Analysis of greenhouse gas emissions of the University of Luxembourg

Year 2019

Condensed report

Laurent Betry, chief sustainability officer

Fernand Mamba Wa Mamba, student in Master in Sustainable Development

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Summary

Sustainable and societal development is one of the priority areas of the University of Luxembourg in its 2020-2029 strategic framework. It has launched an institutional initiative for a sustainable university in its 2022-2025 quadrennial plan, which aims, among other objectives, to establish the institutions' contributions to the national and European roadmaps towards a climate-neutral and resource-efficient development .

As a first step, the University has set out to better understand the greenhouse gas emissions generated by its activities, operations, and resources. This report presents the calculation of the University's greenhouse gas emissions for **2019** – the last year before the Covid 19 pandemic reduced activity and imposed mobility restrictions – based on the recommendations of ISO 14061-1 and 14069 on the quantification and reporting of greenhouse gas emissions, the GHG Protocol and the *Bilan Carbone.*

In 2019, the University's activities generated **44 080 tons of CO2 equivalent (tCo2e)** in direct and indirect greenhouse gas emissions, with a margin of error of approximately 7,150 tCo2e, 16%. The emissions would decrease to **41 ktCO2e**, if we had used the market-based approach, and apply a zero-emission factor to electricity consumption, as all our premises have entered green electricity procurement contracts.

Direct emissions generated by the University's resources using fossil fuels (scope 1 of the GHG protocol) represent **1% of total emissions**, or 558 tCO2e. **Indirect emissions** linked to the consumption of energy for the University's activities (scope 2) represent **10% of emissions**, or 4 558 tCO2. Finally, **other indirect emissions** produced by the University's operations (scope 3) account for **89%, or 39 964 tCO2e, of total emissions**.

The University's emissions emanate from the following sources: **purchase of goods and services** (16 710 tCO2e - 38% of total emissions), **mobility**, local travel, and business trips (15 199 tCO2e - 34%), **fixed assets**, including buildings and student residences (7 058 tCO2e - 16%), **energy consumption** (5,103 tCO2e - 12%) and **wastewater** (10 tCO2e).

This initial analysis of the University's greenhouse gas emissions will serve as a tool to define and monitor its contribution to national and European emission reduction targets and constitutes a baseline against which any quantified target or action measures can be compared.

From this analysis, some preliminary findings emerge on which the University can build an initial action plan:

- **Procurement** is the University's largest emission item. By focusing on the most significant purchasing categories, it could achieve rapid and concrete results by systematically including environmental and carbon clauses in its public contracts and also by selecting its largest suppliers and most ordered products on the basis of precise information on the emissions generated upstream.
- **Staff and student mobility** unsurprisingly accounts for a third of the University's emissions. The share of private cars in commuting emissions can be reduced by promoting car-sharing and public transport. As for **business travel**, the analysis shows that the impact of flights can be limited by focusing on short-haul flights and their partial substitution by train.
- In terms of **energy**-related emissions, separate monitoring of consumption between administrative and research buildings would be the first step towards better understanding. The University's digital activities (computing centre, HPC and data science activities) also have a significant impact; monitoring of electricity consumption and cold production should thus be enhanced. Finally, the University has not yet committed itself to projects aimed at producing, or financing the local production, of energy from renewable sources.

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1. Methodology

This analysis of the University's greenhouse gas emissions is based on the recommendations for calculating carbon accounting set out by the IPCC. We have used the two main **reference systems** in this area, namely the Bilan Carbone and the GHG Protocol.[1] Given the specificities of higher education and research institutions, we decided to report greenhouse gas emissions as closely as possible to the activities developed by the University. The categorisation does not therefore correspond exactly to the recommendations of each of these guidelines.

Reference year. This first analysis is intended to be recent but also representative. For this reason, the greenhouse gas emissions have been calculated for the **year 2019**, the most recent year not impacted by the Covid-19-related activity reductions.

Organisational boundaries. This analysis covers the activities of the University of Luxembourg, a public higher education and research institution.[2]

The University operates on four **sites**: the Belval campus in Esch-sur-Alzette (registered office), the Limpertsberg and Kirchberg campuses in Luxembourg City and the Weicker building, also in Luxembourg. The buildings located on these sites and occupied by the University are included in the organisational boundaries of this analysis, whether they are made available free of charge by the Administration des Bâtiments Publics or by the Fonds Belval or rented by the University from its operating budget.

In addition, the University also manages some 40 **student residences**. These are rented by the University, which in turn rents or makes them available to its students and visitors. As we consider that these residences only function because the University hosts these foreign students and visitors, we consider that the greenhouse gas emissions related to these operations should be included in the University's emission inventory.

Finally, although **university restaurants** located on the campuses or in the buildings managed by the University operate mainly, if not exclusively, for staff and the student community, we have not sought to include greenhouse gas emissions related to catering activities due to the complexity and specificity of these operations.

Operational boundaries. The review of the University's operational boundaries revealed four additional exceptions, excluded from the present analysis:

- **Waste**: relevant data are not centralised, not sufficiently segmented nor readily available.
- **Purchase of electricity and the combustion of natural gas for heating purposes for the common areas of the student residences** The difficulty in identifying and separating the relevant data does not allow for the calculation of emissions.
- **Fugitive greenhouse gas emissions:** reports consulted on the upgrading of circuits show them to be negligible.
- **Financial investments**: as the University's cash is exclusively deposited in current and term bank accounts, this is excluded.

Scopes. The GHG Protocol imposes an additional classification among the categories of greenhouse gas emissions. These are the three **scopes**. The GHG Protocol recommends that all organisations report at least the

[1] The first standard is of French origin, developed by ADEME, the agency for ecological transition, in 2004 and serves as a support for the regulatory obligation to calculate and report greenhouse gas emissions in France. The GHG Protocol, launched by the World Business Council for Sustainable Development and the World Resources Institute in 2000, is the most widely used method in the world.

[2] From a **financial control** point of view, the University has only two participations in which its capital share is the majority. It was deemed that the emissions linked to the operation of the Luxembourg University Foundation are negligible; as for the University of Luxembourg Competence Centre, it seems more appropriate to us that this structure should define its own greenhouse gas emission reporting in relation to its own activities.

emissions related to scopes 1 and 2. Very briefly, this categorisation, which we will use throughout this analysis, is as follows:

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

Scope 3 emissions are the most difficult to capture, but this is where the potential for control and reduction is greatest. We have ensured that the most representative scope 3 emission items are included in our analysis. Broadly speaking, the boundaries of our analysis are as follows:

