Preliminary* TU Graz

2023 Greenhouse Gas Balance

and comparison with the 2017 and 2020 GHG balances and with the 2021 and 2022 GHG monitoring reports

Florian Ensbacher, Isabella Zieser, Günter Getzinger

Last updated: 17 June 2024

*This GHG balance is provisional because the provisional 2023 emission factors are currently still being used to calculate emissions. As soon as the 2023 emission factors are available, a final version of the 2023 GHG balance will be prepared.

This report on TU Graz's 2023 greenhouse gas balance (Version_1.0, last updated: 17 June 2024) was prepared on behalf of TU Graz (Buildings and Technical Support). It provides an overview of the results in the emission categories of energy, mobility, material use, new buildings/renovations, and canteen. The GHG balance was prepared using the 2017 and 2019–2021 versions of the *ClimCalc* tool (ClimCalc_v3.2_EF2021, ClimCalc_v2.5_EF2017, ClimCalc_v2.1_EF2019, and ClimCalc_v3.1.3_EF2020) (Alliance for Sustainable Universities in Austria 2022).

Client: TU Graz/Organisational Unit 9504.0 - Buildings and Technical Support (GuT) Technical Facility Management

Contractor: STS - Science, Technology and Society Unit/ISDS

Subject of the contract: Preparation of the TU Graz 2023 greenhouse gas balance, taking into account the categories *Energy, Mobility, Material use, New buildings/Renovations,* and *Canteen,* using data collected at the TU Graz main and secondary locations.

Project management (PL)/Project processing (PB): Ass.Prof. Dipl.-Ing. Dr.phil. Günter Getzinger (PL), Florian Ensbacher, BSc. (PB), Isabella Zieser (PB

Contract period: January to June 2024

Version: Version_1.0, 17.06.2024

Data provided by:

- TU Graz Organisational Units
    - Assistance to the Rector: Statistics and Data Protection
    - Purchasing Service
    - Finance and Accounting
    - Buildings and Technical Support
    - Institutes with official vehicles
    - International Office – Welcome Center
    - Communications and Marketing
    - Human Resources
    - Institute of Thermal Turbomachinery and Machine Dynamics
    - TU Graz Verlag [Publishing House]
- External organisations
    - Harnisch Gebäudeservice Graz
    - Österreichische Mensen Betriebsgesellschaft mbH
    - Printkultur [HTU Copyshops]

Table of contents

1 Descriptions of methods and system limits

This 2023 TU Graz greenhouse gas balance (GHG balance) is the third complete and accurate TU Graz GHG balance published after the 2017 and 2020 GHG balances.

The 2017 and 2020 GHG balances and the 2021 and 2022 GHG monitoring reports serve as a basis for comparing the 2023 data, while the 2017 GHG balance also serves as the reference balance for the "Climate-neutral TU Graz 2030" project (TU Graz 2020) adopted by the TU Graz Rectorate in 2020.
In 2023, signs that things are returning to normal after the changes due to the coronavirus pandemic in 2020–2022. This is particularly noticeable in the *Mobility* category, where emissions from commuting and stays abroad by students and staff, as well as their business trips, returned to the levels seen in 2017. However, rising energy prices and the subsequent energy-saving measures have led to significant reductions in emissions although the university has returned to its full operating capacity.

1.1 Method descriptions

The TU Graz GHG balance is prepared to provide a comprehensive overview of the development of GHG emissions at TU Graz in the categories of energy, mobility, material use, new buildings/renovations, and canteen every three years. All data are collected precisely.

The new buildings/refurbishments category was included in the 2022 GHG monitoring for the first time. The methodology used to record the "grey" GHG emissions from new buildings and renovations (i.e. GHG emissions that arise during the production of relevant building materials) involves recording the masses of the most important building materials and multiplying these by their respective emission factor.

The 2023 CO_2e emissions were calculated using the *ClimCalc* tool (Alliance for Sustainable Universities in Austria 2024). The emission factors used come from the Environment Agency Austria. The emission factors for 2021 available in May 2024 were used (version ClimCalc_v3.2_EF2021), **which is why this is only the preliminary GHG balance for 2023**. The emission factors used to balance the building emissions (grey emissions) are the Environment Agency Austria factors for 2022. Final balances are available for the reference 2017 GHG balance and the 2020 GHG balance (i.e. these were prepared using the 2017 and 2020 emission factors, respectively). The 2021 and 2022 GHG monitoring reports are also provisional monitoring reports; as with the 2023 GHG balance, provisional emission factors were also used to prepare these. The following table shows the emission factors (EF) used:

Table 1: Emission factors used to prepare the 2017 and 2020–2023 balances and monitoring reports

	General emissions	Flight emissions
2023 GHG balance – preliminary	EF 2021	EF 2019
2022 GHG monitoring – preliminary	EF 2019	EF 2019
2021 GHG monitoring – preliminary	EF 2019	EF 2019
2020 GHG balance – final	EF 2020	EF 2020
2017 GHG balance – final	EF 2017	EF 2017

The provisionally used emission factors for flight emissions are a special case, because the 2019 emission factors reflect the conditions in 2023 more accurately than the 2021 emission factors.

The following categories and subcategories were surveyed completely and accurately to prepare this preliminary 2023 balance:

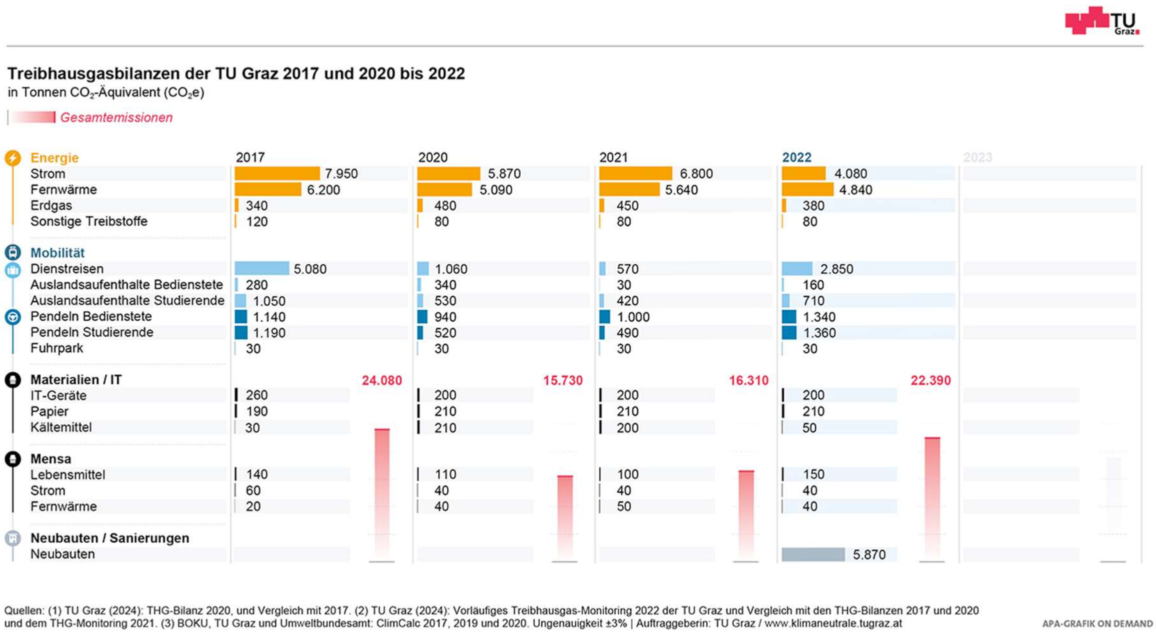

Figure 1: Categories in which data were collected and comparison of the TU Graz 2017, 2020, 2021, and 2022 greenhouse gas balances

1.2 System limits

The net floor area of TU Graz in 2017 and 2020–2023 is shown in Table 2 (reference date: 1 October in each case):

Table 2: Total net floor area, either heated or heated with district heating, at TU Graz in 2017 and 2020–2023

Year	Total net floor area in m^2	Net heated floor area in m^2	Net floor area heated with district heating in m^2
2023	277,728	249,842	196,047
2022	267,738	242,040	195,489
2021	255,375	231,981	195,307
2020	253,362	230,037	195,042
2017	240,283	217,326	189,889

The numbers of staff and students at TU Graz were taken from the TU Graz Intellectual Capital Reports for the respective years. In addition, the number of staff at shareholdings was added to the number of general staff, with these data provided by the *Assistance to the Rector: Statistics and Data Protection* organisational unit. Shareholdings are included in

GHG monitoring/the GHG balances if they are very closely connected to TU Graz in terms of their finances, location, and/or personnel.

To prepare the 2023 GHG balance, the number of people involved in other collaborations and lease agreements was also recorded in addition to the investments. These are referred to as "external companies" that rent space on the premises of the three TU Graz campuses.

