Universiteit Antwerpen

UANTWERP'S CARBON FOOTPRINT REPORT 2021: ENERGY AND MOBILITY

MARCH 2023

ecolife

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

As part of its sustainability strategy, UAntwerp performed a baseline measurement of its carbon footprint for the reference year 2018 for its main Antwerp campuses (Campus Drie Eiken, Groenenborger, Mutsaard, Middelheim and Stad). Ecolife was asked to reassess UAntwerp's carbon footprint for the impact categories energy and mobility for the reference year 2021. This follow-up measurement has a twofold aim: 1) to analyse the impact of several COVID-related measures on the energy use and mobility flows of UAntwerp and 2) to fine-tune the data collection and to improve the data quality given a full carbon footprint assessment of the reference year 2022 in 2023. For this footprint of 2021 Campus Mutsaard is included in Campus Stad, so the campuses considered in this study are Campus Drie Eiken (CDE), Campus Groenenborger (CGB), Campus Middelheim (CMI) and Campus Stad (CST).

The carbon footprint of the UAntwerp was carried out conform the Bilan Carbone® (version 8) methodology of the French Association Bilan Carbone, with CO_2 emission values adapted to a Belgian context. This Bilan Carbone® methodology is compatible with the Greenhouse Gas Protocol (GHGP) and ISO standardisation.

After a general explanation of a carbon footprint, this report contains a detailed description of the calculation methodology, with data sources, method of collection and processing of consumption data and the Bilan Carbone® calculation tool. The results are presented per activity or impact category, including uncertainty estimates. We analyse the impact of COVID-related measures on the energy use and mobility flows of UAntwerp. We advise on fine-tuning the data collection and improving the data quality given a full carbon footprint assessment of the reference year 2022 in 2023.

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3. THE CARBON FOOTPRINT

3.1 What is the carbon footprint?

A carbon footprint of an organization or a company quantifies the impact the organization or the company has on the global warming of the earth. This carbon footprint, also known as the climate footprint, is expressed in CO_2equivalents (abbreviated as CO_2e).

Since the industrial revolution the amount of greenhouse gas has increased strongly. Greenhouse gases are gases that cause a greenhouse effect because they absorb a large amount of infrared radiation (this radiation cools down the earth). There are different kinds of greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrogen monoxide (N_2O) and fluor gases. The contribution of each greenhouse gas depends on the 'global warming potential' (GWP), the extent to with the gas blocks the heat radiation and in this way contributes to the warming of the earth. This global warming potential depends on the quantity, lifetime and power of the greenhouse gas. To be able to compare the effects of the different gasses, the quantity of a specific gas is expressed in CO_2e, this is the equivalent amount of CO_2 that is needed to heat the earth equally over the next 100 years. For example, 1 ton of methane equals 34 tons of CO_2.

The carbon footprint of an organization or a company is the sum of all the greenhouse gases (expressed in CO_2e) that are released during the activities of the organization or the company[1].

3.2 What is our carbon footprint?

The total amount of greenhouse gases worldwide in 2019 was 49,8 billion tons of CO_2e (=49,8 Gigaton CO_2e). In the figure below from the World Resources Institute, an overview per sector, activity and greenhouse gas is presented.

1 Biological short-cycle emissions form e.g. human respiration or wood combustion do not contribute to the carbon footprint, provided that CO2 is captured by planting new trees or crops for human consumption. Emissions of changes in land use (for example, burning forests if the forests are not re-planted) are included in the carbon footprint.

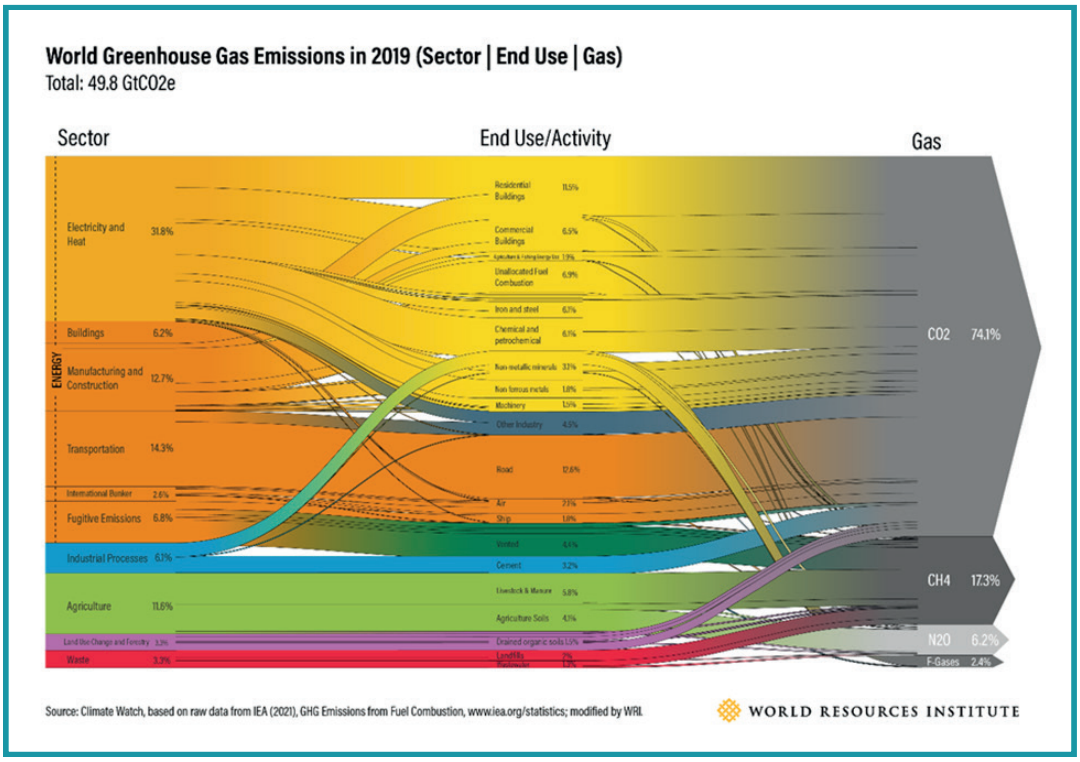

Figure 1: World Greenhouse Gas Emissions in 2019 per sector, use and gas

If we divide the total emissions in 2019 by 7,7 billion people this gives 6,5 tons of CO_2e per person. Three quarters consist of CO_2, mainly from the energy sector (see Figure 1).

According to the OECD (Organisation for Economic Co-operation and Development), the total emissions in Belgium in 2019 was 116,4 million tons of CO_2e[2], which means about 10 tons of CO_2e per Belgian. This number only includes gases emitted in Belgium. In 2017 VITO has performed a study in Flanders that also includes the consumption of goods produced elsewhere. If also gases emitted abroad, caused by consumption in Flanders, are taken into account this results in 20 tons of CO_2e per person in Flanders[3]. According to this study, 2/3 of the footprint per person in Flanders (about 13 tons of CO_2e) is emitted outside Flanders.

3.3 Climate agreement Paris 2015

In 2015, at the 21st Climate Conference (COP 21) the world leaders reached the 'Paris Agreement' where the goal was set to restrict global warming to 2°C and to aim for a global warming of 1,5°C (in comparison to the average temperature in pre-industrial time). Momentarily we have a rise of 1,2°C compared to the pre-industrial time. This is shown in Figure 2 from Climate Action Tracker.

2 OECD (2022), Dataset greenhouse gas emissions, https://stats.oecd.org/Index.aspx?DataSetCode=air_ghg.

3 Vercalsteren A., Boonen K., Christis M., Dams Y., Dils E., Geerken T. & Van der Linden A. (VITO), Vander Putten E. (VMM) (2017), Koolstofvoetafdruk van de Vlaamse consumptie, studie uitgevoerd in opdracht van de Vlaamse Milieumaatschappij, MIRA, MIRA/2017/03, VITO, VITO/2017/SMAT/R.

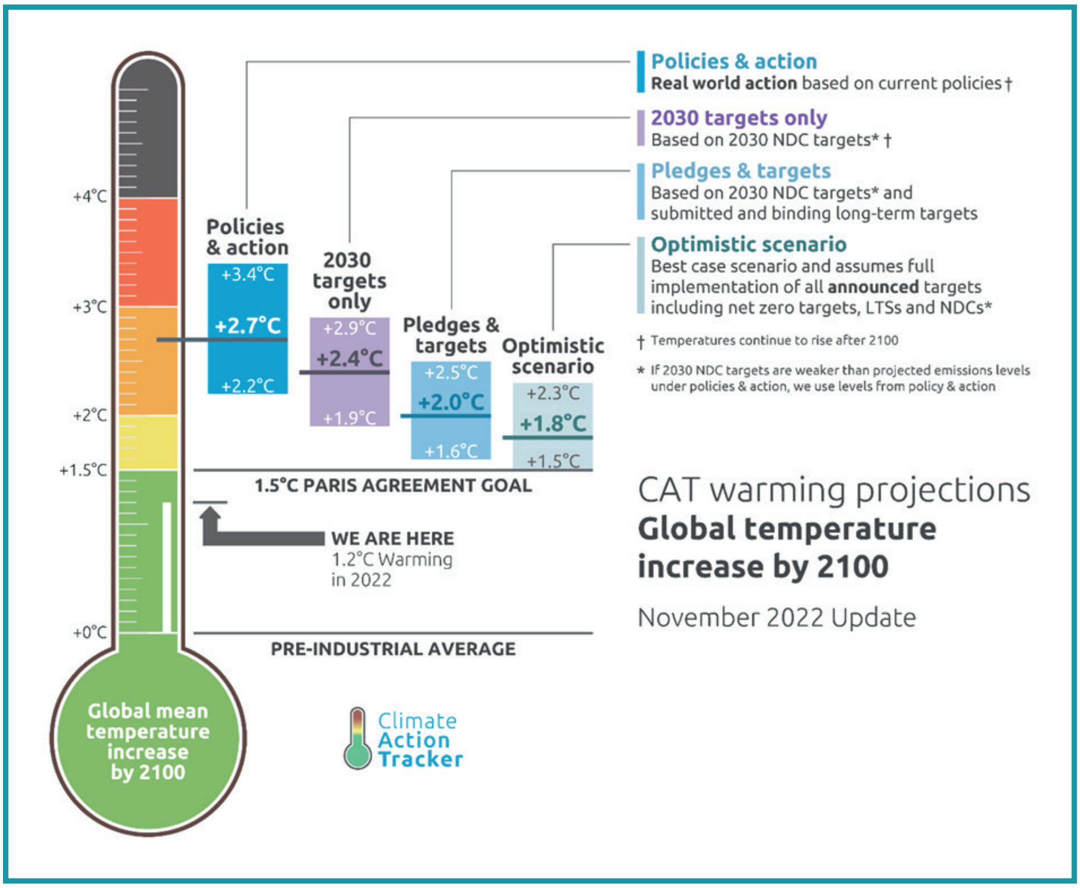

Figure 2: CAT warming projections

By way of comparison: we live now in a climate where the average temperature is about 5°C higher than in the Ice Age 20.000 years ago.