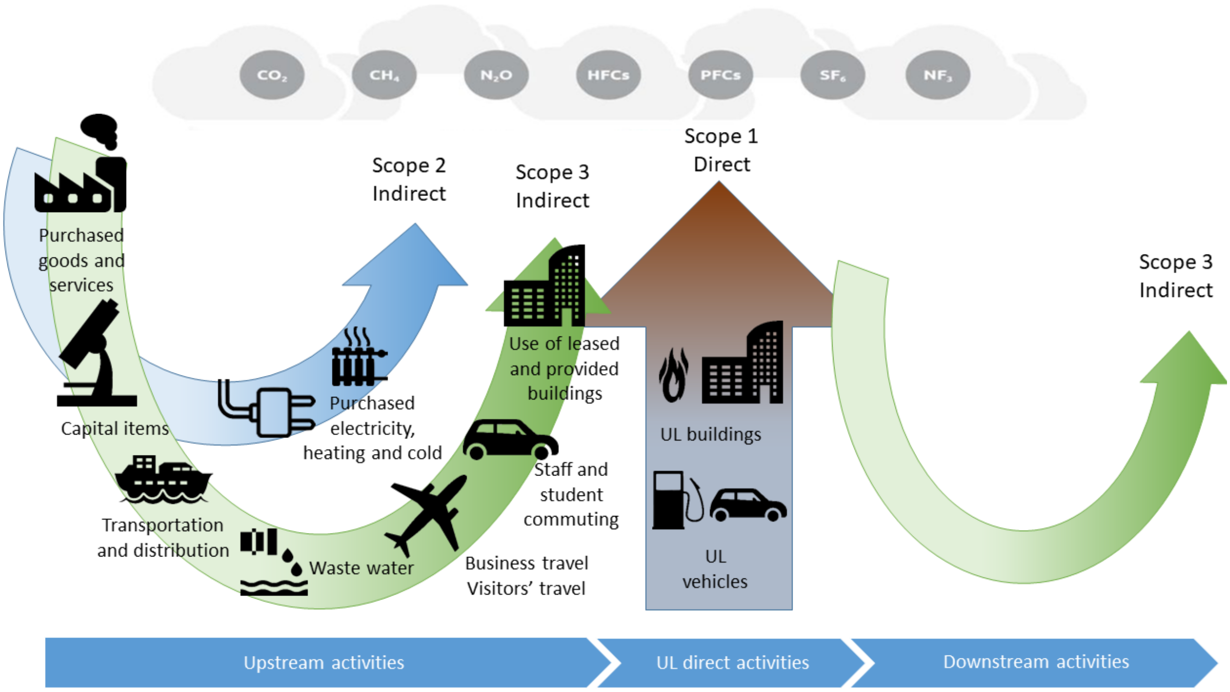

Figure 1 – Emission sources included in University emitting profile by scope

Methodology. The calculation methodology is fully described in the full report of the University's greenhouse gas emissions analysis. This covers the collection of activity data by emission category, as well as the type of data collected, i.e. physical data and monetary approach. Emission factors and calculations of emissions and associated uncertainties are also described.

Electricity consumption and GHG emissions. We have chosen to reflect the greenhouse gas emissions related to electricity consumption according to the "**location-based**" approach, based on the average emission factor of the national electricity grid. We believe that using the “market-based” approach by reporting our electricity consumption as carbon-free, because the University has exclusively entered into 100% green contracts (Ecomix, Naturstrom and Nova Naturstrom options), would be misleading. Indeed, this approach takes into account what you buy and not what you physically get, and it does not require that the extra payment that is made to buy green electricity leads to the installation of additional capacity of production of renewable energy. We also believe that the emission factor for electricity consumption provided by the Institut Luxembourgeois de Régulation reflects in a sensitive way the transition of Luxembourg towards a more renewable production, in any case much more decarbonised.

2. Overall results

In 2019, greenhouse gas emissions from the University of Luxembourg's activities totalled **44 ktCO2e**.

The overall uncertainty of the analysis is estimated at **16%**. This includes a high degree of heterogeneity between the emission categories: emissions relating to energy emissions have a low uncertainty due to the precision of the data collection, whereas calculations based on business travel or fixed assets reflect the highest uncertainty due to a very manual collection process and very approximate data.

Emissions from electricity consumption are presented on a location-based basis. The University's total emissions would decrease to 41 ktCO2e, if we had used the market-based approach thanks to a zero-emission factor for electricity consumption (due to the systematic use of 100% green procurement contracts).The University's direct emissions (scope 1) represent only 1% of total emissions. Indirect emissions associated with the consumption of electricity, heat and cold (scope 2) make up 10% of total emissions, while other indirect emissions (scope 3) account for most the University's greenhouse gas emissions, namely 89%.

The largest category of emissions is that related to the purchase of goods and services, accounting for 38% of emissions. This is closely followed by emissions related to mobility (34%), while emissions related to fixed assets amount to 16% of the total. Emissions related to energy consumption represent only 12% of overall emissions.

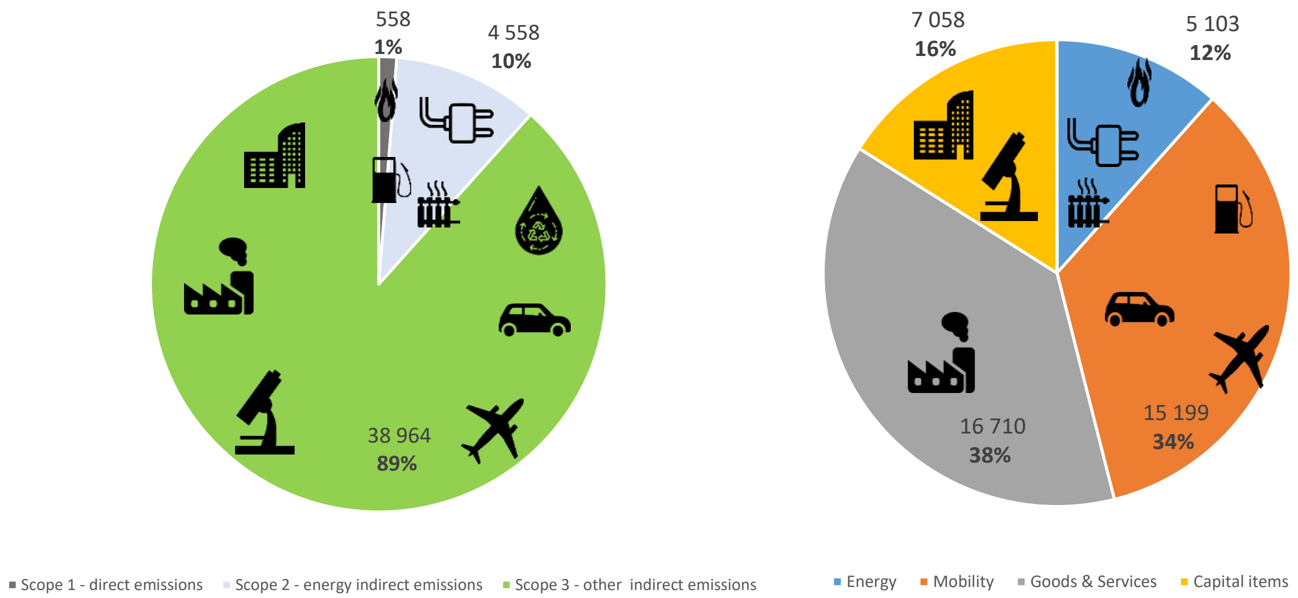

Figure 2 – GHG emissions of the University, by scope (left) and by emission category (right)

The details of the University's greenhouse gas emissions in 2019 are as follows:

2019			Emissions		Uncertainties	
			tCO2e	Share	%	+/- tCO2e
Energy	Scope 1	Gas	545		6,6%	36
	Scope 2	Elec/heating/cold	4 558		8,8%	401
			5 103	*12%*	*7,9%*	*403*
Mobility	Scope 1	Fuel	13		7,1%	1
	Scope 3	Commuting	9 865		22,4%	2 206
	Scope 3	Inter-campus moves	37		31,0%	11
	Scope 3	UL business travel	3 643		42,9%	1 563
	Scope 3	Visits to UL	1 641		42,0%	690
			15 199	*34%*	*18,4%*	*2 791*
Goods & services	Scope 3	Water	5		11,1%	1
	Scope 3	Goods & services	16 705		35,9%	5 994
			16 710	*38%*	*35,9%*	*5 994*
Capital items	Scope 3	Buildings	2 119		52,2%	1 106
	Scope 3	Residences	529		58,3%	308
	Scope 3	Other capital items	4 410		55,0%	2 425
			7 058	*16%*	*38,0%*	*2 683*
Waste	Scope 3	Waste water	*11*		*12,4%*	*1*
Total emissions			**44 080**		**16,2%**	**7 147**

Table 1 – Detailed GHG amounts and related uncertainties from the University activities

3. Detailed results

3.1. Energy

Emissions resulting from energy consumption (to power, heat or cool the campuses and buildings used by the University) amount **to 5 103 tCO2e** and represent **12% of the University's total emissions**. They are divided between those linked to the combustion of natural gas by boilers (on the Limpertsberg campus and in the Lippmann building), which represent 11% of all energy emissions and are to be reported as direct emissions from a fixed installation (Scope 1), and those linked to the purchase of energy from distributors: they therefore represent 89% of energy emissions and are classified in Scope 2 (indirect emissions associated with the production of imported energy). This last category is broken down into emissions due to electricity consumption, which account for 51% of energy emissions, emissions relating to heat supplied by the urban networks of the Kirchberg and Belval districts (33% of the total) and emissions from the cold consumption of the network managed by the Belval fund supplying the computing centre based at the Maison du Savoir (5% of the total).