Table 3: Number of staff at TU Graz in 2017 and 2020–2023

Staff	According to the respective Intellectual Capital Report (A)	Collaborators/ Competence centres (B)	External companies with rental agreements and use of the campus car parks (C)	External companies with rental agreements and without use of campus car parks (D)
Individuals in 2023 (reporting date: 31.12.2023)	3,935	868		
Individuals in 2022 (reporting date: 31.12.2022)	3,854	873	n.b	n.b
Individuals in 2021 (reporting date: 31.12.2021)	3,914	992	n.b	n.b
Individuals in 2020 (reporting date: 31.12.2020)	3,852	935	n.b	n.b
Individuals in 2017 (reporting date: 31.12.2017)	3,324	385	n.b	n.b
Full-time equivalents (FTE) 2023	2,637.9	665.3	86.5	240.4
Full-time equivalents (FTE) 2022	2,612.0	682.6	n.b	n.b
Full-time equivalents (FTE) 2021	2,596.7	757.3	n.b	n.b
Full-time equivalents (FTE) 2020	2,475.1	716.0	n.b	n.b
Full-time equivalents (FTE) 2017	2,219.7	298.5	n.b	n.b

According to the respective intellectual capital report: These are the staff members who have an employment contract with TU Graz. This figure is used, for example, when calculating specific flight emissions.

Collaborators/competence centres: These are staff members who, due to TU Graz's participation in competence centres, have the same status as TU Graz staff to some degree. They are relevant for the GHG balance if their workplace is located on a TU Graz campus. TU Graz collaborators located outside of Graz are not included here. These individuals are relevant with respect to all key figures relating to energy management and car park management, as well as for the total TU Graz emissions.

External companies with rental agreements with use of the campus car parks: These are external companies that rent space at Inffeldgasse 33 (EBS building), managed by TU Graz Errichtungs- und Betreiber GmbH. This building is located on the Inffeldgasse campus and, therefore, is integrated into TU Graz's car park management system; staff can obtain parking authorisation from TU Graz. Therefore, these external company staff numbers are included in the key figures for car park management and for energy management.

External companies with rental agreements and without use of the campus car parks: These external companies rent space for premises directly from TU Graz (Sandgasse 34, Silicon Austria Labs SAL) as well as in the building managed by Data House Styria GmbH (Sandgasse 36, Data House). These buildings are located on the Inffeldgasse campus, but outside the TU Graz car park management area; therefore, they have their own underground car park, which is not directly managed by TU Graz. TU Graz has also not rented any of the underground car park spaces to these companies. The bicycle parking spaces in this underground car park are used by TU Graz. The data for staff working in these two buildings are therefore only relevant with regard to the key figures relating to energy.

Table 4: Number of students at TU Graz in 2017 and 2020–2023 according to the respective intellectual capital report

Students *(cut-off date: 21.12.2023)*	16,507.0		**16,507.0**
Students *(cut-off date: 21.12.2022)*	15,976.0		**15,976.0**
Students *(cut-off date: 21.12.2021)*	16,082.0		**16,082.0**
Students *(cut-off date: 21.12.2020)*	16,091.0		**16,091.0**
Students *(cut-off date: 21/12/2017)*	16,816.0		**16,816.0**

Some of the data used in the following are based on estimates, which are explained in the report. However, it can be assumed that the resulting inaccuracy does not exceed +/- 3%.

2 GHG balance

2.1 Summary

In total, TU Graz emitted **around 18,000 tonnes of CO_2e** in **2023**. This is around 4,400 tonnes or around **20% less** GHG emissions than in **2022 with 22,400 tonnes of CO_2e**. This decrease is mainly due to the fact that no emissions were recorded from the construction of new buildings or the renovation of existing buildings in 2023. The observed increase compared to 2020 and 2021 is explained primarily by increased staff and student travel.

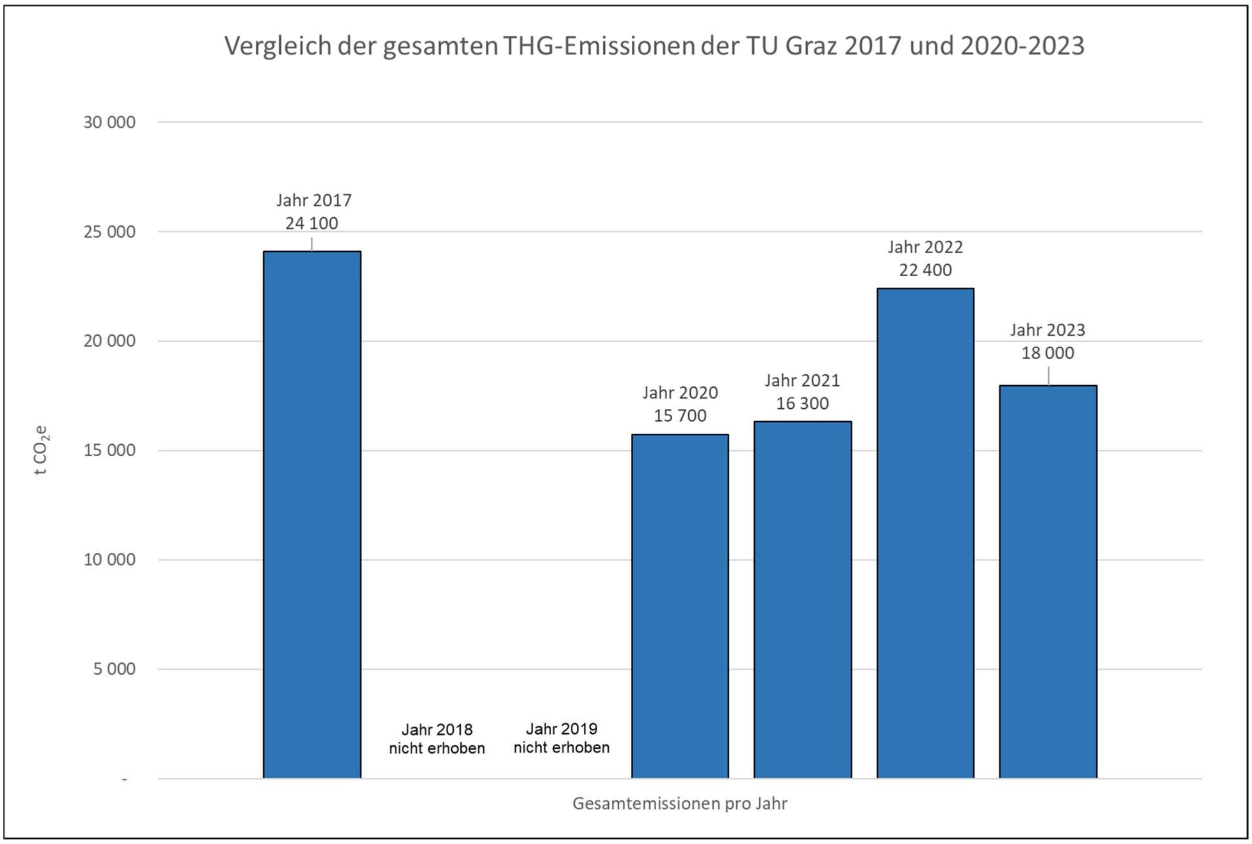

Figure 2: Comparison of total GHG emissions at TU Graz in 2017 and 2020–2023

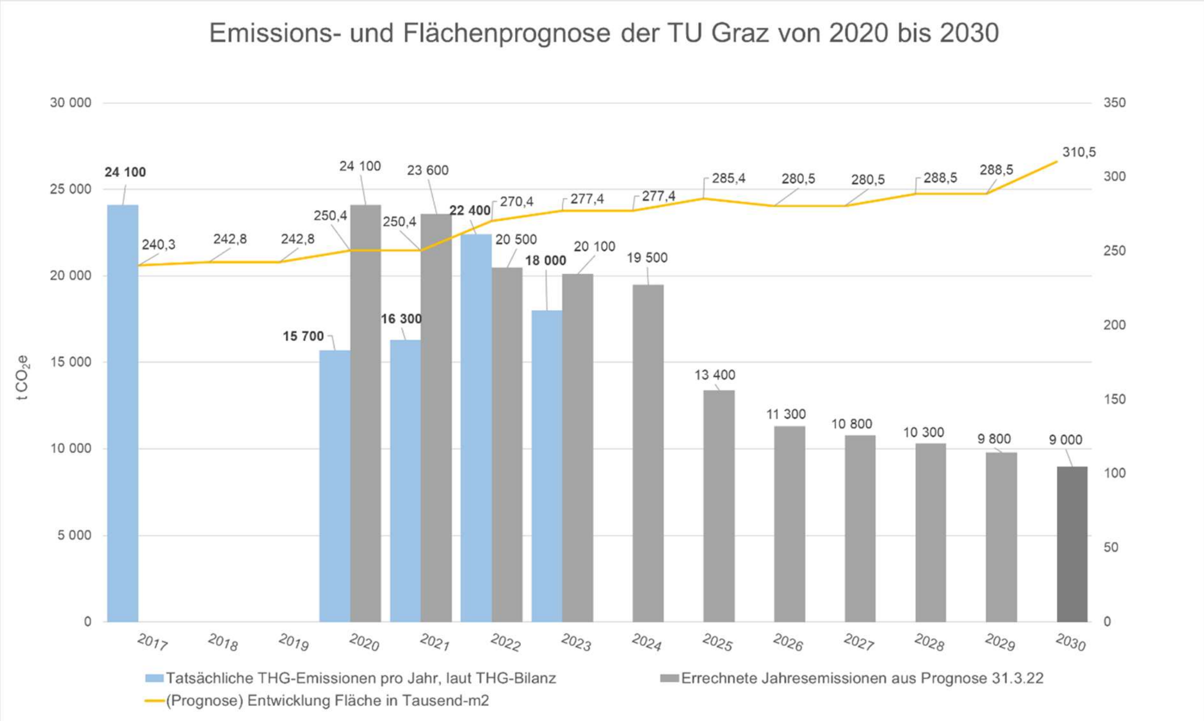

Figure 3: Predictions for emissions and areas at TU Graz from 2020 to 2030

The (preliminary) calculation of the total TU Graz 2023 GHG emissions results in about 18,000 tonnes of CO_2e; therefore, this is nearly 2,100 tonnes of CO_2e below the maximum emissions limit, i.e. 20,100 tonnes of CO_2e, set for 2023.