To stay on track at 1,5°C, we need to obtain a maximum of emissions of 27 billion tons of CO_2e worldwide in 2030. The United Nations expect there will be 8,5 billion people in 2030, which means 3 tons of CO_2e per person. In 2050 the emissions worldwide should be restricted to 10 billion tons of CO_2e, if we take into account a projected world population of 9,7 billion people, this means about 1 ton of CO_2e per person. After 2050 the world should be climate neutral and emissons should drop to 0 ton of CO_2e. On the path towards this 0 ton of CO_2e, it should be kept in mind that every hundredth of a degree of warming that can be avoided matters.

3.4 Why calculate your carbon footprint?

Over the years, multiple footprint indicators have been developed to measure environmental impact, for example, the ecological, carbon, water, material and nitrogen footprint. Of all footprint indicators, companies and governments use the carbon footprint the most. The standardisation of the carbon footprint is also currently the most developed. Companies and organisations are getting more and more interested in their carbon footprint mainly for two reasons: financial vulnerability and social responsibility.

Firstly, a high carbon footprint creates financial vulnerability for an organisation. The carbon footprint is strongly linked to the use of fossil fuels, and fossil fuel prices may increase or fluctuate in the future. Furthermore, in the future different types of CO_2 taxation will most likely become more important. A carbon footprint calculation provides insight into the expected future costs of greenhouse gas emissions and fluctuating energy prices.

Secondly, a calculation of an organisation's carbon footprint is also in line with corporate social responsibility (CSR), global climate targets and the UN Sustainable Development Goals (SDGs). Reducing its climate footprint is increasingly regarded as an organisation's social responsibility.

When determining which organisation's activities should be included in the carbon footprint, both financial vulnerability and social responsibility should be taken into account. If the organisation is not responsible for the emissions or if the emissions do not pose a financial risk for the organisation, the emissions do not need to be included in the organisation's carbon footprint.

For organisations, projects and products, the carbon footprint has been standardised in ISO Standards 14064-1 (for organisations and companies), 14064-2 (for projects) and 14067 (for products).

Furthermore, the Bilan Carbone® methodology (www.association+carbone.fr), developed at the time by the French ADEME, is now used in many Western European countries and can be considered as the reference methodology for calculating the carbon footprint of companies and regions. The Bilan Carbone® method used in this study complies with ISO standards and Greenhouse Gas Protocol.

3.5 Direct and indirect emissions: scope 1, 2 and 3

The carbon footprint consists of the organisation's on-site direct emissions versus indirect emissions outside the organisation's location. Those indirect emissions can be caused by energy consumption both onsite and off-site. As a result, in accordance with ISO standards, the carbon footprint is subdivided into three scopes.

Scope 1 (direct GHG emissions) consists of all the direct greenhouse gas emissions onsite or by the cars the organisation or company owns. This involves its' own fuel consumption for heating, machinery and mobility, as well as possible leaks of cooling gases from cooling installations.

Scope 2 (electricity indirect GHG emissions) consists of the indirect greenhouse gas emissions caused by the direct consumption of purchased electricity onsite. These indirect emissions come from the electricity generating facilities.

Finally, **Scope 3 (other indirect GHG emissions)** contains all other indirect emissions, related to the production of purchased products (goods and services), the processing of waste, commuting, transport and business travel (excluding company cars, which are included in scope 1). Data from numerous organisations that have assessed their Scope 3 emissions thoroughly show that Scope 3 emissions are by far the largest part of the carbon footprint of the majority of organisations.

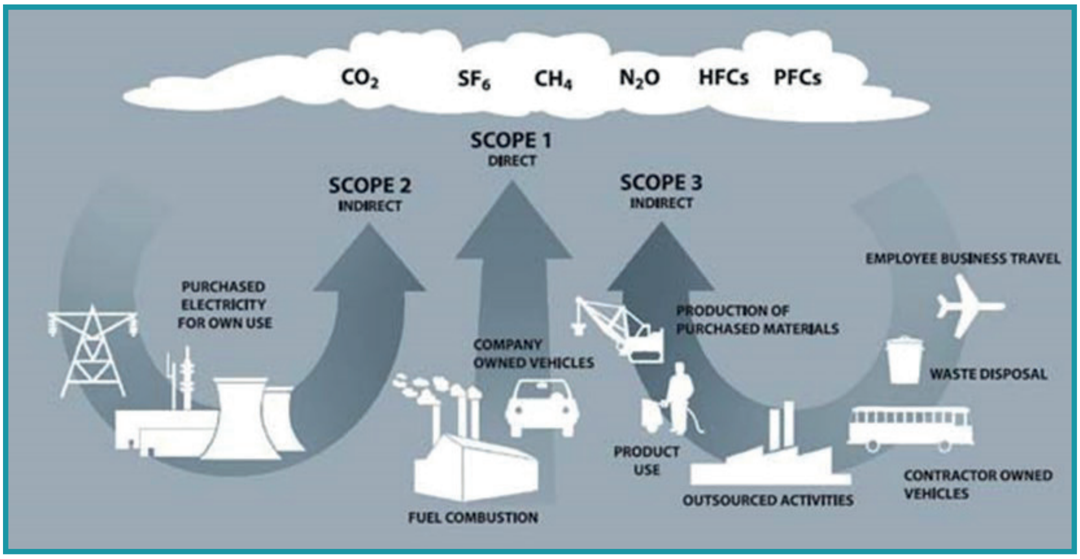

Figure 3: ISO scopes

4. METHODOLOGY

The assessment of an organisation's carbon footprint is conducted through the following methodological steps:

- Scope definition;
- Selection of impact categories;
- Data collection;
- Calculation and result analysis;
- Establishing actions for reductions.

4.1 Scope definition

This carbon footprint for Energy and Mobility in 2021 of the UAntwerp has the following scope.

Sites:

- four student campuses Drie Eiken, Groenenborger, Middelheim, and Stad;
- administrative, research and education buildings;
- student homes owned by UAntwerp (these were included because for energy use, only the data for the whole campus were available, including both educational buildings and student homes);

Activities:

- activities related to administration and academic research: energy use in the buildings from UAntwerp, business travel, employee commuting;
- activities related to education: student mobility (including airplane travel for foreign students studying at the UAntwerp), energy use at the student homes on the campuses;

Not included in the carbon footprint are (due to lack of data):

- private student homes not owned by the UAntwerp;
- transport of goods;
- mobility (airplane, car, train) from non-student visitors (e.g. guest lecturers);
- UAntwerp's spin-offs;
- Work at home;

4.2 Impact categories

In this report we only analyse three impact categories:

1. **Energy**: emissions related to direct energy use (natural gas, heating oil, electricity used on campuses);
2. **Transporting people**: emissions from employee commuting, business travel and student mobility, including direct and indirect emissions from the production of fuels and vehicles;
3. **Capital goods**: emissions from the production of business cars;

4.3 Data collection

4.3.1. Approach

There are two types of data: emission factors or footprint intensities (e.g. kg CO_2e per unit consumption) and consumption and infrastructure data. The footprint intensities are data from the Base Carbone LCA (life cycle analysis) database that is used in the Bilan Carbone® V8 Excel file. The consumption and infrastructure data, presented in the table below, are collected by the UAntwerp and processed by Ecolife.

4.3.2. Reference year and data quality

Consumption and infrastructure data of the UAntwerp for the year 2021 were collected by Marleen Clerinx (environmental coordinator), Carla Uwents (sustainability coordinator), Ragna Verswyvel (voluntary employee), Matthias Verstraeten (climate coordinator) and Krist Nulens (energy expert, department infrastructure).

The uncertainty values of the footprint intensities were taken from the Bilan Carbone® V8 file. Data uncertainty values were estimated using the following rules:

- 5% uncertainty on internal data from own direct measurements with local meters (e.g. kWh electricity);
- 15% uncertainty on internal data with assumptions (e.g. liters of diesel and petrol from business cars, assumption on which kind of diesel and petrol);
- 30% uncertainty on data extrapolated with assumptions (e.g. km travel based on postal codes from employees);
- 50% uncertainty on data with very uncertain extrapolations (e.g. student mobility based on modal split from other universities).

All the data for ISO Scope 1 and 2 have uncertainty levels below 20%, which is within the internationally accepted limit of data uncertainty according to the Bilan Carbone® method.

4.3.3. Overview of input data

After the UAntwerp collected all the data, it was processed by Stijn Bruers (Ecolife) and Christine De Munck (Ecolife) to become suitable for the Bilan Carbone® method, conforming to the methodology outlined in the previous chapter. The following table contains all the relevant input data to be used in the Bilan Carbone® Excel sheets. Data for the four campuses were calculated: Campus Drie Eiken (CDE), Campus Groenenborger (CGB), Campus Middelheim (CMI), and Campus Stad (CST).