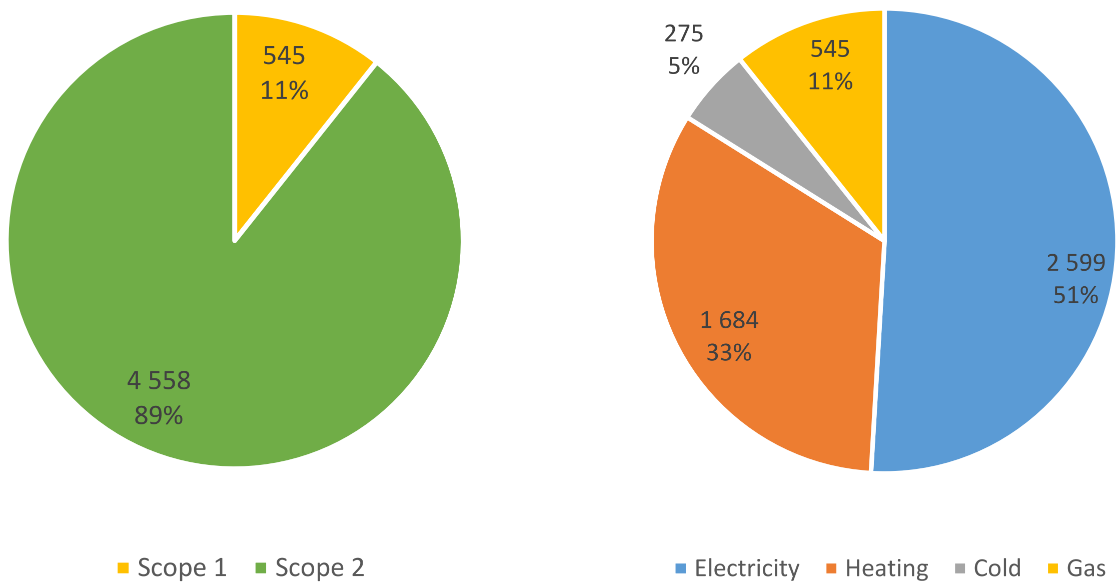

Figure 3 – Emissions relating to energy consumption, by scope and energy carrier

Emissions from electricity consumption are based on a "location-based[3]" emission factor taken from the electricity labelling report for the years 2019-2020 published by the Institut Luxembourgeois de Régulation (ILR), setting the average emissions per kWh of electricity consumed at 182,4 gCO2e.

The figure 4 below puts into perspective the distribution for each individual building of the institution of the emissions and this by energy vector.

Emissions of the Limpertsberg and Kirchberg campuses, accounting for 32% of energy emissions, are much higher than for the other buildings. The main reason for this is the use of gas heating, either direct combustion in the boiler (Limpertsberg) or via the district heating network (Kirchberg), as gas emits more per kWh consumed. Moreover, these campuses are large and spread out, the buildings are older and less energy efficient.

The Maison du Savoir also accounts for a high proportion of energy emissions (516 kgCO2e, or 10% of the total) but it is by far the building with the largest surface area in the University. The MSA's emissions per square metre ratio is the lowest of all the buildings in the institution. We chose to take the computing centre out of MSA, knowing that it hosts the University's computer servers on the Belval campus and includes the High-Performance Computing activities of the entire institution. This separation allowed us to identify the energy impact of the computer centre and to avoid creating confusion in the calculation of the MSA's energy emissions.

[3] The fact that the University and the building managers have entered into 100% green procurement contracts does not mean that the electricity consumption is decarbonised. Indeed, this so-called "market-based" method, which reports emissions calculated on the basis of a purchase contract, allows the organisation to base itself on a financial transaction that does not alter the physical consumption of electricity, and this is undifferentiated and undifferentiable with respect to its origin. The basis for calculating green contracts in Luxembourg is often electricity produced from renewable sources (hydroelectricity in Norway) in the previous year and which may have been consumed locally. It is not available for physical consumption. Furthermore, it has not been proven that the certificates of origin made available to the buyer of the green contract invariably lead to an increase in green electricity production.
However, if the university had been able to install photovoltaic arrays and opt for self-consumption of the electricity produced, we would have recorded negative emissions. In the case of resale to the electricity grid and therefore so-called avoided emissions from conventional electricity production, we could have reported these crediting emissions in parallel (without compensation).

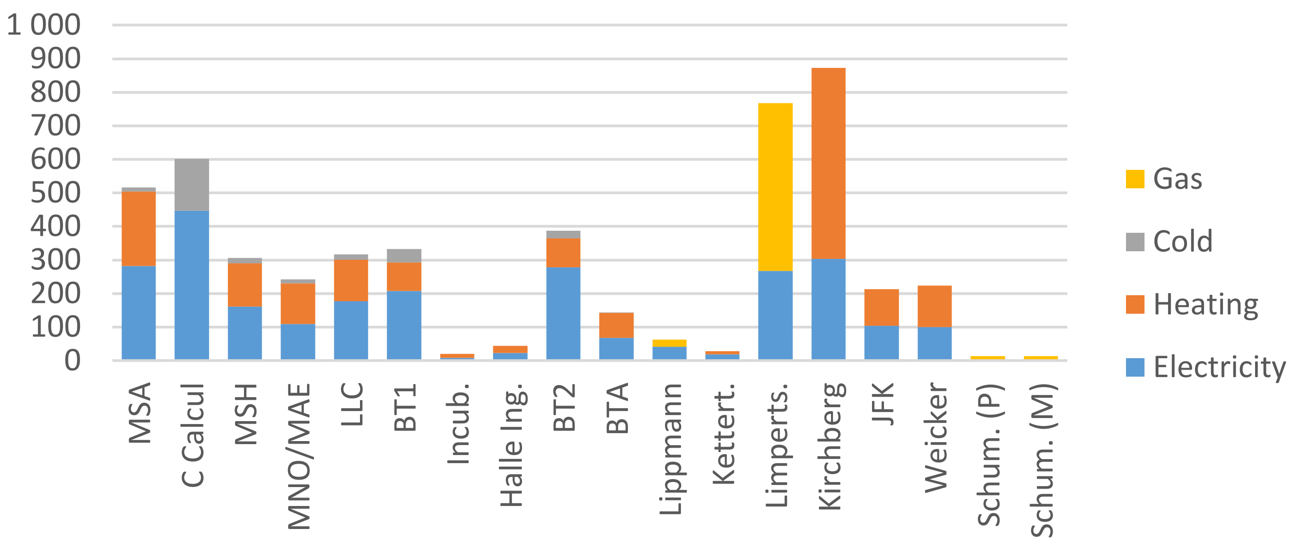

Figure 4 – Emissions relating to energy consumption, by building and energy carrier (tCO2e)

Also noteworthy are the high emissions of the BT1 and BT2, related to the fact that these buildings host research laboratories requiring a permanent and high supply of electrical energy, in particular related to low-temperature fridges.