GHG emissions are divided into three different scope categories: Scope 1 emissions are emissions caused directly by an organisation, Scope 2 emissions are indirect, energy-related emissions (arising from the generation of purchased electricity, steam, and district heating and cooling), Scope 3 emissions are also indirect emissions (upstream and downstream, along the entire value chain, for example, caused here by mobility, material use, or newly constructed buildings). The following graphs depict the emissions by scope category in 2017 and 2020–2023.

Scope 3 emissions increased significantly in 2023 compared to 2020 and 2021. This can be explained by the fact that the restrictions related to the coronavirus pandemic were lifted, and the business air travel increased as a result. Scope 3 emissions were higher in the year 2022, as the "grey emissions" from newly constructed buildings are included in the balance for this year. Scope 1 and Scope 2 emissions are lower in 2023 than in 2021 and 2022, as the switch to UZ 46-certified electricity was started in the energy sector, and the number of heating degree days in 2023 was significantly lower than in the previous years of 2021 and 2022. In addition, a number of energy-saving measures were implemented in 2022 in response to the significant increase in energy prices, particularly in the area of space heating.

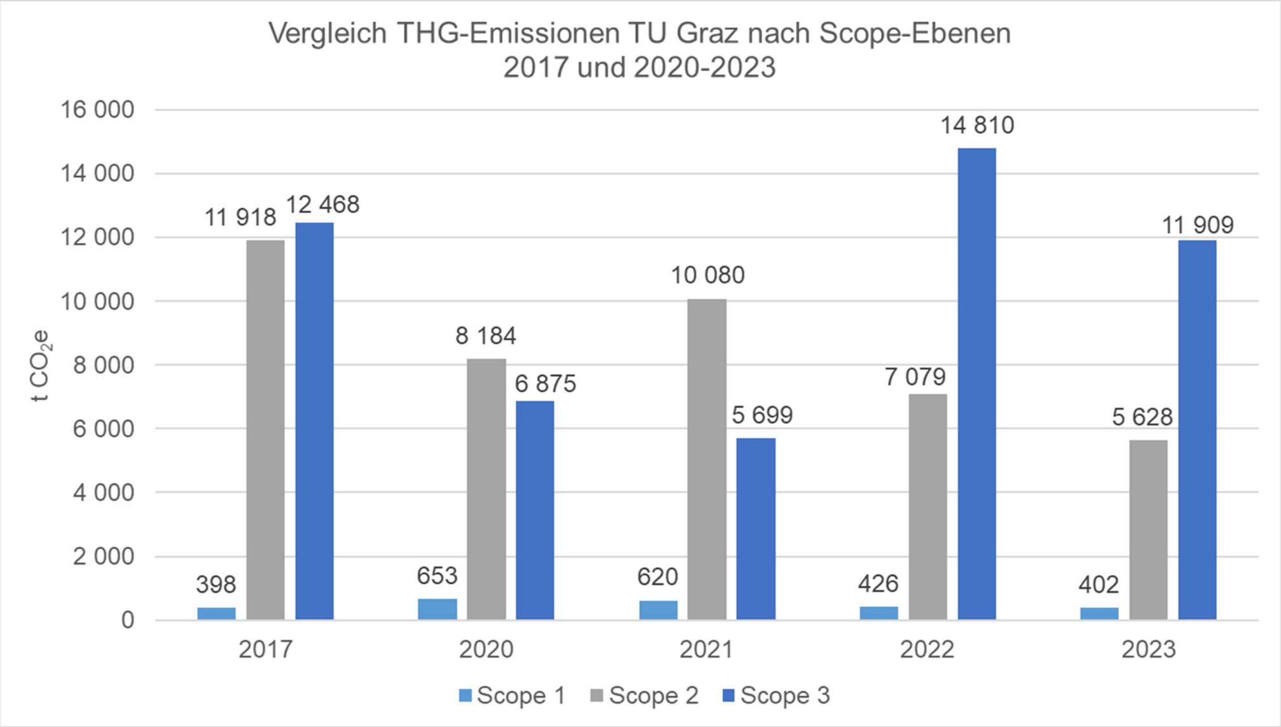

Figure 4: Comparison of TU Graz GHG emissions by scope category in 2017 and 2020–2023