Impact category		CDE	CGB	CMI	CST	Total	Unit	Uncer-tainty
General information	Number of students	4.756	4.838	371	12.438	22.403		0%
	Number of employees (FTE)	2.252	670	471	1.954	5.347		0%
	Used surface	89.422	45.546	13.622	181.493	330.083	m^2	5%
Energy	Natural gas (LHV)	12.920.567	7.448.814	1.903.580	10.670.579	32.943.540	kWh	5%
	Heating oil	0	0	0	54.682	54.682	liter	5%
	Purchased electric-ity, Belgian average	9.467.275	5.536.766	1.339.753	3.438.769	19.782.563	kWh	5%
Capital goods	Vehicles					52,5	tons	30%
	Depreciation period vehicles					5	years	
Transporting people - employee commuting	Average pas-senger car	5.706.856	1.041.549	844.251	2.312.436	9.905.092	vehicle.km	30%
	Electric bike and motorbike, speed pedelec	1.058.409	267.479	159.858	802.718	2.288.464	passenger. km	30%
	Moped	25.658	12.158	0	26.105	10.785	passenger. km	30%
	Motorcycle	76.975	36.474	19.982	52.209	19.135	passenger. km	30%
	Bus, tram, metro	840.313	413.377	329.707	2.166.685	13.100	passenger. km	30%
	Train	1.289.335	735.568	454.596	5.645.129	135.500	passenger. km	30%
	Bike	6.902.110	2.753.822	1.114.011	6.695.841	200	km	30%
	On foot	153.950	151.977	54.951	1.115.974	1.740	km	30%

Transporting people - business travel	Car (petrol)					17.453	liters	15%
	Car (diesel)					8.234	liters	15%
	Car, taxi or rental					3.540	passenger. km	30%
	Bus					8.600	passenger. km	30%
	Train, country not known					33.300	passenger. km	30%
	Train, Belgium					2.772	passenger. km	30%
	Train, The United Kingdom					6.650	passenger. km	30%
	Train, Germany					15.153	passenger. km	30%
	Train, Finland					300	passenger. km	30%
	Train, France					18.061	passenger. km	30%
	Train, The Netherlands					7.839	passenger. km	30%
	Train, Spain					160	passenger. km	30%
	Train, Denmark					410	passenger. km	30%
	Plane, <500 km, 20-50 seats					31.903	passenger. km	30%
	Plane, 500-1000 km, 51-100 seats					343.442	passenger. km	30%
	Plane, 1000-3500 km, 51-100 seats					3.066.629	passenger. km	30%
	Plane, > 3500 km, 101-220 seats					3.435.576	passenger. km	30%
Transporting people - student travel	plane, short-haul					1.434	number of flights	50%
	plane, long-haul					1.486	number of flights	50%
	Car					17.522.127	passenger. km	50%
	Bus					13.237.437	passenger. km	50%
	Train, Belgium					52.453.626	passenger. km	50%
	Train, The Netherlands					8.992.000	passenger. km	50%

Table 1: Consumption and infrastructure data

In general, the collected data were considered to be sufficiently accurate, with most uncertainties below or equal to 30%. Data with higher uncertainties, in particular student travel, are due to rough extrapolations from other universities (VUB and KULeuven). In future footprint calculations, these data must be further improved using student mobility surveys.

4.4 Calculation method

Each impact category has several consumption activities. For example, the impact category ‘energy’ consists of the consumption of fuels (e.g. natural gas) and electricity (e.g. from biomass). The impact category ‘business travel’ includes travel by car, train, bus and airplane.

The footprint of a consumption activity is always the product of the consumption amount (e.g. kWh, kg, km or euro) and the footprint intensity or emission factor (kg CO_2e per kWh, kg, km or euro).

4.4.1. Energy

Energy: natural gas and heating oil

Description	The direct energy emissions from natural gas (ISO scope 1) result from the use of natural gas (kWh) for heating and appliances.
Scope	All buildings at the 4 campuses, including student homes and student restaurants.
Assumptions	For campus Mutsaard which is part of campus Stad, 50% of the total energy use is accounted to UAntwerp.
Calculation equations	Footprint = footprint intensity gas (kg CO_2/kWh primary energy) x kWh primary energy (thermal energy of natural gas or heating oil).

Energy: electricity

Description	The direct energy emissions from electricity (ISO scope 2) consist of the emissions at the power plants and result from the use of electricity (kWh).
Scope	All buildings at the 4 campuses, including student homes and student restaurants.
Assumptions	For campus Mutsaard which is part of campus Stad, 50% of the total energy use is accounted to UAntwerp. All electricity is bought from NV Vlaams EnergieBedrijf (VEB), which buys guarantees of origin of renewable sources, namely wind turbines in Antwerp. According to the Convenant of Mayors 2021, this electricity can be regarded as fully green electricity with zero emissions during production. Scope 3 emissions for production of renewable energy plants at 0,014 kg CO_2e/kWh and inline losses for electricity (4,58% according to the Council of European Energy Regulators (CEER)[4]) are still accounted for.
Calculation equations	• Footprint purchased electricity = footprint intensity VEB electricity (kg CO_2/kWh) x kWh purchased electricity. • Footprint purchased electricity Scope 3 = footprint intensity renewable scope 3 electricity (kg CO_2/kWh) x kWh purchased electricity.

4.4.2. Transporting people

Transporting people: employee commuting

Description	The emissions (ISO scope 3) for employee commuting are direct emissions of vehicles and indirect emissions of fuel production, vehicles and transport infrastructure.
Scope	Vehicle kilometres for (electric) cars, motorbikes and electric bikes, passenger kilometres for bus/tram/subway and train.

4 CEER (2020), Energy Quality of Supply Work Stream, 2nd CEER Report on Power Losses,Ref: C19-EQS-101-03.

Assumptions	In 2021 there were 42 working weeks. We assume there is no correlation between the distance campus-home and the % of telework.

Calculation equations

- The total distance travelled by all employees one way to the campus is calculated based on the postal code of home address and campus site.
- A UAntwerp survey concerning working at home gave the following result:

Number of days per week to the campus	% employees			
	CDE	CGB	CMI	CST
5	45%	43%	15%	19%
4	21%	26%	16%	26%
3	20%	17%	46%	32%
2	7%	8%	17%	13%
1	3%	2%	5%	6%
0	4%	4%	1%	4%
Total	**100%**	**100%**	**100%**	**100%**

Based on this survey, the distance travelled by all employees per campus per week one way is calculated. This distance is multiplied by two (for two-way travel) and by 42, the number of weeks in 2021 that the UAntwerp campuses were open.

- A UAntwerp staff mobility survey contains, for each campus, the transport modes for the main trajectory as well as the pre- and post-trajectories. For the main trajectories, the outcomes are presented below:

Ways of transport main trajectory	CDE	CGB	CMI	CST
Motorcycle	0,16%	0,22%	0,00%	0,14%
Bus, tram, subway De Lijn	4,82%	6,73%	11,06%	11,27%
Bus, tram, subway TEC	0,40%	0,90%	0,00%	0,24%
Bus, tram, subway MIVB	0,00%	0,00%	0,00%	0,03%
Bike-sharing (Velo-Antw, Villo-Brussel)	0,00%	0,56%	0,34%	1,28%
Electric motorcycle	0,00%	0,11%	0,00%	0,03%
Electric bike	5,02%	3,93%	4,36%	3,67%
Electric/hybrid car alone or with relatives	0,84%	0,56%	0,17%	0,24%
Electric or hybrid car with colleagues	0,04%	0,00%	0,00%	0,00%
Bicycle	42,90%	50,28%	37,02%	34,28%
Motor	0,48%	0,67%	0,67%	0,28%
Speed pedelec	1,56%	0,90%	1,01%	0,55%
On foot	0,96%	2,81%	1,84%	5,93%
Train	8,01%	13,58%	15,24%	29,98%
Car alone or with relatives	34,21%	18,52%	27,81%	11,99%
Car with colleagues	0,60%	0,22%	0,50%	0,07%
Total	**100%**	**100%**	**100%**	**100%**

- Per transport mode, the number of kilometers travelled in 2021 is calculated by multiplying the corresponding % from the survey above with the total amount of kilometers travelled by all staff.
- For carpooling, the distance travelled by an employee is divided by 1,5 (assuming that a detour to pick up a colleague might be necessary).
- Footprint = distance travelled by transport mode (km) x footprint intensity of transport mode (kg CO_2/km).

Transporting people: employee business travel

Description	The emissions (ISO scope 3) for staff business travel are direct emissions of the vehicles and indirect emissions of fuel production, vehicles and transport infrastructure. In the footprint intensity of planes also the non-CO_2 emissions are accounted for[5].
Scope	Domestic and international travel with cars, busses, trains and airplanes.
Assumptions	• The footprint of business travel is calculated for the entire UAntwerp (not for each campus separately). • The amount of petrol and diesel consists of the fuel used by company cars[6] and the fuel use declared in the staff expense report. We assume half of the amount of fuel in the staff expense report is petrol and half is gasoline. We assume a same price of 1,5 euro per liter of petrol and per liter of gasoline. • For bus rides declared in the staff expense report there are 80 entries. We assume 10 km of bus ride per entry. • For taxi rides declared in the staff expense report there are 177 journeys. We assume 20 km per journey. • For train journeys declared in the staff expense report there are 333 journeys. We assume 100 km per journey. • For flights, distances are calculated from airports to airport. • For bus transport, the number of staff bus tickets (for campus Drie Eiken and Stad) are used (10 rides for one 'Lijnkaart', average distance of 10 km per ride).
Calculation equations	• Footprint cars = fuel use (litre) / footprint intensity of fuel (kg CO_2/litre). • Footprint per transport mode (other than cars) = distance travelled (km) x footprint intensity of transport mode (kg CO_2/km).