We can already draw the following preliminary conclusions:

- Energy represents a small part of the University's total emissions, as the University benefits from recent buildings that meet the expected energy performance standards. This is confirmed by the lower energy consumption and better emission performance of the buildings located in Belval in comparison to the Kirchberg (campus);
- Heating produced by direct combustion of **natural gas** (Limpertsberg, Lippmann) weighs **unfavourably** on energy emissions, especially as these buildings have poor performance in terms of insulation and operation of the heating network;
- The heterogeneity of use of the University's buildings makes it necessary to **monitor separately the energy consumption of buildings** hosting intensive research activities, and office or administrative buildings;
- The **impact of the University's digital activities** is significant. The development of High-Performance Computing will necessarily affect greenhouse gas emissions: a specific action plan focusing on this central activity of the University's strategy would help identifying relevant solutions;
- In general, the University should increase the perimeter, granularity, and frequency of its **monitoring**. This could be done, for example, by installing meters on the internal electricity network; and
- Finally, this analysis highlighted the **absence of electricity production from renewable sources** by the University, either for self-consumption or through the financing of external projects (e.g. energy cooperatives).

3.2 Mobility

Mobility-related emissions total **15 199 tCO2e** and represent **34% of the University's total emissions**. Except for the tiny share of emissions caused by the combustion of fuel for the small fleet of service vehicles (0,25% - scope 1), all emissions are indirect emissions excluding energy (scope 3). Uncertainty amounts to 18% due to data extrapolation on home-campus travel or assumptions made on business trips (routes and distance travelled).

Reported in this category are the impacts of staff and student commuting (9,8 ktCO2e, 65% of mobility emissions), University staff and student business travel (3,6 ktCO2e - 24%) and visitor travel (1,6 ktCO2e - 11%). Travel between campuses accounts for a negligible part of the mobility emissions here.

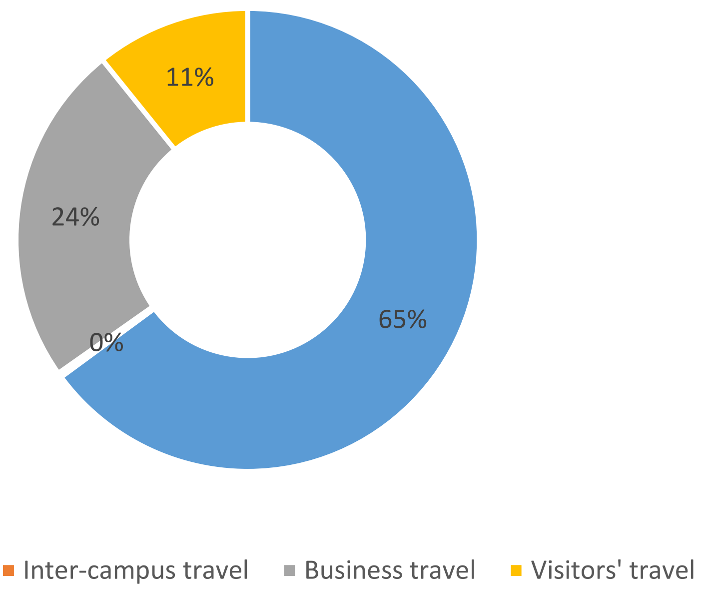

Figure 5 - Share of the mobility activities in the emissions relating to mobility

The distribution of mobility emissions by mode of transport shows that the car (both individual and shared) is the main mode of transport used for staff commuting and the second most important for students. It is also by far the largest emitter of greenhouse gases. It represents 7,0 tCO2e, or 46% of mobility emissions. Travel by train, which is the main mode of transport for students, accounts for a much smaller share (6 times fewer emissions on average than a non-shared private car) and represents only 7% of mobility emissions. For business, staff and visitor travel, air travel is the most common mode of transport, both in terms of distance and emissions (3,7 tCO2e or 24% of mobility emissions). It should be noted that emissions related to the accommodation and meals are also included in mobility emissions.

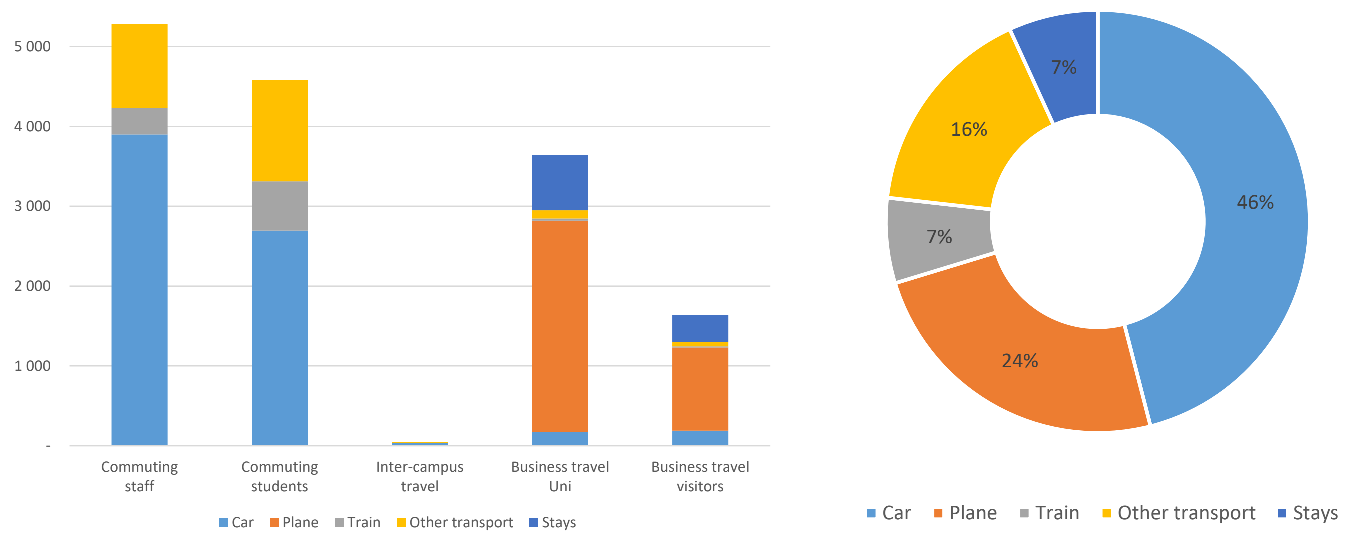

Figure 6 – Emissions and share of means of transport in mobility-emissions (tCO2e and %)

Home-to-campus travel

Emissions from home-to-campus travel (9 865 tCO2e) were derived from the mobility survey launched by the Infrastructure Department at the beginning of 2020. The raw information on the main mode of transport, frequency of travel and distance travelled has been extrapolated to the entire University population. This results in an estimated uncertainty of 22%. Thus, in 2019, 31 million km were travelled by staff and 33,5 million km by students, more than 1 600 times around the earth or almost 168 times the distance from the earth to the moon.

While the car is used for these daily trips in 41% of cases (52% for staff, 32% for students), it accounts for 2/3 of greenhouse gas emissions. In contrast, public transport emits far less: the train, which is used for 37% of home-campus journeys (27% for staff, 47% for students), emits only 10% of these emissions, while the bus, used in similar proportions by staff and students (between 19% and 24%), emits 23% of commuting-related emissions.