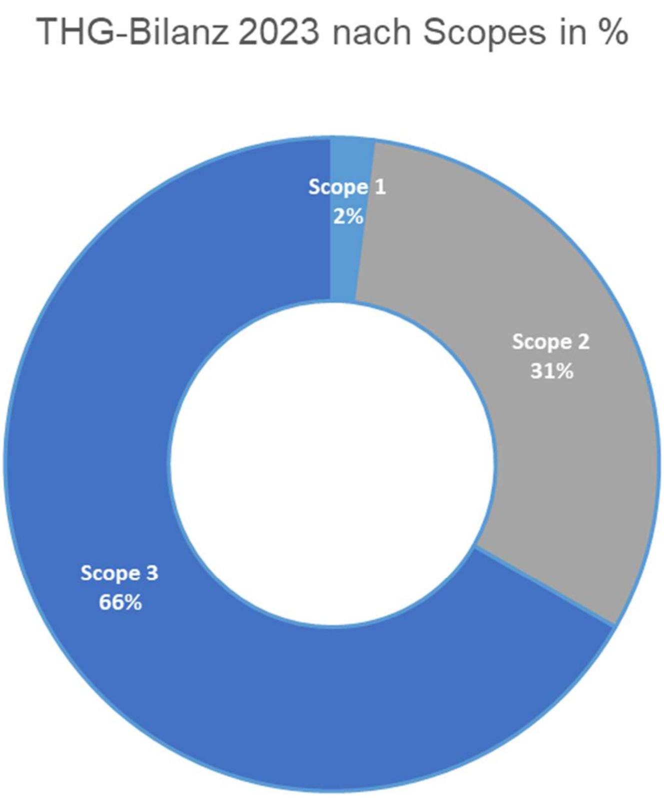

Figure 5: 2023 GHG balance by scope category in %

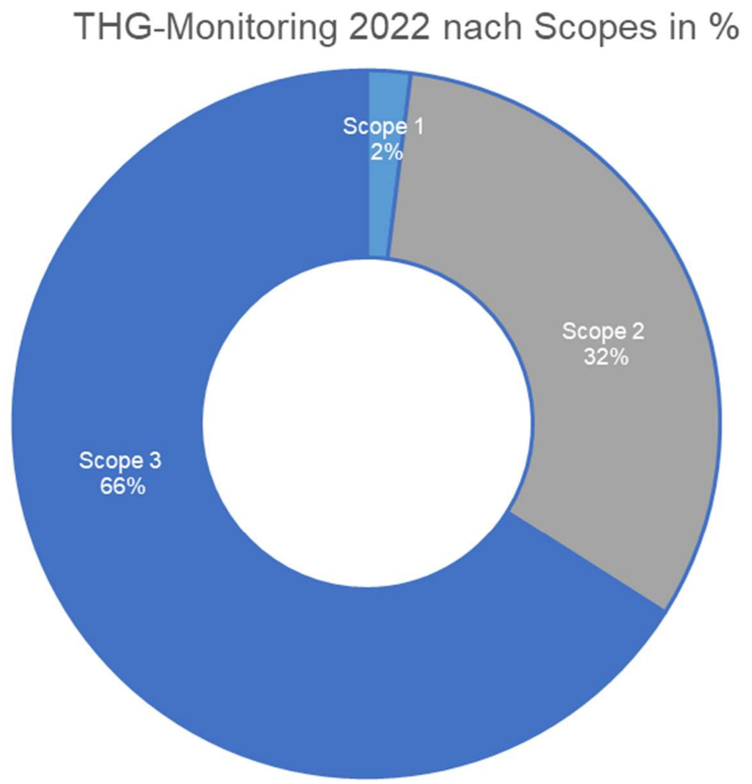

Figure 6: 2022 GHG monitoring by scope category in %

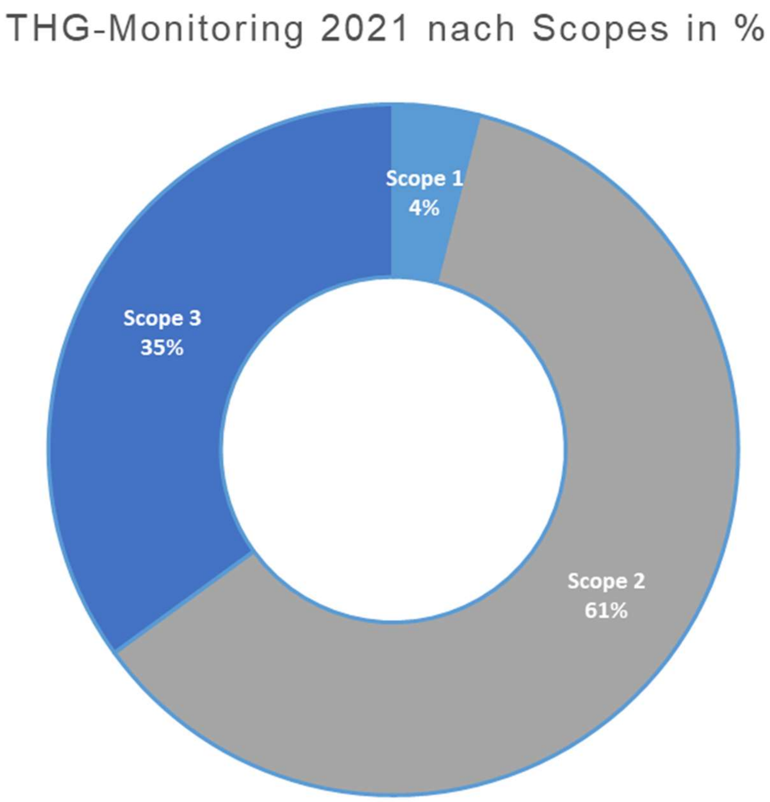

Figure 7: 2021 GHG monitoring by scope category in %

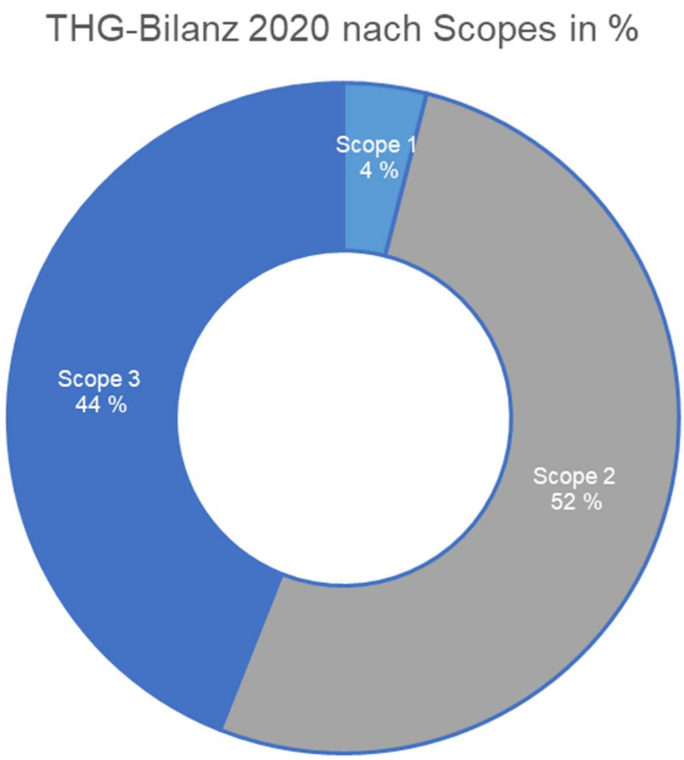

Figure 8: 2020 GHG balance by scope category in %

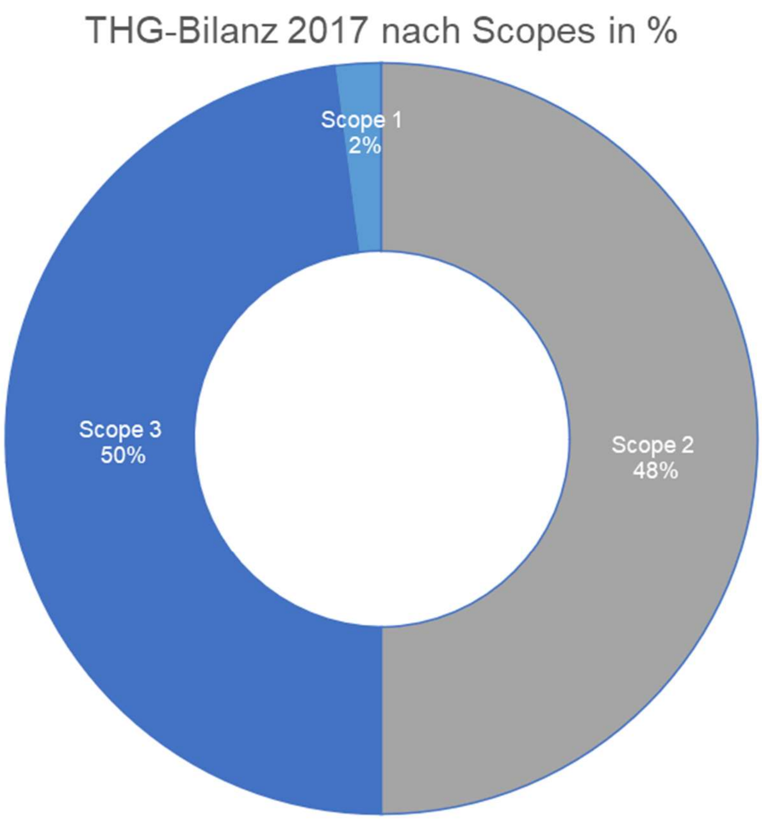

Figure 9: 2017 GHG balance by scope category in %

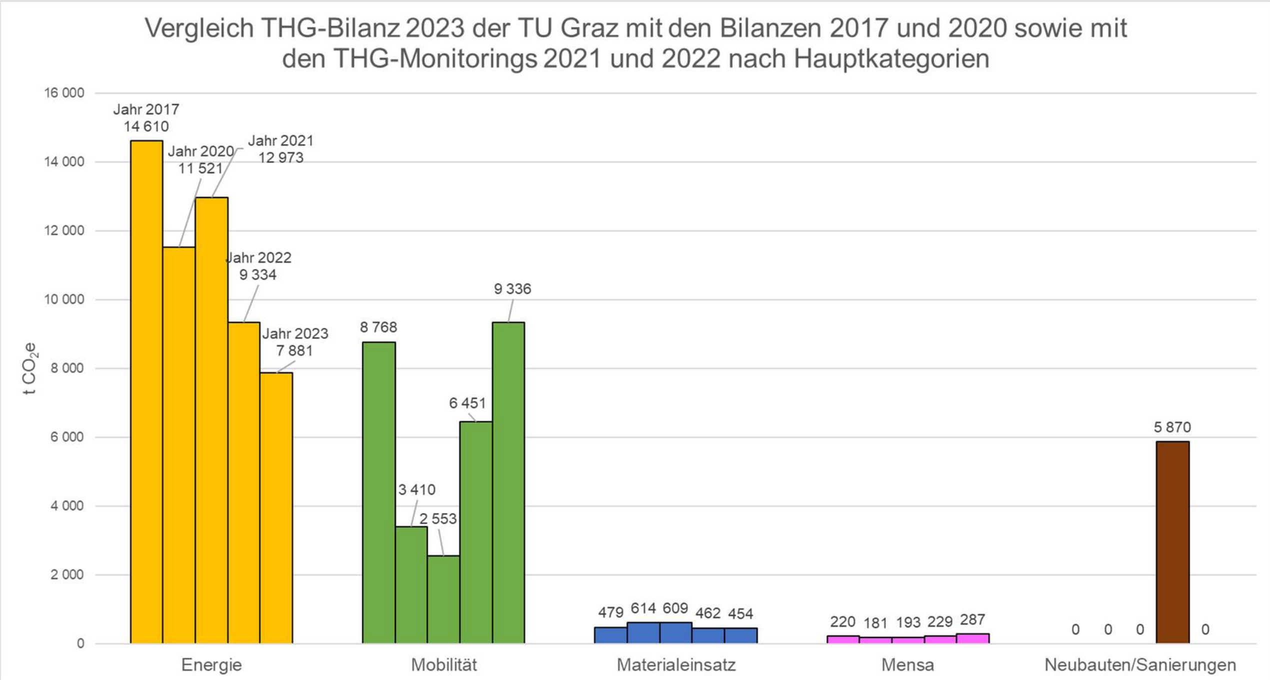

Figure 10: Comparison of TU Graz 2023 GHG balance with the 2017 and 2020 balances and with the 2021 and 2022 GHG monitoring reports by main categories

The largest share of emissions is seen in the *Mobility* category (around 9,340 tonnes of CO_2e), followed by the *Energy* (around 7,880 tonnes of CO_2e), *Material use* (454 tonnes of CO_2e), and *Canteen* (287 tonnes of CO_2e) categories.

This was a first for TU Graz in 2023: Since GHG reporting was begun, never before has mobility taken first place as the category with the most emissions. This result can be explained primarily by the high increase in the number of stays abroad, business trips, and commuter kilometres recorded, as well as the simultaneous successful measures in the area of energy.

The 2021 and 2022 GHG monitoring reports and the 2023 balance were calculated using provisional emission factors. The final 2017 and 2020 emission factors were used to prepare the 2017 and 2020 GHG balances.