Transporting people: student mobility

Description	The emissions (ISO scope 3) for student mobility are the direct emissions of the vehicles and the indirect emissions of the production of fuels, vehicles, and transport infrastructure. In the footprint intensity of planes also the non-CO_2 emissions are accounted for.
Scope	• The footprint of student mobility is calculated for the entire UAntwerp (not for every campus individually). • Student mobility includes both commuter students who travel from their homes to the campus (and return) all days they have classes or exams, and residential students who travel from their homes to their student rooms (and return) once a week. Hence, there are three possible trajectories included: home-campus, home-student room and student room-campus. • For Belgian students enrolled at the UAntwerp, data include vehicle kilometres with cars and passenger kilometres by bus, train and tram/subway. • For international students visiting the UAntwerp data includes only distances travelled by international train (the Netherlands for Dutch students) and airplane.

5 In addition to the CO_2 emissions from burning kerosene, planes also produce non-CO_2emissions that contritube to global heating. The emissions consist of oxides of nitrogen, soot particles, sulphate aerosols, and water vapour at high altitude.

6 All the liters in the file 'Brandstofwagens2021' are aggregated, except for the Fiat Ducato for catering.

Assumptions	• The footprint of Belgian student mobility is based on extrapolations from VUB and KULeuven data. Both VUB and KUL have a similar modal split[7], independent of the average home-campus distance of students: 2/3 of the overall distance travelled by motorized vehicles, is by train, 1/5 is by car and the rest by bus, tram, subway or motorbike. In this assessment, we assume that the modal split at the UAntwerp is comparable to that at VUB and KUL. • Foreign students other than Dutch students are assumed to travel by plane. The number of short-haul flights (from an EU-country, average distance 1000 km) and long-haul flights (non-EU country, average distance 6000 km), as well as the number of international students and their country of origin, are used to calculate the airplane footprint. • Students from the Netherlands are assumed to travel by train from their homes to Antwerp 40 times per year, for an average distance of 2 × 100 km.
Calculation equations	• Average distance travelled per student by transport mode = average distance travelled per VUB student by transport mode x average home-campus distance of UAntwerp student (based on postal codes of student home address) / average home-campus distance of VUB student. • Footprint by transport mode = distance travelled (km) x footprint intensity of transport mode (kg CO_2/km).

4.4.3. Capital goods

Capital goods: vehicles

Description	The indirect emissions (ISO scope 3) for vehicles are emissions from the production of cars.
Scope	All service vehicles (company cars, vans, small trucks, trailers and tractors)[8].
Assumptions	The depreciation period of cars is 5 years. A car is estimated to weight on average 1,5 tons.
Calculation equations	Footprint of vehicles = number of vehicles x average weight of vehicle (ton/car) x footprint intensity of average car (kg CO_2/ton) / depreciation period.

7 See reports Ecolife (2017), The Carbon Footprint of the VUB 2016, and Futureproofed (2012), Nulmeting CO_2-emissies KU Leuven in het jaar 2010.

8 The number of vehicules consist of all the vehicules listed in the file of fuel use by company cars provided by UAntwerp.

5. RESULTS

This chapter contains the results of the carbon footprint calculation for the impact categories Energy and Mobility of the UAntwerp for the data year 2021. Firstly, the total carbon footprint will be compared with other references, such as emissions related to car travel or CO_2 absorbed by trees. Next, the footprint results per impact category are discussed. The total footprint can also be expressed per person (employee or student), for comparisons with other universities or future recalculations of the UAntwerp footprint.

5.1 Total carbon footprint for Energy and Mobility

UAntwerp's carbon footprint for Energy and Mobility for 2021 is 24.033 tons of CO_2e. This is the equivalent of driving 90 million kilometers by car. It also corresponds with the total annual carbon footprint of nearly 1200 average Belgians. It requires 1 million trees to absorb this amount of CO_2 within one year. In 2021 there were 22.403 students, which equates to 1,07 tons of CO_2e per student and 5.347 FTE staff members, which equates to 4,49 tons of CO_2e per FTE.

In Table 2 the results per impact category are given.

Impact category	Emissions		Uncertainties	
	ton CO_2e	%	ton CO_2e	%
Energy	8.499	35,4%	465	5%
Mobility	15.476	64,4%	2.552	16%
Business cars	58	0,2%	29	50%
Total	**24.033**	**100%**	**2.595**	**11%**

Table 2: Total carbon footprint results

This carbon footprint has a total uncertainty of 11%, which is the combination of the uncertainties in the Bilan Carbone® emission factors and the UAntwerp data.

5.1.1. Energy in 2021

The total amount of emissions for the impact category energy is 8.449 tons of CO_2e. In Figure 4, the details per campus are given.

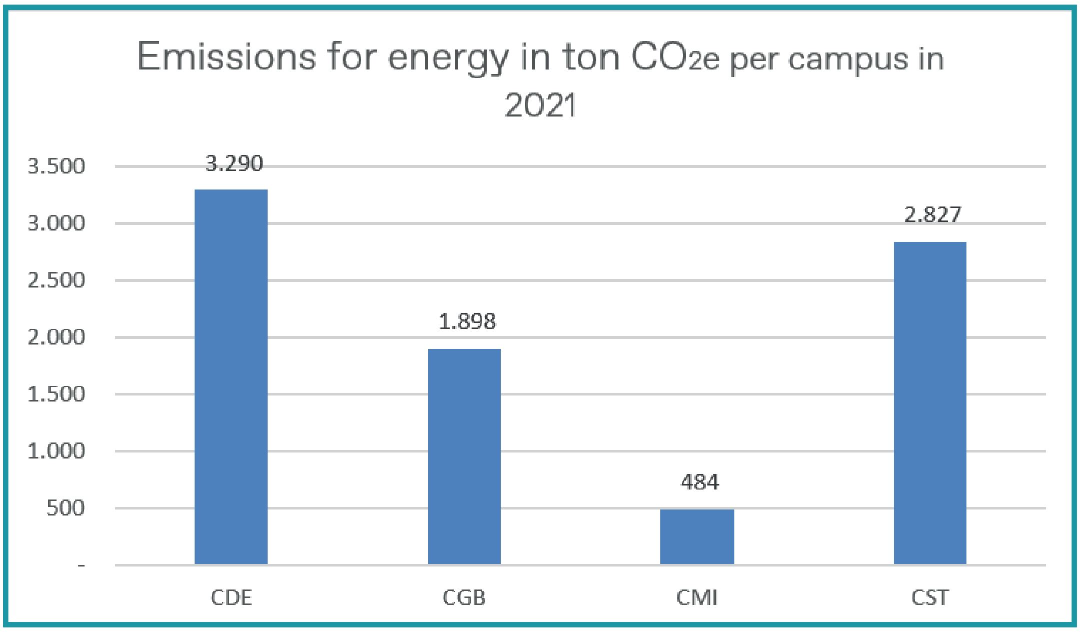

Figure 4: Emissions from energy per campus

Figure 5 shows the emissions of gas, heating oil, and electricity in tons CO_2e per campus. Heating oil is only used in the campus Stad. Because electricity is considered to be green, gas and heating oil contribute significantly more to the emissions than electricity.

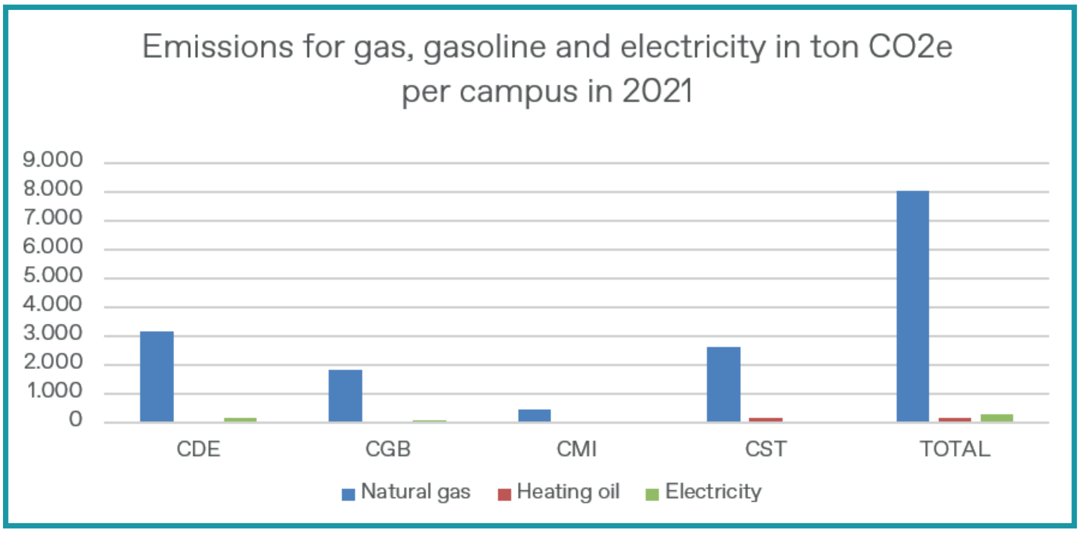

Figure 5: Emissions from gas, heating oil and electricity separately

Table 3 shows the use of electricity in kWh, gas in kWh, and heating oil in liters along with the CO_2e emissions per campus and per square meter.

Electricity	CDE	CGB	CMI	CST	TOTAL
kWh	9.467.275	5.536.766	1.339.753	3.438.769	**19.782.563**
ton CO_2e	139	81	20	50	**290**
kg CO_2e per m^2	1,6	1,8	1,5	0,3	**0,9**

Natural gas	CDE	CGB	CMI	CST	TOTAL
kWh	12.920.567	7.448.814	1.903.580	10.670.579	**32.943.540**
ton CO_2e	3.151	1.817	464	2.603	**8.035**
kg CO_2e per m^2	35,2	39,9	34,1	14,3	**24,3**

Heating oil	CDE	CGB	CMI	CST	TOTAL
liter	0	0	0	54.682	**54.682**
ton CO_2e	0	0	0	174	**174**
kg CO_2e per m^2	0,0	0,0	0,0	1,0	**0,5**

Table 3: Use and emissions of electricity, gas and heating oil per campus

Campus Stad has the lowest emissions per m^2: 0,3 kg CO_2e per m^2 for electricity and 15,3 kg CO_2e per m^2 and for heating (natural gas and heating oil combined). The other campuses have approximately 1,5 kg CO_2e per m^2 for electricity and approximately 35 kg CO_2e per m^2 for heating.