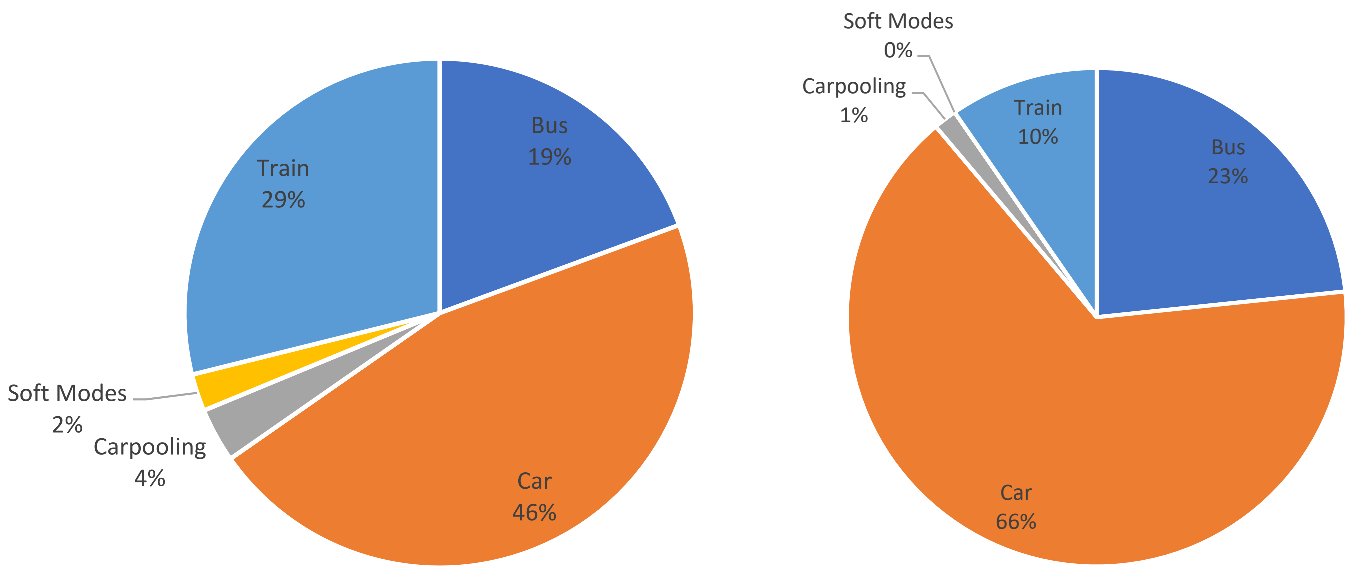

Figure 7 – Commuting: share of transport modes by (left) distance travelled, and (right) by GHG emissions)

The unshared private car emits 40% more than the bus and between 3 and 6 times more than the train. **Increasing the use of the train** in daily trips between home and campus would have a direct and significant benefit in terms of reducing greenhouse gas emissions. Even if the impact of **bus use** on home-to-campus travel is mixed, it remains favourable compared to that of the private car.

According to the emission analysis, only 2% of distance travelled are by foot or bicycle. The mobility survey carried out by the University shows with more details that, among the respondents, 28% of journeys of less than 10 km are made using one of these two active modes. Improving this result would be obviously a major objective of a mobility policy, but with only a small impact on greenhouse gas emissions.

Business and visitors' travel

Emissions related to business travel by members of the University (staff and students) totalled 3 643 tCO2e.

Calculated based on the available transactional reports from a few travel agencies and from the expense reports recorded by the SFC, these emissions are combined with a significant uncertainty estimated at 43%[4].

Emissions from business travel in 2019 are overwhelmingly due to air travel, with long-haul travel (over 3 500 km) accounting for 51% of business travel emissions. Emissions resulting from train travel are non-existent (1% of the total), and lower than emissions from private cars. Emissions related to the stay (accommodation, meals, per-diem, and grants) represent 19% of the total emissions of business travel, while means of transport other than the car, plane and train represent only 3% of the total.

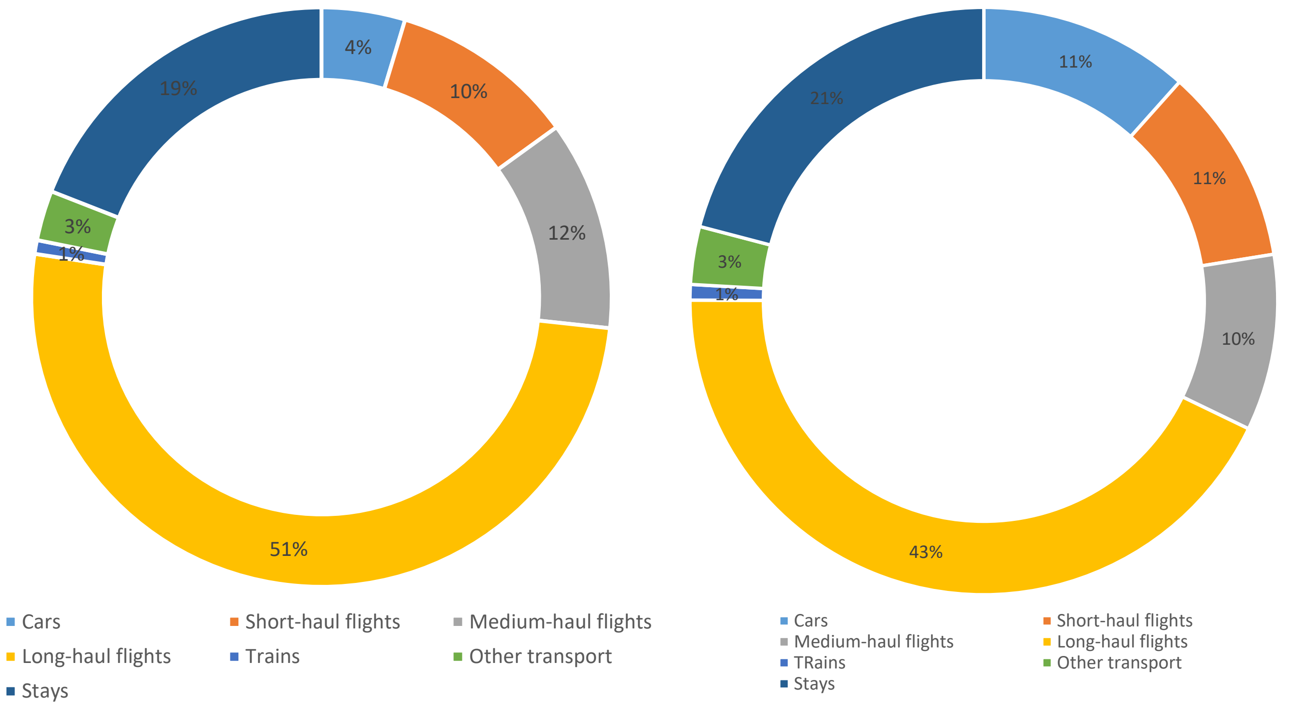

Figure 8 – Share by mode of travel of emissions relating to business travel (left) and visitors' travel (right)

As for the travel of visitors, whose travel and accommodation costs are covered by the University, their emissions amount to 1 641 tCO_2e. Calculated according to the same approach, the same constraints and assumptions, the uncertainty is evaluated at 42%.

Emissions from visitor's travel in 2019 are mainly due to air travel (63% of visitors' emissions, with long-haul flights accounting for 43% of total emissions). The use of private cars appears to be higher than for business travel, at 11%. Emissions related to the stay represent almost the same 21% of total emissions. Emissions related to train travel, as for business travel, marginal.

Emissions from the use of private cars, planes and trains for business and visitor travel were calculated based on in-depth analysis and physical data collection. This makes it possible to compare the distance travelled with emissions.

[4] Indeed, the data collection, in the absence of full reporting of business travel by the travel agencies, was done using the information available on the expense reports, which is only accounting information. We also wanted to include in the analysis the emissions from travel at the destination (taxi and bus) and from stays (accommodation and meals on site): the monetary approach, described above, provides average emission factors with very large uncertainties.