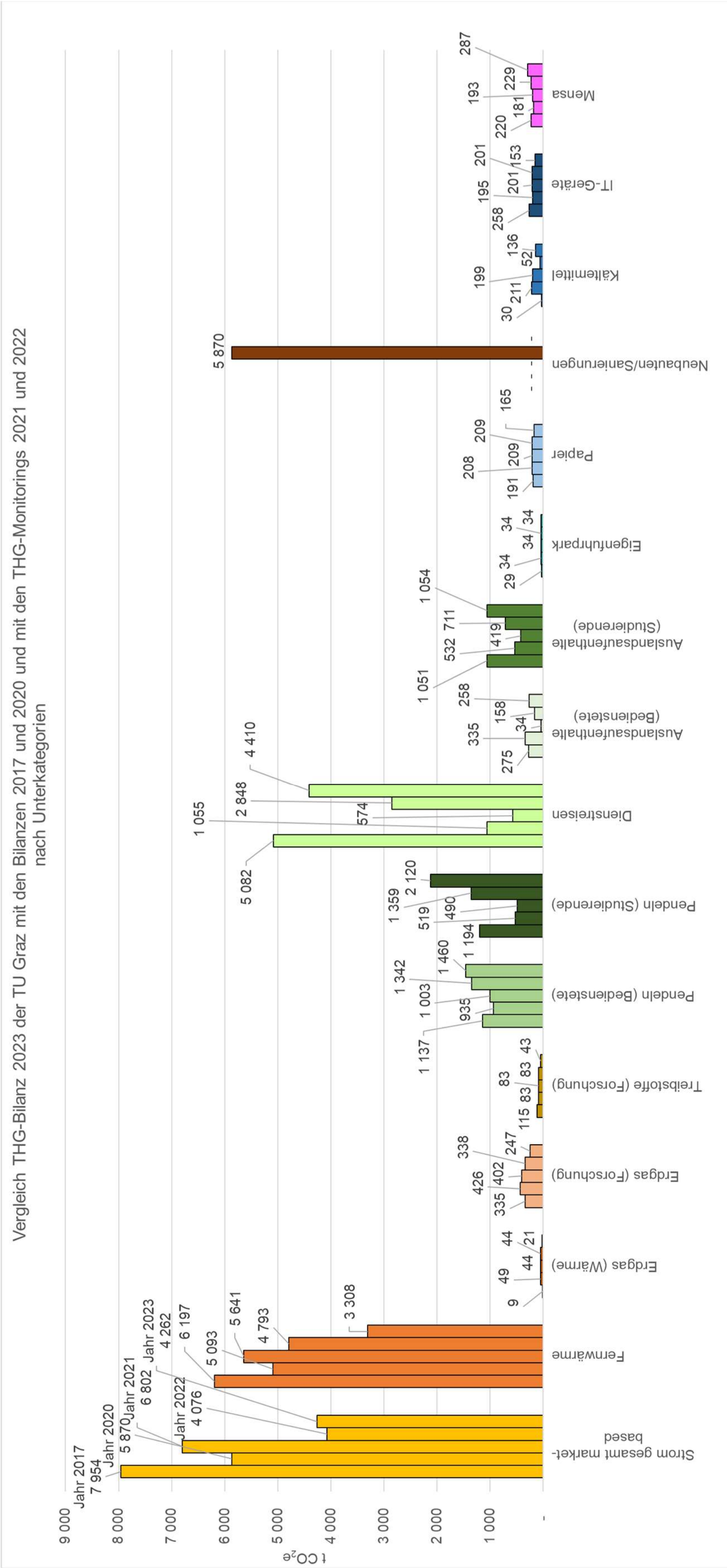
Vergleich THG-Bilanz 2023 der TU Graz mit den Bilanzen 2017 und 2020 und mit den THG-Monitorings 2021 und 2022 nach Unterkategorien
t CO2e
Jahr 2017
Jahr 2020
Jahr 2021
Jahr 2022
Jahr 2023
Strom gesamt market-based
Fernwärme
Erdgas (Wärme)
Erdgas (Forschung)
Treibstoffe (Forschung)
Pendeln (Bedienstete)
Pendeln (Studierende)
Dienstreisen
Auslandsaufenthalte (Bedienstete)
Auslandsaufenthalte (Studierende)
Eigenfuhrpark
Papier
Neubauten/Sanierungen
Kältemittel
IT-Geräte
Mensa

Figure 11: Comparison of TU Graz 2023 GHG balance with the 2017 and 2020 balances and with the 2021 and 2022 GHG monitoring reports by subcategory

2.2 Energy

GHG emissions in the *Energy* category are calculated for the *electricity, district heating, natural gas (heating), natural gas (research), and fuel (research)* subcategories by recording consumption data (kWh or MWh), which are then multiplied by the corresponding emission factor.
The following graph shows an overview of consumption in these subcategories in 2017 and 2020–2023. The *electricity* subcategory was divided into *electricity consumption (excl. WP, excl. PV and excl. LS)*[1]*, electricity consumption from PV, electricity consumption WP*, and *electricity consumption LS*. In addition, the first switch to UZ 46-certified green electricity or electricity products of comparable quality (Campus Alte Technik and partly Campus Neue Technik) took place in 2022. The resulting consumption is shown separately here as *electricity consumption UZ 46-certified (excl. WP, excl. PV, and excl. LS).*

The subcategory *electricity consumption LS* has been newly introduced in this balance and shows the electricity consumption resulting from charging electric cars at TU Graz.

It is important to present consumption data, because these results show whether the consumption of electricity and heat have increased or decreased at TU Graz (regardless of its GHG emissions). From page 16 onwards, the energy consumption is also presented in a tabular form. When interpreting these data, please note that TU Graz has grown in terms of space and that factors such as restrictions related to the coronavirus pandemic, the number of heating degree days, but also energy-saving measures and thermal renovation (i.e. improvements) influence consumption.

A total of 7,881 tonnes of CO_2e were produced in the *Energy* category in 2023. This accounts for around 46% of TU Graz's total greenhouse gas emissions.
The three most emission-intensive subcategories are electricity (consisting of electricity consumption without and with UZ-46 certification and electricity consumption from our own PV systems), district heating, and natural gas (research) .

The majority of natural gas at TU Graz is used for research and not for heating. As the graphs below show, the natural gas used for research accounts for 247 tonnes of CO_2e and thus around 3% of emissions in the *Energy* category, while natural gas for heating accounts for 0.3% with 21 tonnes of CO_2e.

The data for this category were provided by the Buildings and Technical Support organisational unit, and additionally by the Institute of Thermal Turbomachinery and Machine Dynamics in the case of fuel applications.

[1] HP = heat pumps; PV = photovoltaics, LS = charging stations

The following graphs show the emissions per subcategory in the *Energy* category:

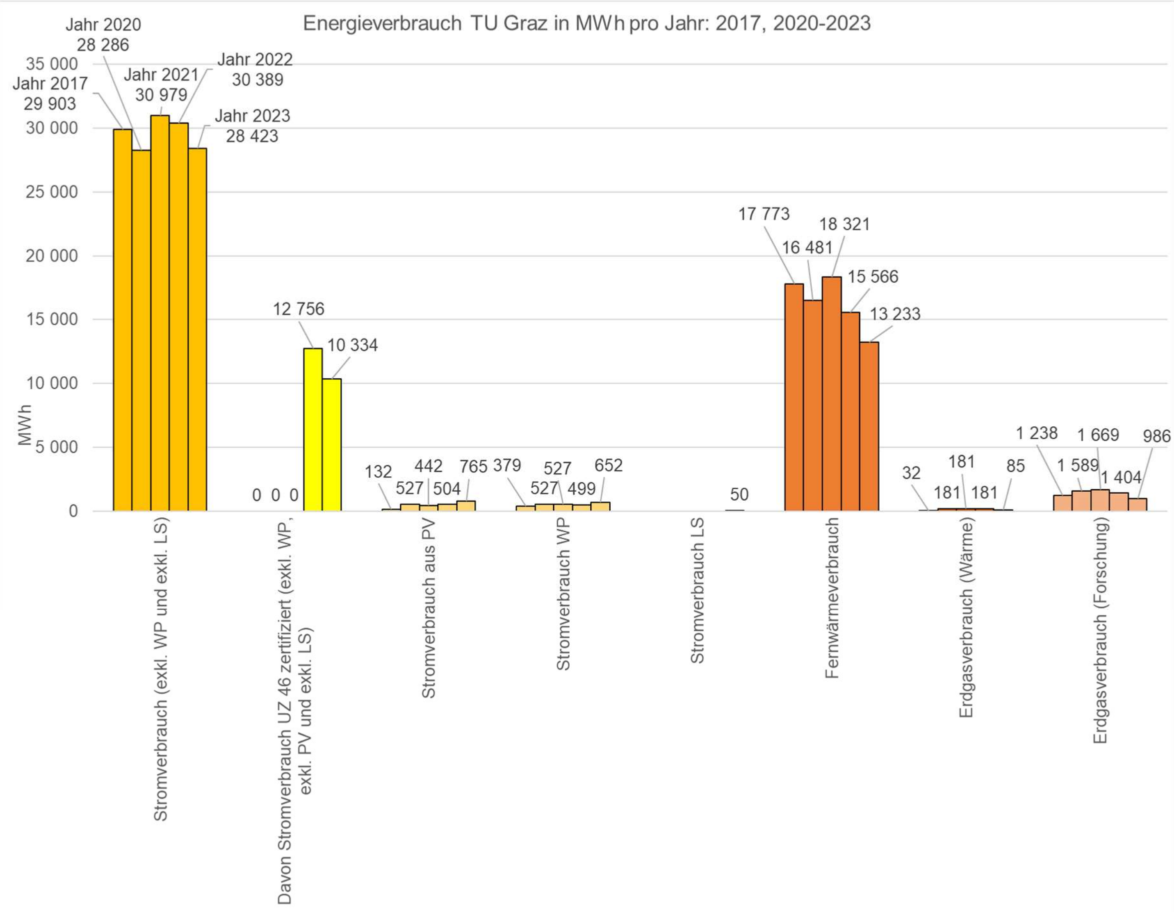

Figure 12: Energy consumption at TU Graz in MWh per year for 2017, 2020–2023

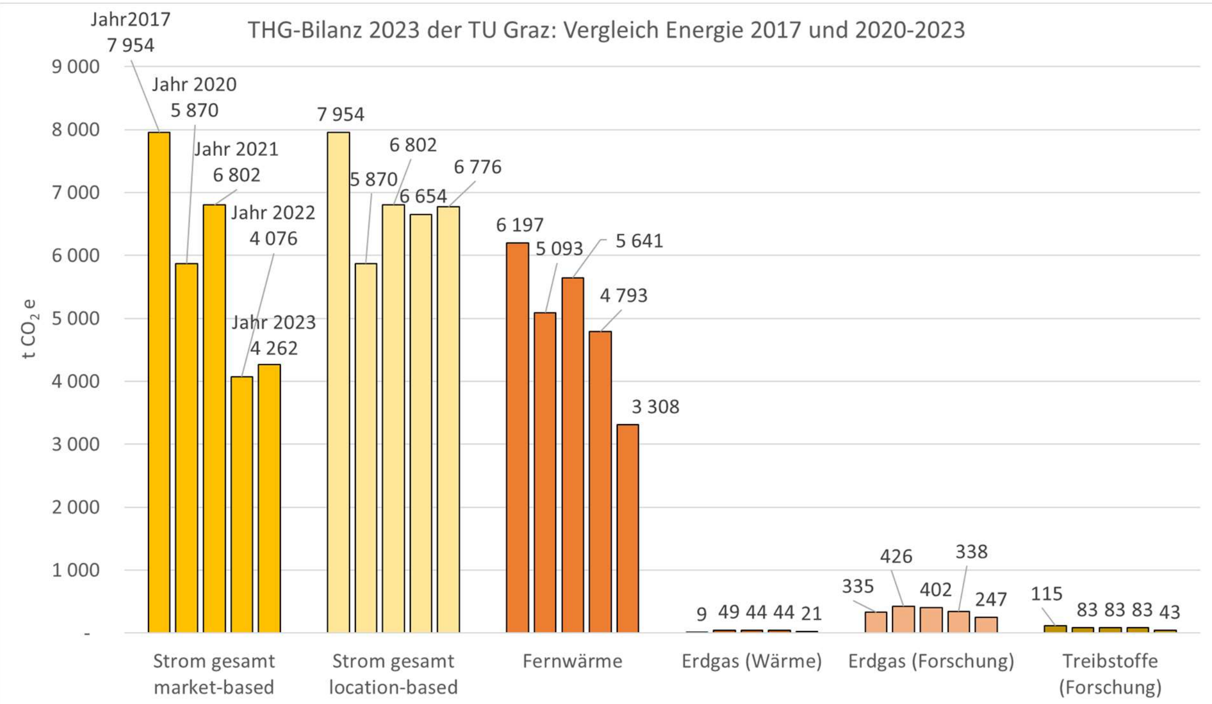

Figure 13: TU Graz 2023 GHG balance - Comparison of energy emissions in 2017 and 2020–2023

By switching parts of the Campus Neue Technik and Campus Alte Technik to UZ 46-certified green electricity, emissions from electricity have fallen significantly compared to previous years (market-based). In the market-based calculation, and in the absence of the actual emission factors for the purchased electricity products, an assumption has been made that the electricity products purchased by TU Graz that are not UZ 46 (or comparable)-certified have the higher location-based emission factor. The GHG emissions calculated on this basis to obtain the total electricity consumption (excl. PV) are shown in light yellow in Fig. 9. When reporting the total TU Graz emissions, the GHG emissions from electricity consumption are presented as market-based.[2]
The emissions from district heating have dropped due to the lower number of heating degree days in 2023 compared to previous years and due to energy-saving measures.

The following table shows how consumption, the emission factor (EF), and emissions from electricity (with/without UZ 46 certification and PV) have changed over the years. **The 2021 and 2022 GHG monitoring reports and the 2023 balance were calculated using provisional emission factors.**

The consumption and emissions from heat pumps and the electricity consumption of the charging stations are also listed.

100% of the PV electricity generated at TU Graz is consumed on the university premises.

Table 5: Comparison of the TU Graz 2023 GHG balance for pandemic-related in 2017 and 2020–2023

Comparison of 2023 GHG balance for electricity: 2017 and 2020–2023			
	Consumption in kWh	Emission factor in kg CO_2e/kWh	Emissions in tonnes of CO_2e
2023			
2023 electricity without UZ 46 certification (location-based EF)	18,139,212	0.2260	4.099
	by heat pumps: 651,933		By heat pumps: 147
	by LS: 50,000		By LS: 11
2023 electricity with UZ 46 certification (market-based EF)	10,985,624	0.0120	132
2023 Total electricity (location-based EF)	29,124,835	0.2260	6,582
2023 PV	765,219	0.0400	31
PV on 1.1.2023 = 1,079 MWp			
Total	**29,890,054**		**4,262**

[2] market-based = calculation of GHG emissions according to purchased electricity products (UZ 46 is considered, remaining electricity purchased: higher location-based EF); location-based = calculation of GHG emissions based on location (UZ 46 is not considered)

2022			
2022 electricity without UZ 46 certification (location-based EF)	17,711,891	0.219	3,879
	by heat pumps: 498,926		by heat pumps: 109
2022 electricity with UZ 46 certification (market-based EF)	12,671,967	0.014	177
2022 total electricity (location-based EF)	30,383,858	0.219	6,654
2022 PV	504,458	0.04	20
PV on 1.1.2022 = 1,079 MWp			
Total	**30,888,316**		**4,076**
2021			
2021 electricity without UZ 46 certification (location-based EF)	30,979,438	0.219	6,784
	by heat pumps: 527,150		by heat pumps: 115
2021 PV	441,582	0.04	18
PV on 1.1.2021 = 0.605 MWp			
Total	**31,421,020**		**6,802**
2020			
2020 electricity without UZ 46 certification (location-based EF)	28,813,347	0.203	5,849
	by heat pumps: 527,150		by heat pumps: 107
2020 PV	526,924	0.04	21
PV on 1.1.2020 = 0.605 MWp			
Total	**29,340,271**		**5,870**
2017			
2017 electricity without UZ 46 certification	30,882,000	0.2573	7,946
(location based EF)	by heat pumps: 379,000		by heat pumps: 100
2017 PV	132,000	0.06	8
PV on 1.1.2017 = 0.145 MWp			
Total	**30,414,000**		**7,954**
Increase/decrease in % electricity without UZ 46 certification (2022 to 2023)	Plus 2%		Plus 6%

Increase/decrease in % electricity with UZ 46 certification (2022 to 2023)	Minus 13%	-	Minus 26%
Increase/decrease in % PV (2022 to 2023)	Plus 52%	Same EF used	Plus 52%
Increase/decrease in % total consumption, market-based (2022 to 2023)	Minus 3%		Plus 5%

Table 6: Comparison of the 2023 GHG balance for district heating: 2017 and 2020–2023

Comparison of 2023 GHG balance for district heating: 2017 and 2020–2023			
Year	Consumption in kWh	Emission factor in kg CO_2e/kWh	Emissions in tonnes of CO_2e
2023	13,233,380	0.2500	3,308
2022	15,566,260	0.3079	4,793
2021	18,321,200	0.3079	5,641
2020	16,480,900	0.309	5,093
2017	17,773,000	0.3487	6,197
Increase/decrease in % (2022 to 2023)	Minus 31%	Minus 19%	Minus 31%

Emissions in the *district heating* category have also dropped by 31% compared to 2022. This is primarily due to lower heating requirements and energy-saving measures. The energy-saving measures were introduced in 2022 and have proved very effective, and there has been continuous improvement in this area.
A similar picture emerges for emissions from the *natural gas* subcategory. Here, savings were made to reduce the consumption for research, and the consumption for heating could be reduced by modifying the heating control system and replacing gas boilers. Overall, the emissions have been reduced by around 30%.

Table7 : Comparison of natural gas GHG balance 2023: 2017 and 2020-2023

Comparison of 2023 GHG balance for natural gas: 2017 and 2020–2023			
	Consumption in kWh	Emission factor in kg CO_2e/kWh	Emissions in tonnes of CO_2e
2023	1,071,016 by research: 986,013 by heat: 85,003	0.2500	**268** by research: 247 by heat: 21
2022	1,585,135 by research: 1,403,843 by heat: 181,292	0.2410	**382** by research: 338 by heat: 44
2021	1,850,579 by research: 1,669,287 by heat: 181,292	0.2410	**446** by research: 402 by heat: 44
2020	1,770,350 by research: 1,589,292 by heat: 181,292	0.2681	**475** by research: 426 by heat: 49
2017	1,269,946 by research: 1,238,221 by heat: 31,779	0.2703	**343** by research: 335 by heat: 9
Increase/decrease in % (2022 to 2023)	Minus 30%	Plus 4%	Minus 30%

Improvements in the subcategory of *fuel research* are also worth mentioning, where consumption was reduced by almost half (-51% for diesel and -38% for petrol). Emissions from this category have fallen by 48% overall.