5.1.2. Comparison with 2018

For the carbon footprint of 2018, performed by Ecolife, the data for energy was gathered internally by UAntwerp. For the data of 2021, UAntwerp used the TERRA platform. In order to make a fair comparison with 2018, UAntwerp provided Ecolife also the TERRA data for 2018.

According to this data, the total emissions for the impact category energy in 2018 are 16.276 tons of CO_2e. This is nearly double the emissions in 2021. The main reason is that in 2021 UAntwerp used green electricity which has an emission factor of 0,0014 kg CO_2e/kWh, whereas in 2018, the electricity footprint was calculated using the energy mix of the VEB's supply at that time, which had an emission factor of 0,35 kg CO_2e/kWh.

The emissions from gas, heating oil and electricity in 2018 are presented in the figure below.

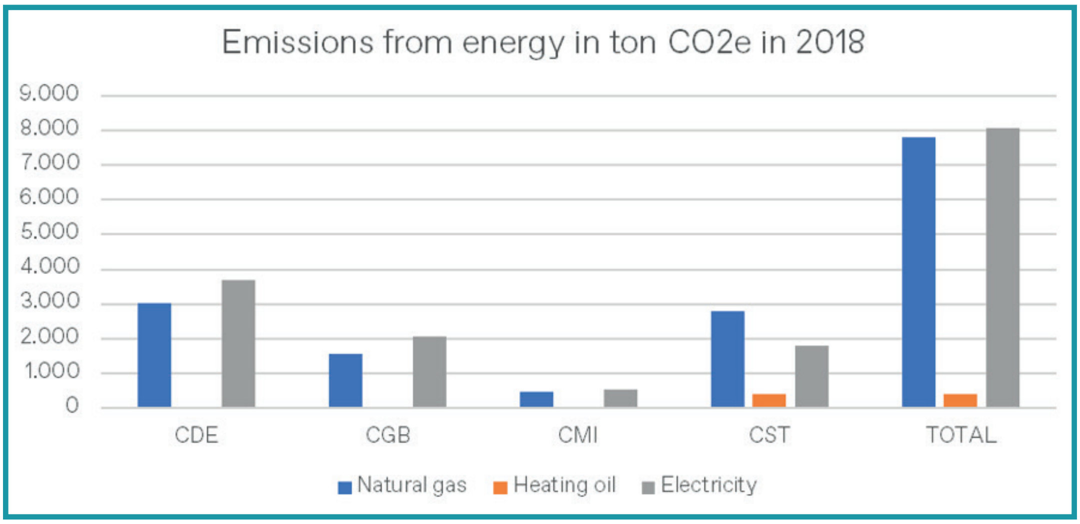

Figure 6: Emissions from gas, heating oil and electricity per campus

In the next chapters, we will compare the amount of gas, heating oil and electricity used in 2018 and 2021.

Electricity use in 2018 and 2021

In Figure 7 the electricity use per campus in 2018 and 2021 is represented.

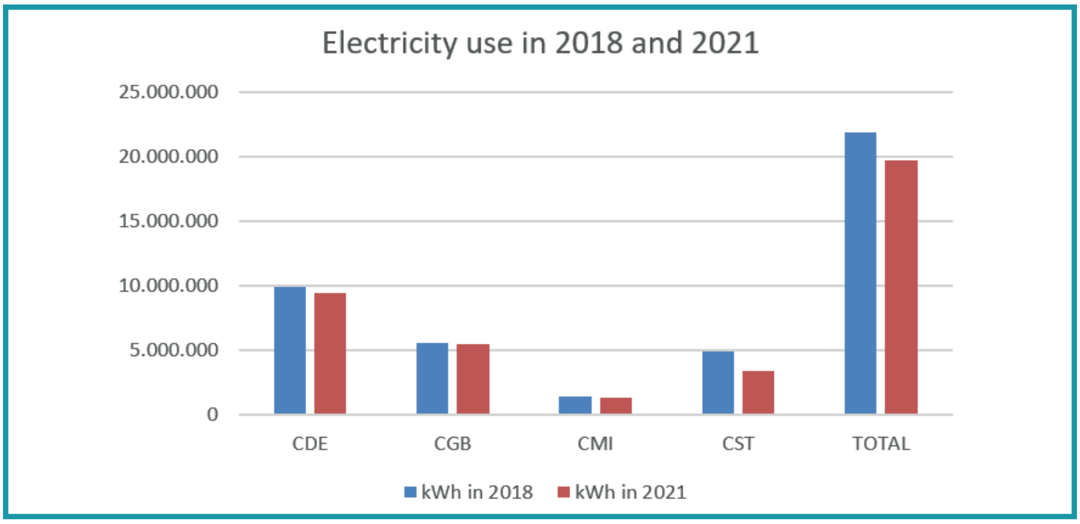

Figure 7: Electricity use in 2018 and 2021 per campus

The use of electricity has decreased on all campuses, though the decrease on campus Groenenborger (CGB) is very small.

In Table 4 the electricity use is compared with the number of students and FTEs in 2018 and 2021.

		CDE	CGB	CMI	CST	TOTAL
Electricity use	kWh in 2018	9.965.813	5.556.396	1.475.413	4.888.340	**21.885.962**
	kWh in 2021	9.467.275	5.536.766	1.339.753	3.438.769	**19.782.563**
	% decrease in kWh	5%	0,4%	9%	30%	**10%**
Number of students	nr of students in 2018	4.236	4.336	294	11.994	**20.860**
	nr of students in 2021	4.756	4.838	371	12.438	**22.403**
	% increase in students	12%	12%	26%	4%	**7%**
Number of FTE	nr of FTE in 2018	1.986	573	420	1.793	**4.772**
	nr of FTE in 2021	2.252	670	471	1.954	**5.347**
	% increase in FTE	13%	17%	12%	9%	**12%**
Electricity use in kWh per student	2018	2.353	1.281	5.018	408	**1.049**
	2021	1.991	1.144	3.611	276	**883**
	% decrease	15%	11%	28%	32%	**16%**
Electricity use in kWh per FTE	2018	5.018	9.697	3.513	2.726	**4.586**
	2021	4.204	8.264	2.844	1.760	**3.700**
	% decrease	16%	15%	19%	35%	**19%**

Table 4: Electricity use compared with number of students and number of FTE

For all the campuses there is a total increase of students: the total increase is 7% (from 20.860 to 22.403). The electricity-use per student decreased from 2018 to 2021 across all campuses: the total decrease is 16% (from 1.049 kWh to 883 kWh per student).

There is an increase in staff across all campuses (from 4.4772 to 5.347FTEs): the total increase is 12%. The electricity-use per staff member decreased from 2018 to 2021 across all campuses; the total decrease is 19%.

Natural gas and gasoline use in 2018 and 2021

In Figure 8 we see the natural gas use in 2018 and 2021.

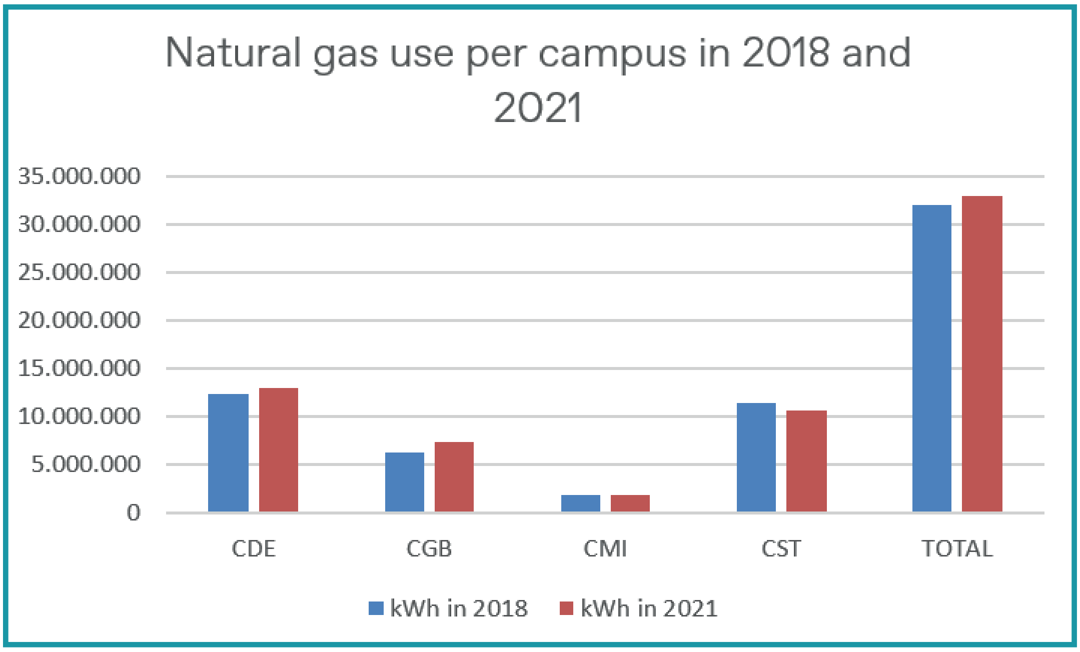

Figure 8: Gas use in 2018 and 2021 per campus

On the campuses CDE, CGB and CMI, the gas use has slightly increased, while the gas use on the campus CST has slightly decreased.

Heating oil is also used on campus Stad. Figure 9 depicts the use of heating oil in campus Stad in 2018 and 2021. The use of heating oil has decreased by 54% (from 119.488 to 54.682 liters).