Most of these trips are made by air, accounting for 88% of the distance travelled, and the associated emissions represent the same proportion. While the proportion of distances travelled by train is equivalent to that of the car (6% for each), it appears that the proportion of emissions associated with car travel is much higher than that caused by the train (9% vs. 1%).

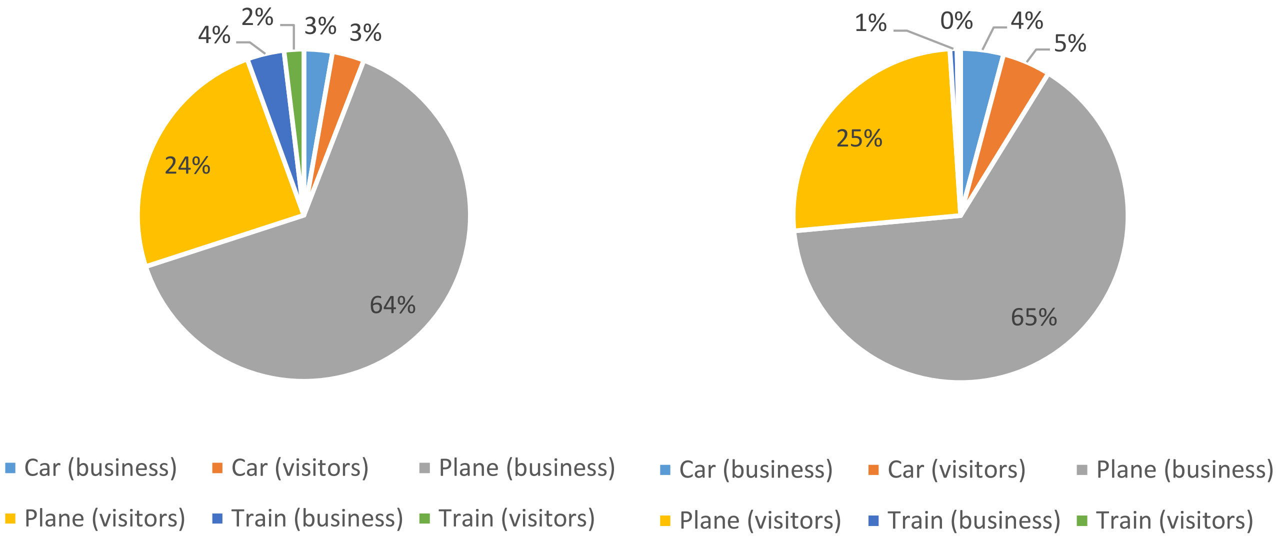

Figure 9 – Business travel and visitors' travel: share of transport modes by (left) distance travelled, and (right) by GHG emissions)

Based on the number of journeys made by air and by train (it was not possible to extract this information for car journeys), it is clear that University travellers, like visitors, use air travel for their business trips in 2/3 of the cases. On average, these journeys cover a distance of between 2,600 and 2,900 kilometres, whereas the train is used for much shorter distances, on average between 340 and 420 kilometres. It also shows that the average emissions per journey by plane are about 500 kgCO2e, whereas the train emits only about 10 kgCO2e per journey: this very significant difference makes it possible to envisage **actions aimed at generalising travel by train** for longer distances if the transport time remains reasonable.

A more detailed analysis of air travel shows a strong predominance of short-haul flights (i.e. less than 1 000 km). Between 46% and 52% of air travel is less than 1 000 km, although it accounts for an average of only 10% of the distance travelled and generates only 14% to 17% of air travel emissions. The average distance travelled per short-haul trip is between 566 and 591 km and emits about 150 kgCO2e per trip, whereas, excluding local trips, the average train trip is between 460 km and 517 km and emits between 14 and 15 kgCO2e. Even if not all short-haul flight journeys can be substituted by train travel (due in particular to pre-routing to airline hubs), there are certainly **opportunities to be seized** in terms of travel mode within this distance range.

3.3 Purchase of goods and services

Emissions related to the purchase of goods and services totalled **16 705 tCO2e**[5] and represent **38% of the University's total emissions**. This is the largest item in terms of greenhouse gas emissions within the University.

[5] Except for water consumption in each building, available data, such as detailed composition of purchases products and services and related physical units (kg, l, m3, units…) received were not precise and complete enough to come up with physically based emissions. Hence, the reported emissions are all based on a monetary approach. Data was extracted from the SAP accounting system for the year 2019 and restated to neutralise the VAT impact. G/L accounts have been aggregated and average emission factors applied. These data

The main categories of emissions are consumables, repair and maintenance activities, small non-capitalized equipment, professional fees, as well as miscellaneous expenses such as professional clothing, laboratory equipment or conference registrations.

Emissions from the purchase of non-capital goods account for three-quarters of the total emissions in this category, with the remainder coming mainly from the purchase of services (19%). Emissions related to food (catering and reception services, etc.) complete the picture with 5% of total emissions.

Purchases of consumables (liquid gas, cleaning products, office equipment, packaging, small equipment) generate greenhouse gas emissions estimated at 6 ktCO2e, i.e. around 36% of total purchasing emissions. Repair and maintenance activities on machines, vehicles or buildings generate emissions close to 2,4 ktCO2e (14% of the total), barely more than the emissions generated by the purchase of small, non-capitalized equipment, such as small IT equipment, small office furniture, small equipment, or low-value licenses. What is called below professional services such as lawyers, architects, communication agencies, audit, or consultancy firms, which the University contracted in 2019, generated emissions of around 1,4 ktCO2, or 9% of purchasing emissions.

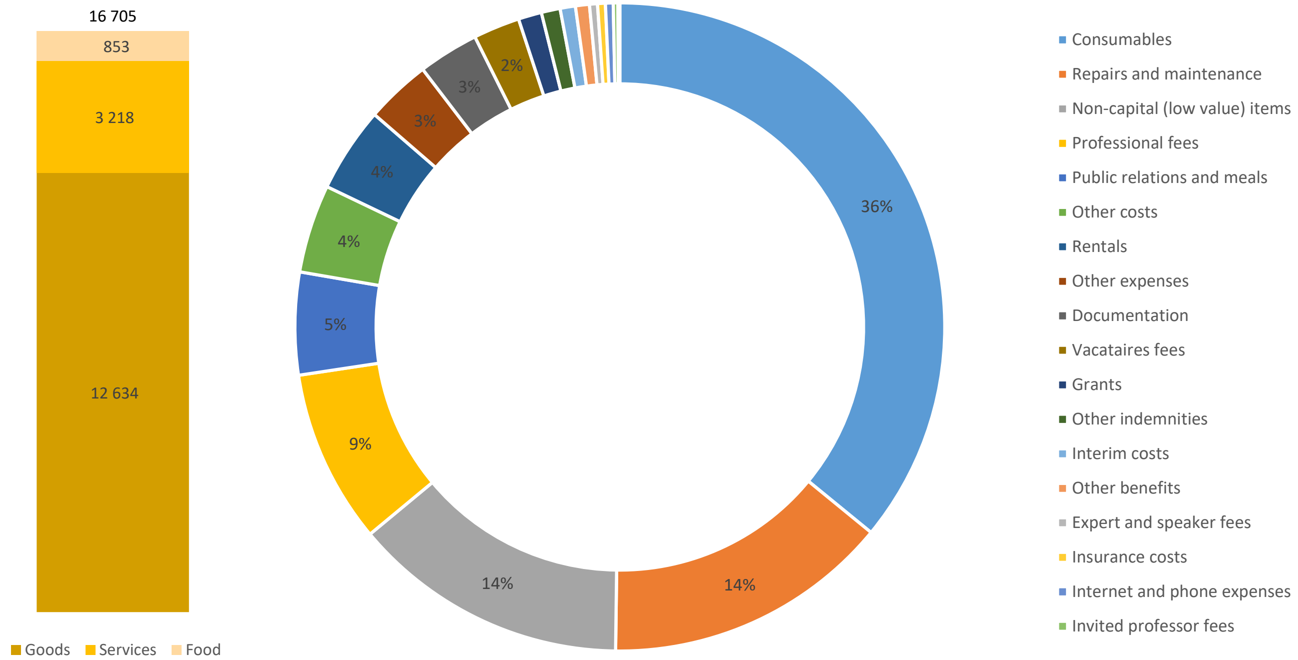

Figure 10 – Emissions relating to purchase of goods and services (tCO2e) and share of purchase categories in these emissions

