying processes** in order to better detect and reduce it. Considerations regarding business travel and the purchase of high-carbon products have been mentioned above.

This analysis can also be an opportunity and a starting point **for active communication and a strong commitment** from the academic community, partners and stakeholders of the institution around an inspiring and shared vision on the impacts and carbon footprint of its activities.

Appendix

Definitions

Scopes

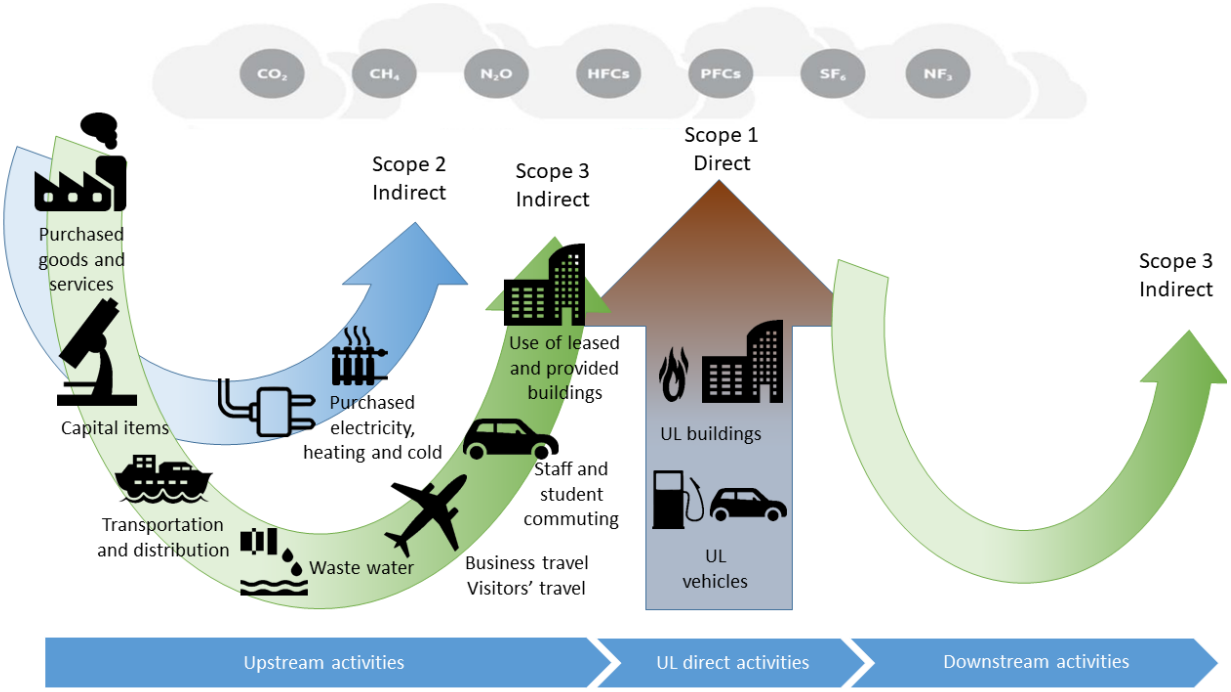
The GHG Protocol, the most widely used framework in the world for accounting and reporting greenhouse gas emissions, has imposed a classification among the categories of these emissions. There are three scopes. The GHG Protocol recommends that all organisations report at least their Scope 1 and Scope 2 emissions. Similarly, French regulations require the companies and institutions concerned to submit a greenhouse gas report (BGES) for Scope 1 and Scope 2 emissions. There is no explicit information in Luxembourg national policy documents about mandatory use of GHG Protocol corporate standards. Yet, because Luxembourg is an EU member, many of its obligations come via EU law that broadly align with GHG Protocol objectives.

Very briefly, this categorisation, which we refer to throughout this analysis, is as follows:

- *Scope 1*: these are direct emissions from fixed or mobile combustion facilities located within the organisational perimeter. These mainly include gas heating, vehicle fuel and refrigerant leaks.
- *Scope 2*: these are indirect emissions associated with the production of electricity, heat, steam and cooling imported for the organisation's activities.
- *Scope 3*: these are all other emission items. We therefore include emissions related to mobility (commuting between home and campus, business travel, visitor travel), purchases of goods and services, use of fixed assets, waste generated by activities, etc.

Scope 3 emissions are undoubtedly the most difficult to capture, but this is where the potential for control and reduction is greatest. We have therefore ensured that the most relevant and representative Scope 3 emission items are included in our analysis.

Below are the emission categories included in our analysis classified by scope.



Uncertainties

Greenhouse gas emissions accounting standards require degrees or levels of uncertainty to be associated with emissions calculations.

These uncertainties arise at two levels: when collecting activity data and when calculating emission factors.

1. L*evel of uncertainty relating to the data collected*. We have followed the recommendations of ADEME (the French agency for ecological transition), using the following levels:
   - 0 to 5% for data obtained from direct measurement (meter readings or bills),
   - 15% for reliable data that has not been measured,
   - 30% for recalculated or extrapolated data,
   - 50% for approximate data,
   - 80% for data known to be of a certain order of magnitude.

2. *Level of uncertainty relating to emission factors*. This is very often provided in addition to the factor in the databases consulted. We used the ADEME *Base Empreinte* database.

On this basis, we were able to associate each emission with total uncertainty resulting from the combination of an emission factor and activity data. The total uncertainty is the square root of the sum of the square of the uncertainty of the activity data (U_{DA}) and the square of the uncertainty of the emission factor (U_{FE}).

$$U_{total} = \sqrt{U_{DA}^2 + U_{FE}^2}$$

We were also able to determine the uncertainty associated with a sum of emissions from different sources. This uncertainty is the ratio between the square root of the sum of the squares of the products of each uncertainty ($U_1 \ldots U_n$) by its emission ($x_1 \ldots x_n$), and the sum of the emissions ($x_1 \ldots x_n$).

$$U_{total} = \frac{\sqrt{(U_1 \,.\, x_1)^2 + (U_2 \,.\, x_2)^2 + \cdots + (U_n \,.\, x_n)^2}}{x_1 + x_2 + \cdots + x_n}$$

For each reported greenhouse gas emissions calculation, a level of uncertainty is stated as a percentage and as a value.