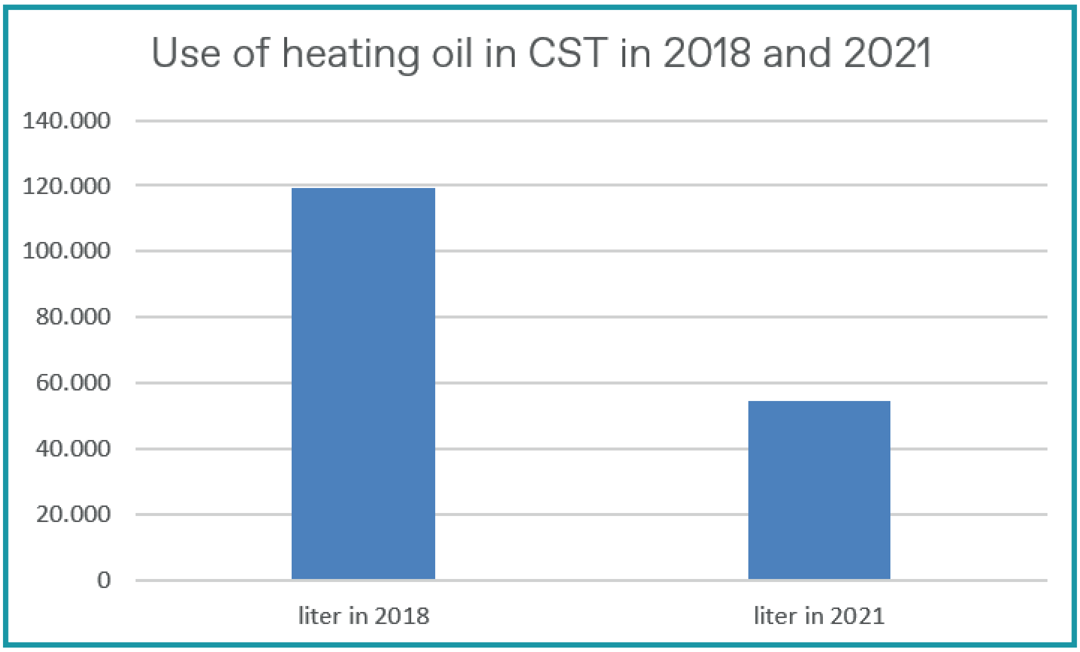

Figure 9: Use of heating oil in CST in 2018 and 2021

In 2018, the heating oil was also used for the adjacent student home. In 2021, the adjacent home had its own heating installation. This explains the sharp decline in heating oil use.

Table 5 shows the use of natural gas and heating oil per campus in 2018 and 2021 along with percentages increases and decreases in the number of students and FTEs.

		CDE	CGB	CMI	CST	TOTAL
Natural gas	kWh in 2018	12.386.988	6.328.893	1.885.403	11.452.250	**32.053.534**
	kWh in 2021	12.920.567	7.448.814	1.903.580	10.670.579	**32.943.540**
	% increase in kWh	4%	18%	1%		
	% decrease in kWh				7%	
Heating oil	liters in 2018				119.488	
	liters in 2021				54.682	
	% decrease				54%	
Number of students	% increase in students	12%	12%	26%	4%	**7%**
Number of FTE	% increase in FTE	13%	17%	12%	9%	**12%**

Table 5: Natural gas and heating oil use per campus in 2018 and 2021

In order to draw conclusions about the use of gas and heating oil in 2018 and 2021, a comparison of the harshness of the winters in those years is made.

Degree-days indicate wether heating in a building is required. A degree-day is calculated as the difference between 16,5° and the average outside temperature measured weighted over today and the last two days. For example, if the average outside temperature weighted in Ukkel is 10°C, we have 16,5-10 = 6,5 degree-days. The degree-days for that day are equal to zero, if the outside temperature is more than 16,5°C.

In 2018, there were 2091 degree-days, and in 2021, there were 2286[9].

In order to compare this with the energy use for heating we convert the amount of heating oil in liters to kWh. We assume 1 liter of heating oil equals 10 kWh. So the total amount of gas and heating oil used in 2018 is 32.053.534 kWh + 1.194.880 kWh = 33.248.414 kWh and in 2021 is 32.943.540kWh + 546.820 kWh = 33.490.360 kWh.

In Figure 10 the energy use for heating per degree-day per campus in 2018 and 2021 is given.

9 Synergrid (2023), Graaddagen, www.synergrid.be/nl/documentencentrum/statistieken-gegevens/graaddagen.

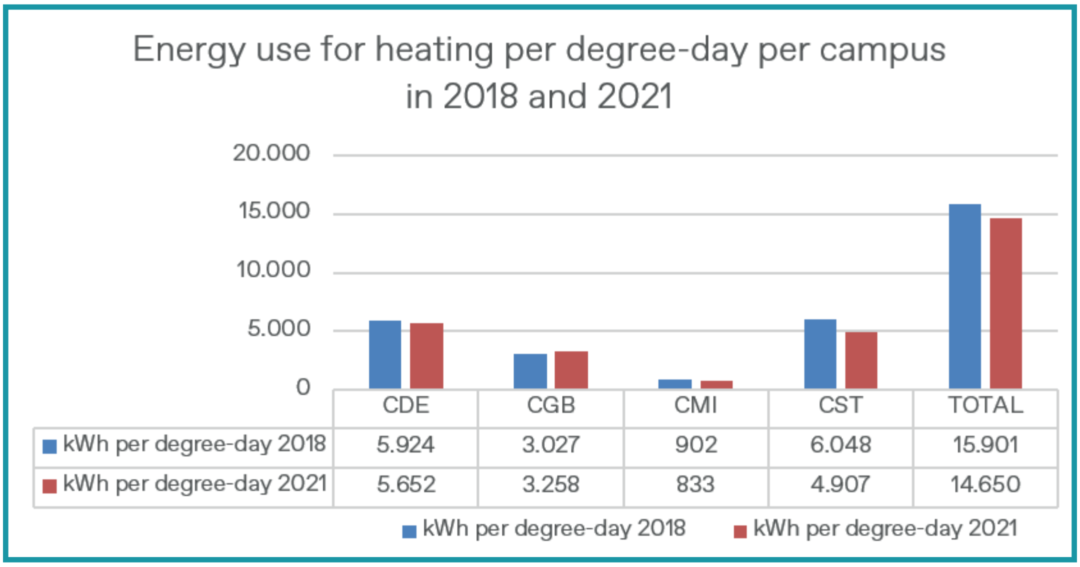

Figure 10: Energy-use for heating per degree-day per campus in 2018 and 2021

There is a decrease in energy-use for heating per degree-day for the campuses CDE (4,6%), CMI (7,6%) and CST (7,7%). On the other hand there is an increase (7,6%) for CGB.

Table 6 shows the energy use for the entire UAntwerp for heating in kWh related to the number of degree-days, and the energy use per degree-day per student and per FTE.

GAS AND HEATING OIL	in kWh	number of degree-days	kWh / degree-day	kWh / degree-day / student	kWh/ degree-day /FTE
2018	33.248.414	2091	15.901	0,8	3,3
2021	33.490.360	2286	14.650	0,7	2,7

Table 6: Comparison heating in kWh and degree-days in 2018 and 2021

For the kWh/degree-day there is a decrease in the total energy use for heating of 7,87% (from 15.901 to 14.650 kWh). The kWh per degree-day per student has decreased by 12,5% (from 0,8 to 0,7 kWh) while the kWh per degree-day per FTE employee decreased with 18% (from 3,3 to 2,7 kWh).

5.1.3. Transporting people in 2021

The total emissions from the impact category transporting people in 2021 was 15.476 tons of CO_2e. Table 7 illustrates the footprint values and uncertainty ranges for the different mobility subcategories.

Mobility	Emissions			Uncertainties	
	kg CO_2e	t CO_2e	%	kg CO_2e	%
Commuting	2.596.840	2.597	17%	1.246.900	48%
Business travel by car	73.830	74	0%	6.848	9%
Business travel by bus	1.185	1	0,01%	0	0%

Business travel by train	4.458	4	0,03%	946	21%
Business travel by plane	1.666.878	1.667	11%	497.428	30%
Student travel	11.133.214	11.133	72%	3.152.779	28%
Total	**15.476.405**	**15.476**	**100%**	**3.426.698**	**23%**

Table 7: Transporting people in detail

In Figure 11 these numbers are presented.

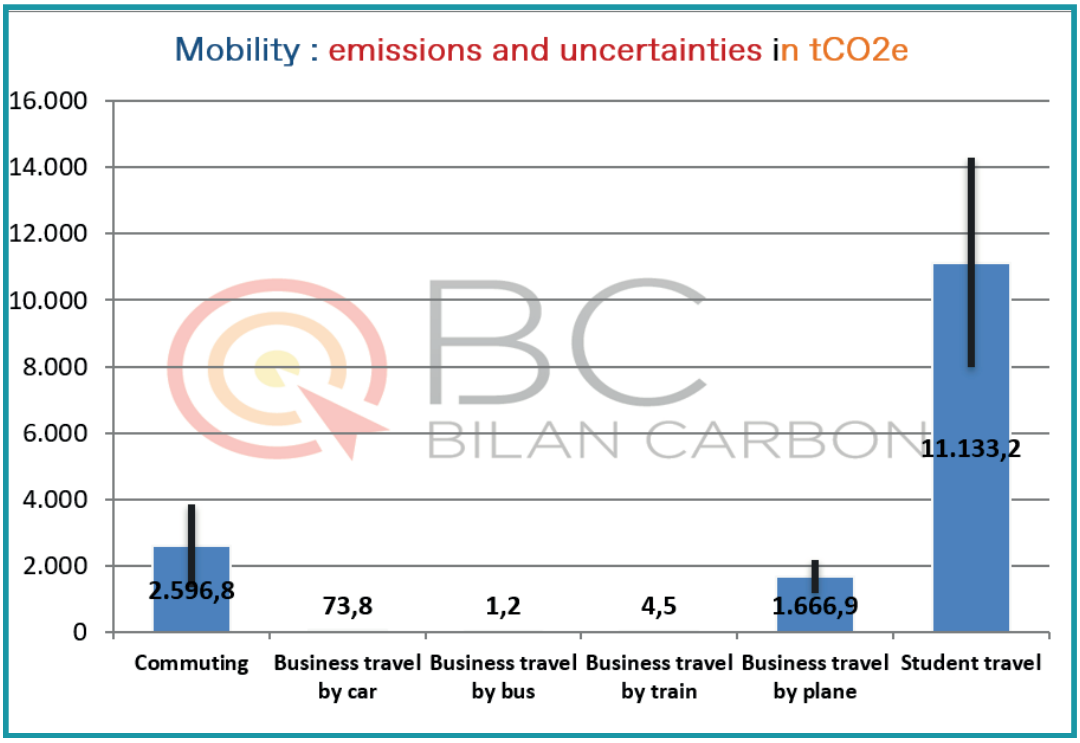

Figure 11: Emissions of mobility subcategories

72% of the mobility footprint is related to student mobility. Because there was no new data on student travel for 2021 and no data on the impact of covid measures on classes, the same calculation method as in 2018 was used.