By comparing the expenditure to acquire these goods and services (€52,9 million excluding VAT in 2019) and the emissions generated by these purchases, we can see the dissonant impact of the procurement of consumables. Indeed, these purchases represent the third largest item of expenditure (excluding salaries and fixed assets) with €7,4 million excluding VAT (14% of expenditure) but are by far the category that emits the most greenhouse gases (36%). In contrast, professional fees are the largest item of expenditure (€9,9 million excluding VAT - 19% of total expenditure) but account for only 9% of emissions. These services, with a high intellectual content, have an average emission factor of around 147 kg per k€ (excl. VAT) of expenditure, whereas consumables, of various

are therefore much less accurate than the physical data. The resulting uncertainty of emissions from purchases is therefore high, at around 36%.

kinds, emit an average of 814 kg of greenhouse gases per k€ (excl. VAT), with a peak of 1 600 kg for chemical and cleaning products.

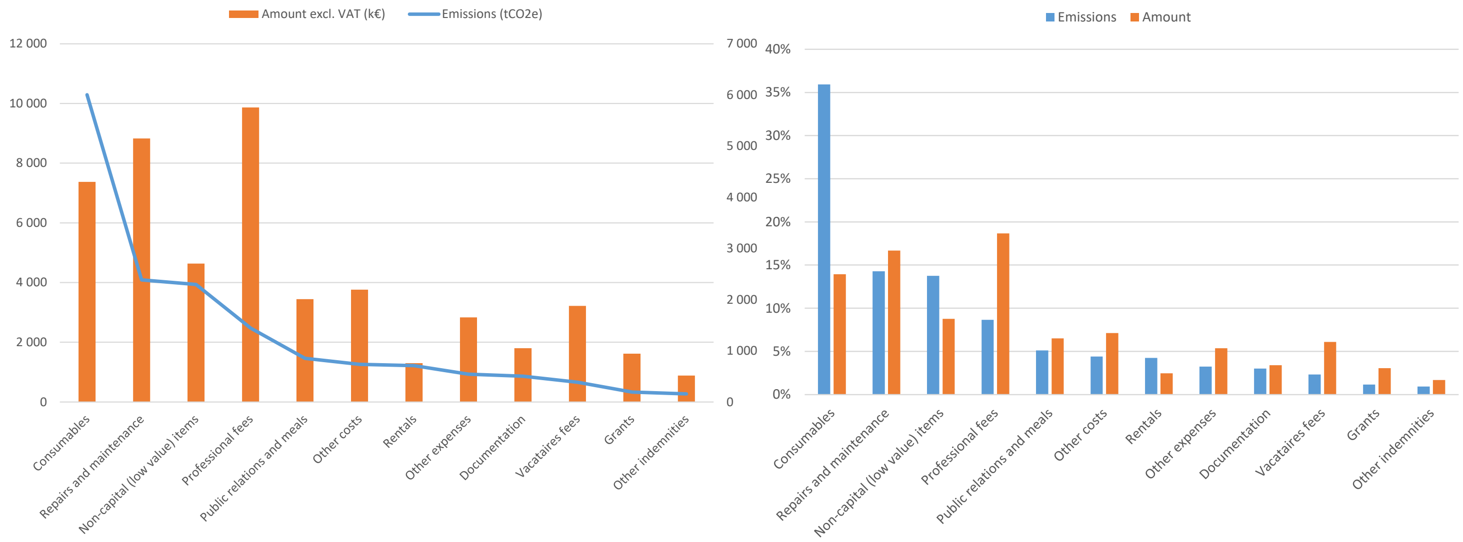

Figure 11 – Expenses to purchase goods and services (k€ excl. VAT) and related emissions (tCO2e), and share of the same expenses and emissions in purchase categories

Besides **collecting physical data** (composition and weight) on these purchases on the top purchasing categories the University should also take advantage of its efforts to rationalise purchases undertaken from 2019 onwards (public contracts by activity, identification of preferred suppliers) to obtain **exhaustive information on the carbon weight of their products** from its most representative and relevant suppliers. This would certainly help the University to enhance the value of green, local, eco-designed or low-carbon purchases, and would provide the Procurement Office with to the means to reduce the University's emissions.

3.4 Fixed assets

The emissions generated by the fixed assets[6] acquired or created by the University in 2019 totalled **7 058 tCO2e** and represent **16% of the institution's total emissions**.

Buildings

The share of emissions in 2019 from the construction of buildings used by the University for its activities amounts to 2 119 tCO2e, or 30% of fixed asset emissions. This is based on a gross internal surface of some 181 000 m2 of office and laboratory space.

[6] Fixed assets are defined in the accounting sense of the term: goods intended to be used on a long-term basis for an organisation's activity. We have adopted the classification used in the University's annual accounts, which defines as an expense any purchase of goods with a unit value of less than €5 000 excluding VAT. We have also followed the GHG Protocol's requirements by allocating the emissions generated at the time of asset acquisition on the basis of the method and duration of depreciation of the University's fixed assets. Finally, we have included in the fixed assets all the buildings used by the University as well as student residences, even if for the first category, they are not recorded in the University's accounts, and for the second, they are only rental expenses.

The degree of uncertainty associated with these emissions is estimated at 38%. The emission factors for buildings and residences are based on the average composition of the materials used. Monetary data for the other fixed assets have a high degree of uncertainty.

This approach does not highlight which buildings perform better than others. The Belval campus accounts for 71% of these emissions, while Kirchberg (campus, JFK building, Weicker building) accounts for 21%, and Limpertsberg campus for 8%. In average, buildings for their construction phase are estimated to emit 469 Kg CO2e per m2 and per year. It may be useful to recall that the greenhouse gas emissions related to energy consumption (presented above) showed a somewhat different distribution: Belval accounted for only 59% of energy emissions (71% of the campus surface), Kirchberg for 26% (21% of the surface) and Limpertsberg for 15% (8% of the surface). Such a shortcut confirms that in general the buildings constructed in Belval have a much better energy and carbon intensity performance.

Student residences

The annual share of emissions relating to the construction of student residences made available by the University for its students and visitors amounted to 529 tCO2e, i.e. 7% of fixed asset emissions. In 2019, there were 43 residences (three of which closed during the year) and 1 104 rooms, spread over eight communes in the south and centre of the Grand Duchy.