Table 8: Comparison of 2023 GHG balance for fuel research: 2017 and 2020–2023

Comparison of 2023 GHG balance for fuel research: 2017 and 2020–2023			
	Consumption in litres	Emission factor in kg CO_2e/litre	Emissions in tonnes CO_2e
2023			
Diesel	11,291	3.2460	37
Petrol	2,228	2.7820	6
Total	13,519		**43**
2020			
Diesel	23,084	3.1335	72
Petrol	3,571	2.8840	10
Total	26,655		**82**
2017			
Diesel	31,325	3.1006	97
Petrol	6,543	2.7218	18
Total	37,868		**115**
Increase/decrease in % (2022 to 2023)			
Increase/decrease in % Diesel	Minus 51%	Plus 4%	Minus 49%
Increase/decrease in % Petrol	Minus 38%	Minus 4%	Minus 40%
Total	Minus 49%		**Minus 48%**

2.3 Mobility

The *Mobility* category is subdivided into *staff commuting*, *student commuting*, *business trips*, *staff stays abroad*, *student stays abroad,* and *own vehicle fleet*. The data for this category were provided by the *CO_2e monitoring tool*, the *International Office - Welcome Center,* and the respective *institutes with company vehicles.* A list of institutes with company vehicles was provided by the *Finance and Accounting* organisational unit (see Annex 2). In addition, the transport survey carried out at TU Graz in 2024 was used as a reference (Herry 2024), i.e. an assumption was made that the modal split in terms of kilometres travelled in the *staff commuting* and *student commuting* subcategories has not changed from 2023 to 2024. In addition to data from this traffic survey, data on staff's commutes to TU Graz premises or to the managed TU Graz car parks served as the basis for an alternative calculation of staff commuter mobility; these were subsequently compared with the results of the 2024 traffic survey.

By producing around 9,340 tonnes of CO_2e, the *Mobility* category has become the one with the highest emissions at TU Graz for the first time. The *business trips* subcategory is the most significant one, producing around 4,410 tonnes of CO_2e in 2020. This is followed by the *student commuting* subcategory with around 2,120 tonnes, *staff commuting* with around 1,460 tonnes, *student stays abroad* with around 1,050 tonnes, *staff stays abroad* with around 260 tonnes, and the *own vehicle fleet* with around 34 tonnes.
This report places a special focus on the *Mobility* emissions category, as TU Graz must take measures to significantly reduce emissions in this area. The emissions target set for flight emissions was exceeded. Measures in this regard have already been adopted as described in the "Climate-neutral TU Graz 2030" roadmap, and an implementation plan has been drawn up (TU Graz 2020). Efforts should be intensified to offset or reduce the steadily increasing emissions observed in recent years to achieve the goals set in the “Climate-neutral TU Graz” roadmap by 2030.

In general, results show that the emission reductions related to the coronavirus pandemic observed in the mobility sector in 2020–2022 are no longer significant in 2023, as university operations have returned to normal. Overall, emissions in the *Mobility* category increased in 2023 by around 45% compared to 2022.

The following graphs show the share of the subcategories in the total emissions for the *Mobility* category as percentages and enable the comparison of these emissions with the GHG emissions for 2017 and 2020–2023. These results show that business trips account for more than 40% of the total emissions from the *Mobility* category. In addition, the values in 2023 are almost the same as the values for 2017 in all subcategories, presumably also due to the more precise 2024 transport survey results (Herry 2024). In the *staff commuting* and *student commuting* subcategories, even new highs have been recorded. **Please note that the 2021 and 2022 GHG monitoring reports and the 2023 balance were calculated using provisional emission factors.**

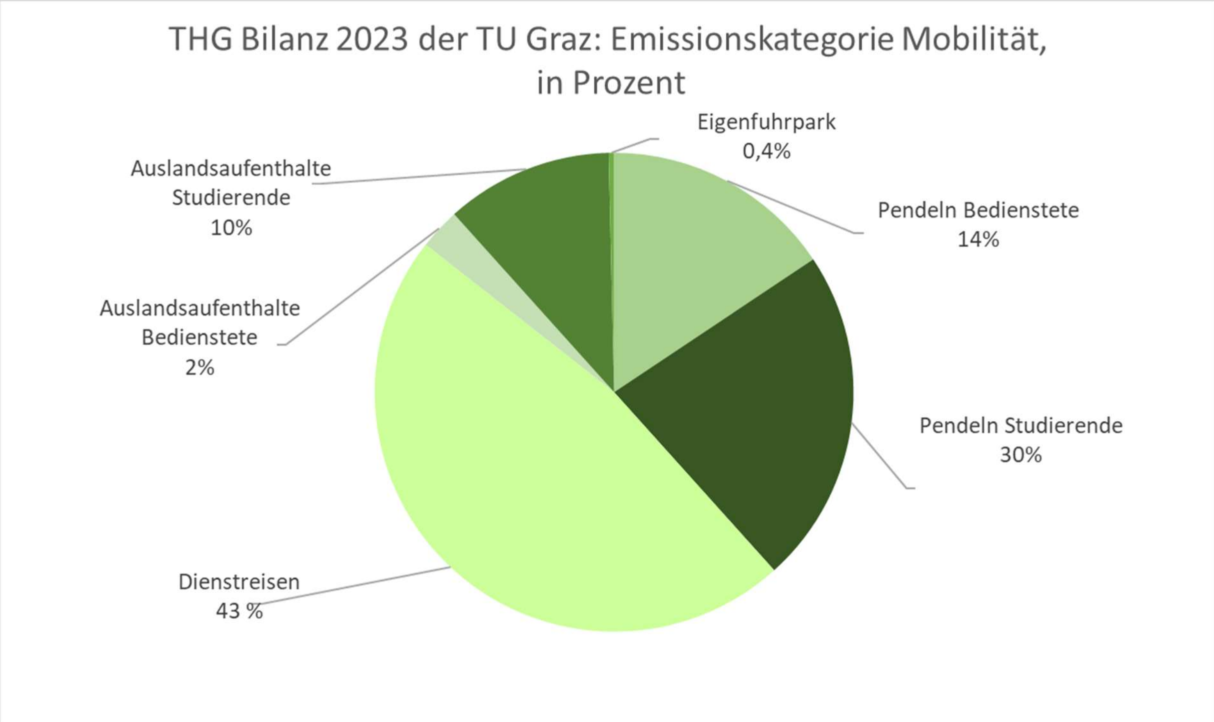

Figure 14: TU Graz 2023 GHG balance - Mobility emissions by category in %

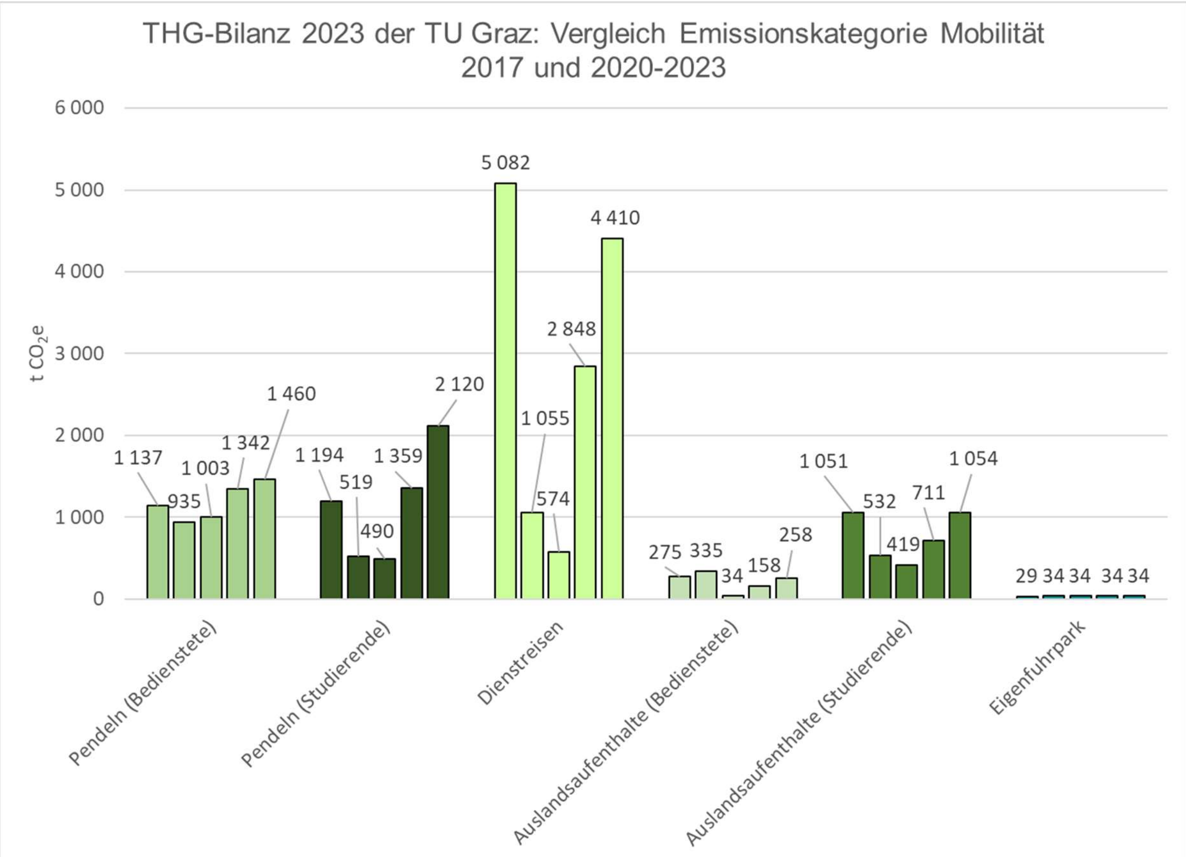

Figure 15: 2023 GHG balance - Comparison of emissions for the Mobility category in 2017 and 2020–2023

2.3.1 Staff commuting

For the first time, data from the new transport survey (Herry 2024) conducted in 2024 were used to analyse the *staff commuting* subcategory emissions. The annual passenger kilometres travelled were adjusted to the number of staff in 2023 for all modes of transport.