Student Mobility

Figure 12 shows the emissions of the different transport modes for student travel.

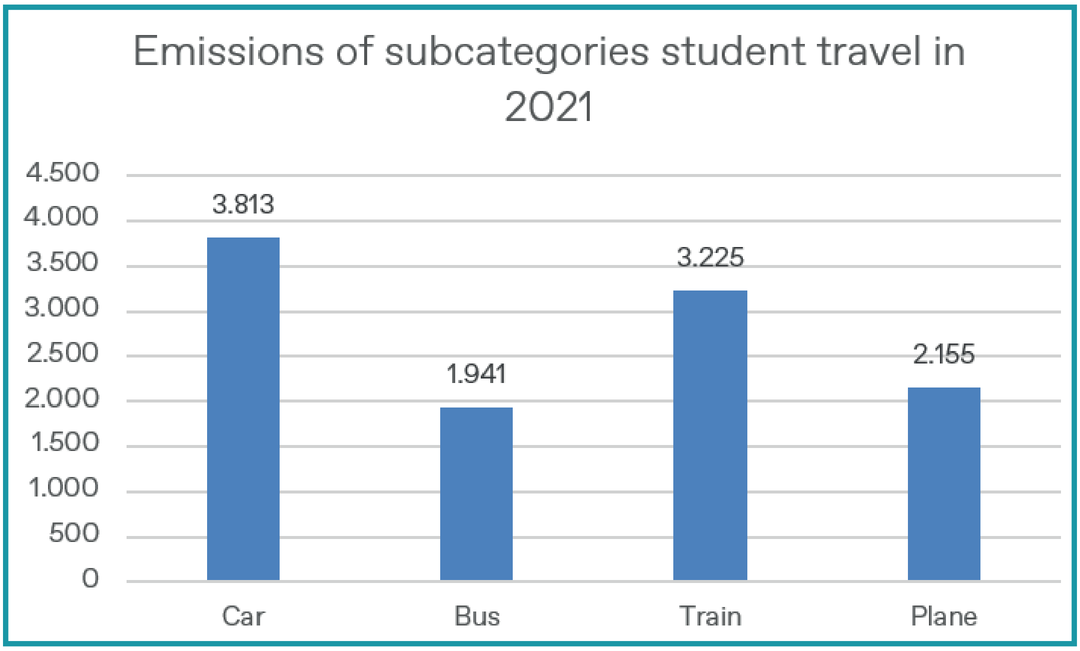

Figure 12: Emissions of subcategories for student travel

Cars account for the majority of emissions, accounting for 3.813 tons of CO_2e.

Commuting

For commuting for the entire UAntwerp we see in Figure 13 that the most kilometers are done by bike and that the car has the biggest impact on the emissions.

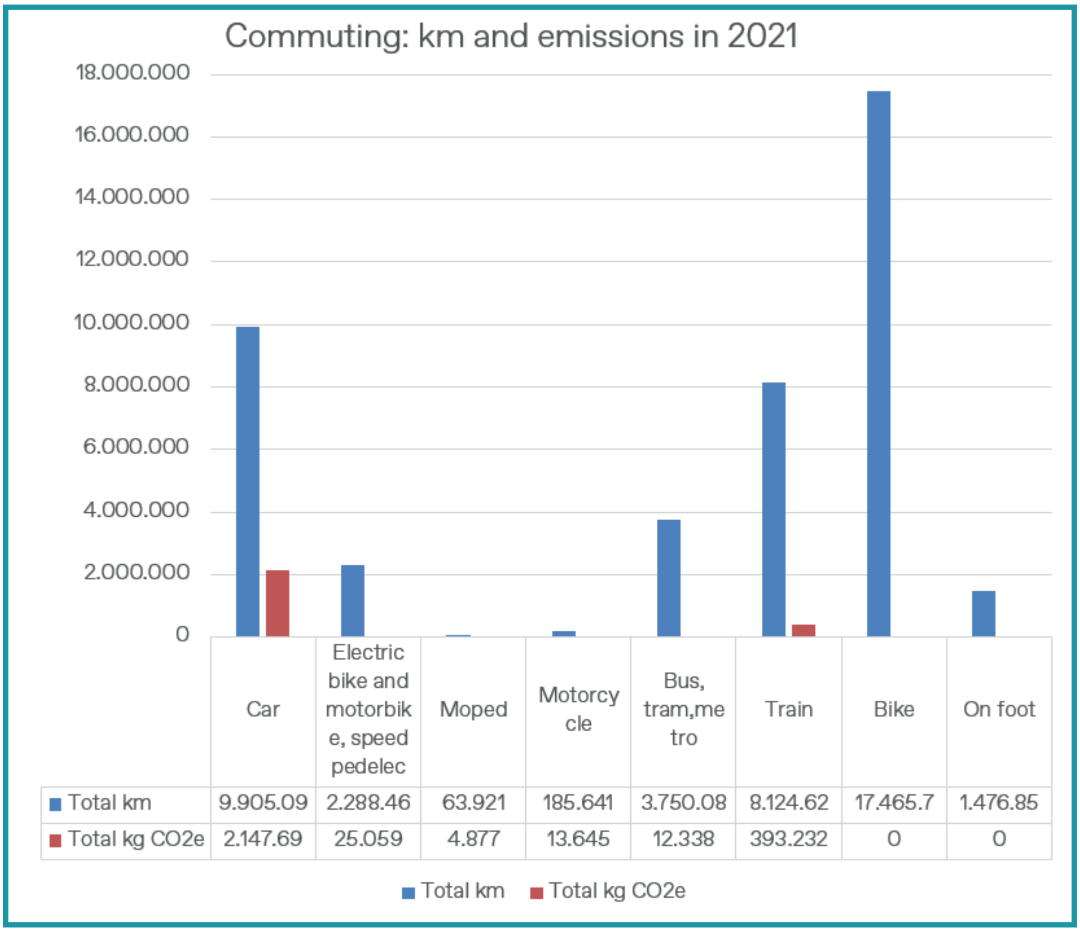

Figure 13: Emissions and kilometers for different transport mode for commuting

In Table 8 the number of kilometers and the emissions in ton CO_2e per transport mode and per campus are given.

	CDE		CGB		CMI		CST	
Transport mode commuting	**km**	**ton CO_2e**	**km**	**ton CO_2e**	**km**	**ton CO_2e**	**km**	**ton CO_2e**
Car	5.706.856	1.237	1.041.549	226	844.251	184	2.312.436	502
Electric bike, motor bike, speed pedelec	1.058.409	12	267.479	3	159.858	2	802.718	9
Moped	25.658	2	12.158	1	0	0	26.105	2
Motorcycle	76.975	6	36.474	3	19.982	1	52.209	4
Bus, tram, metro	840.313	3	413.377	1	329.707	1	2.166.685	7
Train	1.289.335	62	735.568	36	454.596	22	5.645.129	273
Bike	6.902.110	0	2.753.822	0	1.114.011	0	6.695.841	0
On foot	153.950	0	151.977	0	54.951	0	1.115.974	0
Total		**1.321**		**269**		**210**		**797**

Table 8: Emissions for commuting per transport mode and campus

Business travel

For business travel, there is no data for the campuses separately. In Table 9 the consumption data and the according emissions of business travel in 2021 are given in more detail.

	Consumption data	ton CO_2e	% of business travel
Car (petrol) in liters	17.453	48	2,8%
Car (diesel) in liters	8.234	26	1,5%
Car, taxi, in km	3.540	1	0,0%
Bus in passanger.km	8.600	1	0,1%
Train in passenger.km	84.645	4	0,3%
Plane, <500 km, 20-50 seats in passenger. km	27.634	17	1,0%
Plane, 500-1000 km, 51-100 seats, in passenger.km	283.872	111	6,5%
Plane, 1000-3500 km, 51-100 seats in passenger.km	2.829.452	795	46,6%
Plane, > 3500 km, 100-220 seats in passenger.km	3.153.200	704	41,3%
Total		**1.707**	**100,0%**

Table 9: Consumption data and emissions of business travel per transport mode

With 95,4%, air travel is the largest contributor to business travel emissions. It is followed by transport by car, which accounts for 4,3%.

5.1.4. Comparison transporting people in 2018 and 2021

Student Mobility

Since there were no updated data for student mobility in 2021 compared to 2018, the potential impact of covid measures made by UAntwerp couldn't be taken into account.

As the number of students rises, so do the emissions of student travel.

In Figure 14 the emissions in tons CO_2e per transport mode of student travel in 2018 and 2021 are presented.