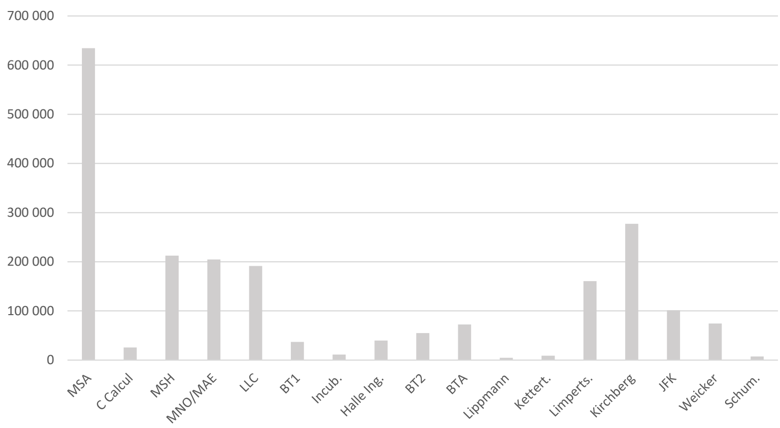

Figure 12 – Annual emissions (kg CO2e) by building from the allocation of the emissions relating to their construction

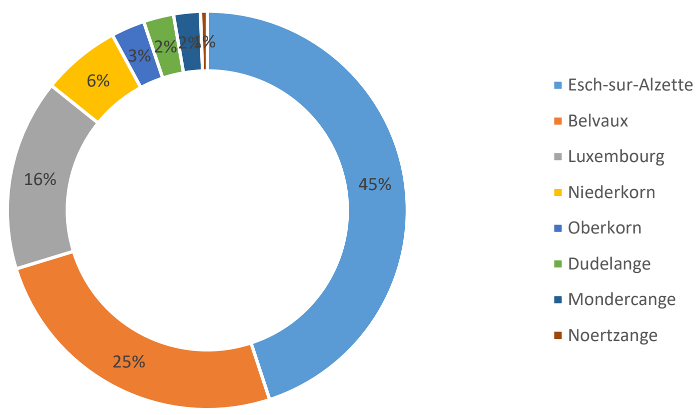

Figure 13 – Share of the student residences by municipality in the annual allocation of the emissions relating to their construction

The greenhouse gas emissions for these residences are concentrated in the city of Esch-sur Alzette: Unival II, with 204 rooms, generates an annual emission of 124 tCo2e for its construction (23,5% of the total emissions of the residences). Sixteen other residences are located in Esch. 25% of the emissions come from residences located in Belvaux: Unival I, with 193 rooms, emits 120 tCo2 (22,6%) for the 2019 share related to its construction. Twelve student residences are in the city of Luxembourg (16%).

Other fixed assets

Finally, greenhouse gas emissions relating to other fixed assets (scientific machinery and equipment, furniture, large IT equipment, software, building fixtures and fittings) totalled 4 410 tCO2e for 2019, i.e. 62% of fixed asset emissions. This corresponds to the annual allocation of emissions generated during the construction of these fixed assets (extraction of raw materials, manufacturing, and transport), distributed on the basis of their respective standard depreciation periods.

With 37%, the largest share of emissions relating to other fixed assets is accounted for by building installation work (partitioning, technical installations, connections). This corresponds fairly closely to the importance of their depreciation in the University's ledger. This is also the case for fixed IT equipment (servers and network), with a 27% share for emissions and for annual depreciation. Scientific machines and equipment have higher emission factors per k€ of depreciation due to their composition and complexity: although this category represents only

6% of depreciation, it totals 11% of emissions. The opposite is true of software and licences: they represent only 9% of emissions, whereas their weight in depreciation is 20%. This is due to a composite emission factor including a minority share of hardware and a significant share of consultancy (intellectual activity with low emissions).

Like for the purchase of goods and services, the University should take advantage of its procurement rationalisation efforts to **identify and benefit from more climate-relevant products, equipment, and suppliers.**

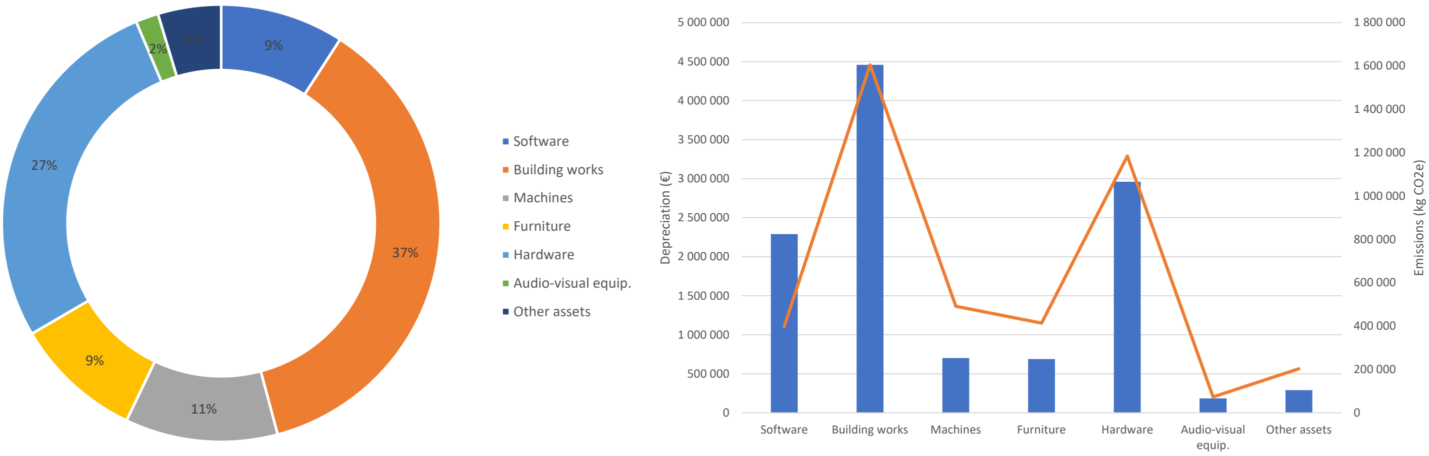

Figure 14 – Share of the other fixed asset categories in the annual allocation of the emissions related to their manufacturing; depreciation costs (€) and emissions (kg CO2e) for each category

4. Perspectives

Since 2019, the international community has increased its climate commitments, in particular the European Union who decided to raise its intermediate commitments to reduce its greenhouse gas emissions by 2030 from -40% to -55% compared to 1990 levels. The effort required will be considerable over the next eight years. The effects of climate change are already being severely felt, and the European public opinion is increasingly aware of the challenges. Expectations are growing and aligning ; there is now a consensus that individual actions alone will not be enough to stop climate change, and that collective, political, and systemic actions must also emerge.

With the present analysis, the University has assessed for the first time the climate impact of its activities, providing a **tool** on which to build a future action plan, and a **baseline** to assess its success.

The University has now the possibility to establish **its operational contribution to the fight against climate change**. This analysis is the first step to set out on the pathway to climate policy, with the setting of the University's **own greenhouse gas emission reduction targets** , at least for 2030 and 2050. The best practice is to draw on the work of the Science Based Target Initiative to identify the trajectory to be followed, on the basis of the most recent scientific work. Breaking down these objectives into **reduction targets by activity or category of emissions** will be the next step, through the setting-up of discussion and working groups to **co-define relevant and effective actions** within the scope of responsibility of the faculties, interdisciplinary centres, and central services. **Monitoring indicators** will be designed to measure progress and assess the impacts and associated reductions in greater detail. A **virtuous cycle of continuous improvement** would be then set in motion, supported by a regularly updated analysis of greenhouse gas emissions, and regularly reassessed reduction targets and renewed actions.

This analysis is also a powerful tool to engage the University community about climate action in the institution: results will be **disseminated**, communicated, and **discussed** so that the whole community **takes ownership of the approach** and **values these initiatives** to reduce the University's current greenhouse gas emissions.

As a short-term action, the University will prepare for the **update of this analysis**, to integrate recent developments touching energy consumption, individual car commuting or greener procurement. For this, the institution will establish a routine for collecting relevant data and clarify responsibilities, allowing these data to be useful in the operational framework for monitoring activities.