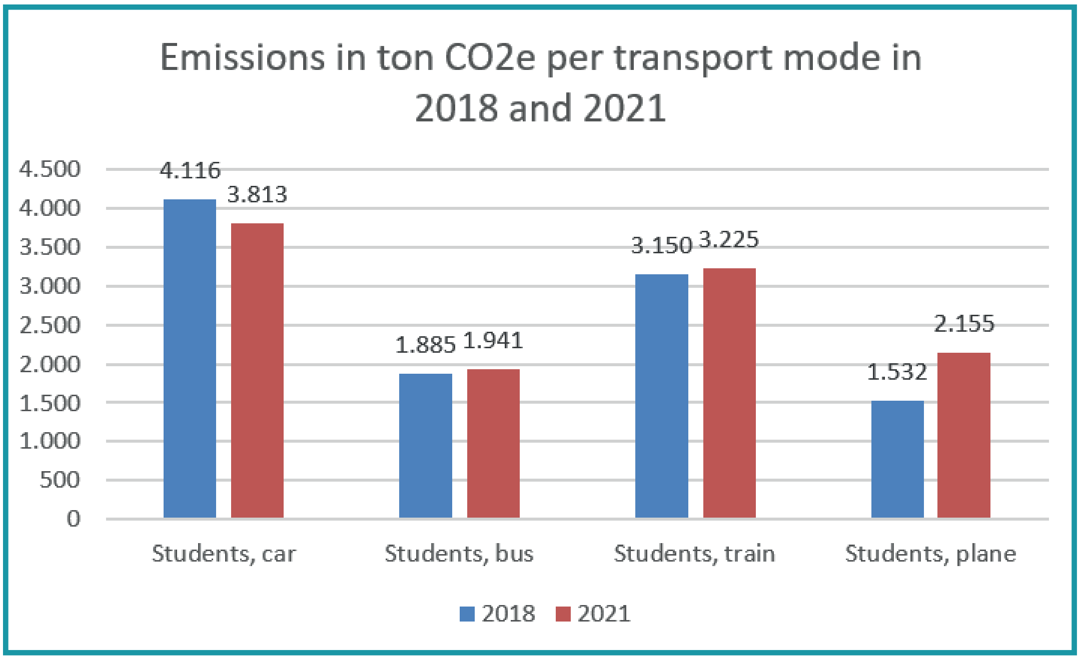

Figure 14: Emissions in ton CO_2e per transport mode in 2018 and 2021

Despite an increase in the number of kilometers driven by car, a decrease in CO_2e emissions is noticed for transportation by car. This is due to revised emission factors on the one hand and less polluting cars on the other.

Commuting

In Table 10 the emissions of commuting in ton CO_2e are compared between 2018 and 2021 per campus, per student and per FTE [10].

		CDE	CGB	CMI	CST	TOTAL
Commuting	ton CO2e in 2018	2.645	512	376	1.609	**5.142**
	ton CO2e in 2021	1.321	269	210	797	**2.597**
	% decrease	50%	47%	44%	50%	**49%**
Number of students	nr of students in 2018	4.236	4.336	294	11.994	**20.860**
	nr of students in 2021	4.756	4.838	371	12.438	**22.403**
	% increase in students	12%	12%	26%	4%	**7%**
Number of FTE	nr of FTE in 2018	1.986	573	420	1.793	**4.772**
	nr of FTE in 2021	2.252	670	471	1.954	**5.347**
	% increase in FTE	13%	17%	12%	9%	**12%**
CO_2e in ton per student	2018	0,62	0,12	1,28	0,13	**0,25**
	2021	0,28	0,06	0,57	0,06	**0,12**
	% decrease	56%	53%	56%	52%	**53%**
CO_2e in ton per FTE	2018	1,33	0,89	0,90	0,90	**1,08**
	2021	0,59	0,40	0,45	0,41	**0,49**
	% decrease	56%	55%	50%	55%	**55%**

10 The emissions for commuting in 2018 for CGB and CMI together is 888 tons of CO2e. In the report of 2018 the distribution between the two campuses was based on number of students. For this report new data provided by UA on the number of FTE in 2018 is used for the splitting over campus CGB and CMI. 57,7% of the emissions is counted for CGB and 42,3% for CMI.

Table 10: Emissions of commuting for 2018 and 2021

For all the campuses there is a drop in the emissions from commuting of roughly 50%. This is a result of the covid measures which facilitate more home work.

Business travel

In Table 11 the consumption data for business travel in 2018 and 2021 are compared.

Consumption data	2018	2021	Evolution in %
Car (petrol) in liters	19.135	17.453	-9%
Car (diesel) in liters	10.785	8.234	-24%
Car, taxi, in km		3.540	
Bus in km	13.100	8.600	-34%
Train in km	145.660	84.645	-42%
Plane in km	11.232.438	6.877.551	-39%

Table 11: Comparison in business travel between 2018 and 2021

For fuel use there is a decrease of 9% for petrol and a decrease of 24% for diesel. For travel by bus, train and plane there is a decrease of roughly 40%. This might be a result of covid measures since people are more used to have online meetings.

In Figure 15 the emissions from business travel for different transport modes are compared.

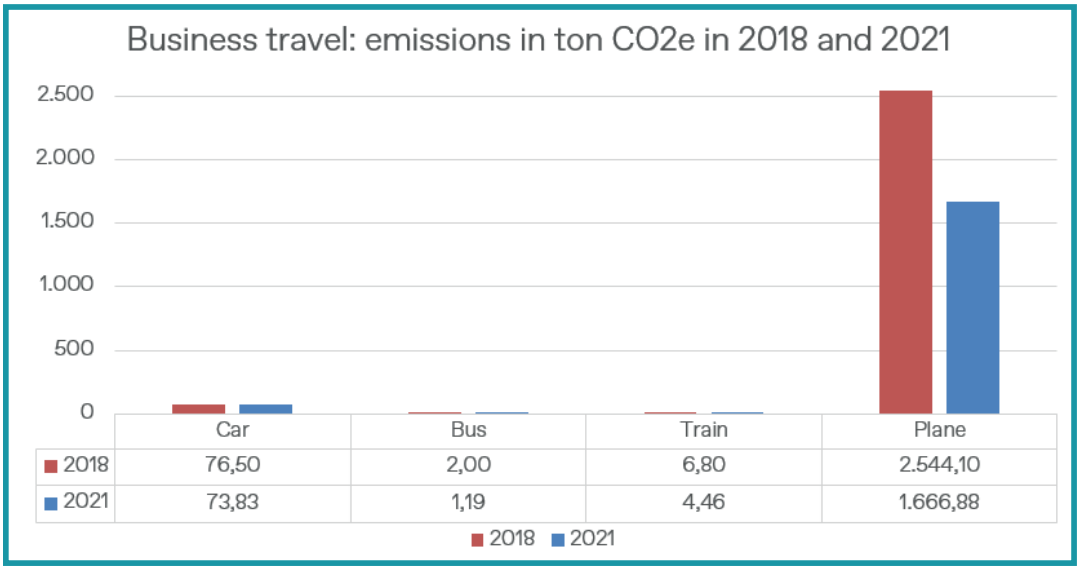

Figure 15: Business travel: emissions in ton CO_2e, in 2018 and 2021

There is a decrease for all the transport modes.

For air travel there has been a compensation of 717,42 tons of CO_2e. The amount of CO_2e was calculated by the travel agencies Omnia and Uniglobe. Travel agencies take solely into account the direct combustions of the fuel during flight. In addition to the CO_2 emissions from burning kerosene, planes also produce non-CO_2 emissions that contribute to global warming. These emissions are taken into account in this report bringing the total amount of CO_2e for air travel with flights booked through both travel agencies to 1.520 tons of CO_2e.

5.1.5. Capital goods

In 2021 there was one less business car than in 2018 resulting in the following emissions in CO_2e:

	2021	2018
Business cars: number of cars	35	36
Business vehicles: ton CO_2e	58	60

Table 12: Comparison in business cars between 2018 and 2021

6. IMPACT OF COVID MEASURES

Energy

For electricity there is a drop of 16% per student and 19% per employee from 2018 to 2021. The amount of energy used for heating is decreased from 15.901 kWh/degree-day to 14.650 kWh/degree-day. Energy use has clearly decreased, most likely as result of fewer courses offered on campus and the option for employees to work from home.

Mobility

For commuting there is a drop for all the campuses of roughly 50% ton CO_2e per FTE. This is due to the ability of working at home as a consequence of covid measures.

The transport by car for business travel has roughly remained unchanged. All the other travel modes (bus, train and plane) have decreased with around 40%. The introduction of online meetings as a covid measure, has likely caused people to travel less.

Because there are no actual data for student mobility in 2021, the impact of covid measures can not be accurately assessed.

7. RECOMMENDATIONS FOR DATA COLLECTION

Energy

The energy data for 2021 was gathered using the TERRA platform. The use of this platform is also recommended for collecting the energy data for 2022.

Campus Mutsaard, part of campus Stad, is also currently in use by by AP Hogeschool. For 2018 and 2021 the estimation was made that 50% of electricity and natural gas of the whole campus was consumed by UAntwerp. For a more accurate footprint separate measurements for UAntwerp and AP Hogeschool are recommended.

Mobility

- **Commuting**

  In 2021, UAntwerp conducted a survey of its staff to learn how often people work from home and what kind of transportation they use to commute. The following recommendations should be taken into consideration:

  - The **distance home-work** should additionally be enquired, **along with the working at home rate**. For this report, data on home-work distance and working at home rate could not be linked, so no correlation between working at home and the distance home-work had to be assumed.

  - The survey about working from home in 2021 received a rather low response rate; staff members should be more strongly encouraged **to participate** so that the results are more representative of the entire UA staff.

- **Business travel**

  For this report, data on air and train travel provided by the travel agencies, data on fuel use for the business cars and data from the staff expense report were used. We recommend:

  - For **train** travel data provided by travel agencies, the exact **travel distance** should also be registered.

  - The **electricity** used by **electric cars or hybrid** cars should also be registered.

  - If the **staff expense report** is still in use in 2022, employees involved in business travelling should be asked to consequently indicate **their transport mode, travel distance and country destination**.

- **Student mobility**

  The calculations for this report's student mobility were made using extrapolations from VUB and KULeuven data. In order to understand more about student travel at UAntwerp, a poll should be carried out in order to systematically collect the following data:

- For **students living in a student room**:
    - the number of times a year they go home,
    - the number of kilometres they travel, and
    - the transport mode.
- For **students who do not live in a student room**:
    - the distance from home to the campus,
    - the transport mode, and
    - the number of times a week they travel from home to campus.
- For **foreign students**:
    - the distance from home to Antwerp,
    - the way of transport, and
    - the number of times a year they travel home.

ecolife

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