These data were also compared with the results from evaluating the entrance data (gate-entry data) to the managed TU Graz car parking areas. When applying this method, saved licence plate data are linked anonymously to the respective place of residence, divided into fossil-fuelled and electric cars (data for hybrids are combined with those for fossil-fuelled cars), and the kilometres commuted monthly are calculated based on the assumption that the route from home to the workplace is covered twice (i.e. there and back) on 15 days each month. The results for all twelve months were totalled. An assumption was made that all staff commuting by car use the car parks managed by TU Graz. This is a plausible assumption insofar as all public car parks near the TU Graz campuses are managed by the City of Graz (with higher parking fees).

Therefore, two different approaches were taken to calculate the number of passenger car kilometres travelled in 2023: One approach used data collected in the most recent traffic survey, and one approach used data from parking authorisations as described above. **The calculation based on the new 2024 traffic survey data was used for this balance** (for comparison, however, the results of both calculation methods are shown in the table below).

The 2024 transport survey data (Herry 2024) were also used to calculate emissions from the other modes of transport (motorised two-wheelers and all types of public transport) and adjusted according to the number of staff in 2023.

Emissions from the *staff commuting* subcategory were higher in 2023 than in 2022, because the number of kilometres driven by car increased. The increase in kilometres travelled by railway is also markedly high, with an impressive 47% increase observed. The 44% increase in kilometres driven by electric cars also illustrates a positive trend towards more environmentally friendly commuting behaviour. Overall, emissions in this subcategory are 9% higher than those in 2022. It is also clear that the car is by far the mode of transport that causes the most emissions. TU Graz would therefore like to encourage staff to switch to using e-cars, for example, by installing charging points for e-cars on TU Graz campuses. As of 2024, there were 30 charging points in operation on TU Graz premises. The number of parking spaces at TU Graz in 2023 was 614 (Nagy 2024).

It should also be mentioned at this point that in the *commuting* subcategories, "walking" and "cycling" account for a high proportion of commuting kilometres by both TU Graz staff and students (see Herry 2024), but these modes are not shown in the GHG balance as they are virtually emission-free.

Please note that the 2021 and 2022 GHG monitoring reports and the 2023 balance were calculated using provisional emission factors. The emission factors for 2021 were used for the 2023 balance, and the emission factors for 2019 were used to calculate the emissions for 2022.

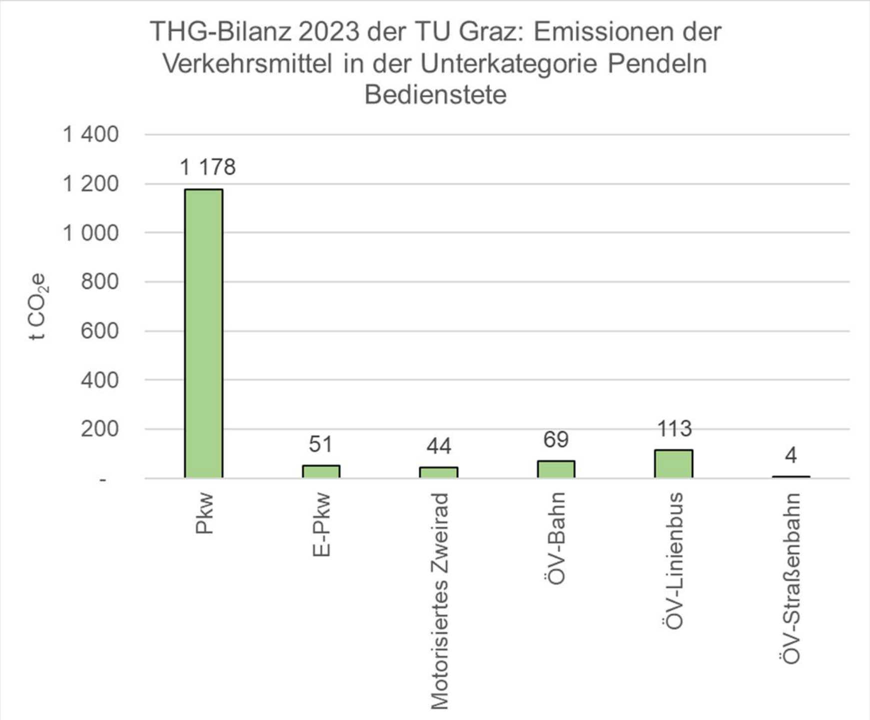

Figure 16: TU Graz 2023 GHG balance – Emissions from the modes of transport in the staff commuting subcategory

Table 9: 2023 GHG balance – Comparison of staff commuting in 2017 and 2020–2023

Comparison of staff commuting in 2017 and 2020–2023			
	Passenger kilometres (pkm)	Emission factor in kg CO_2e/km	Emissions in tonnes CO_2e
2023			
Cars (by parking authorisation, data **not** used)	4,677,810	0.219	1,024
Cars (according to 2024 traffic survey, data used)	5,380,027	0.219	1,178
E-cars (by parking authorisation, data **not** used)	367,590	0.095	35
E-cars (according to 2024 traffic survey, data used)	536,860	0.095	51
Motorised two-wheeler	303,859	0.145	44
Public transport railway	5,320,968	0.013	69
Public transport bus	2,086,670	0.054	113
Public transport tram	873,244	0.005	4
Total	**14,501,628**		**1,460**
2022			

Cars (according to parking authorisations, data used)	4,996,810	0.217	1,084
Cars (according to 2019 traffic survey, data **not** used)	6,876,190	0.217	1,492
E-cars (according to parking authorisations, data used)	372,780	0.088	33
Electric cars (according to 2019 traffic survey, data **not** used)	40,456	0.088	4
Motorised two-wheeler	292,633	0.145	42
Public transport railway	3,627,565	0.013	47
Public transport bus	2,176,539	0.060	131
Public transport tram	937,233	0.005	5
Total	**12,403,560**		**1,342**
2021			
Car	4,006,625	0.217	869
E-car	23,573	0.088	2
Motorised two-wheeler	170,511	0.145	25
Public transport railway	2,113,713	0.013	27
Public transport bus	1,268,228	0.060	76
Public transport tram	546,108	0.005	3
Total	**8,128,758**		**1,003**
2020			
Car	3,676,041	0.218	801
E-car	21,628	0.094	2
Motorised two-wheeler	156,443	0.145	23
Public transport railway	1,939,312	0.019	37
Public transport bus	1,163,587	0.06	70
Public transport tram	475,095	0.005	2
Total	**7,432,106**		**935**
2017			
Car	5,425,184	0.1777	964
E-car	-	Not in *ClimCalc 2017*	-
Motorised two-wheeler	230,882	0.1356	31
Public transport railway	2,862,080	0.014	40
Public transport bus	1,717,248	0.0479	82
Public transport tram	739,459	0.0265	20
Total	**27,250,405**		**1,137**
Increase/decrease in % *staff commuting* from 2022 to 2023			
Car	Plus 8%	Plus 1%	Plus 9%

E-car	Plus 44%	Plus 8%	Plus 55%
Motorised two-wheeler	Plus 4%	0%	Plus 5%
Public transport railway	Plus 47%	0%	Plus 47%
Public transport bus	Minus 4%	Minus 10%	Minus 14%
Public transport tram	Plus 7%	0%	Minus 13%
Total	**Plus 17%**		**Plus 9%**

2.3.2 Student commuting

The 2024 transport survey (Herry 2024) data were also used for the *student commuting* subcategory and adjusted for the number of students in 2023 for all modes of transport. Here too, the car is identified as the dominant source of GHG emissions, even if the passenger kilometres travelled with the car are far fewer than those with the train.

When comparing these data to those from the last transport survey in 2019, results show that fewer TU Graz students used walking and cycling as means of commuting in 2023 than in 2019. This development is presumably due to the introduction of the climate tickets (*Klimatickets*).

Emissions assigned to the *student commuting* subcategory were higher in 2023 than in 2022. This is due to the increased number of students, but above all also to the availability of more precise transport survey data: For the first time, transport stage data could be recorded precisely, for example, the distance travelled by car to the train station (Park&Ride) and so on. The fact that many students abandoned their flats in Graz in favour of living in their parents' household during the coronavirus pandemic, a trend that was only partly maintained after the pandemic ended, may also play a role here. The total number of passenger kilometres travelled in 2023 was 83% higher than in 2022. The passenger kilometres travelled by electric car are particularly significant here. These have risen by 3.326%. Railway kilometres travelled increased by 133%, but the number of kilometres travelled with fossil-fuelled cars and public transport such as buses also increased by over 50%. The associated emissions produced have risen at a similar rate. Overall, 56% more CO_2e emissions were assigned to this subcategory in 2023 than in 2022.

Please note that the 2021 and 2022 GHG monitoring reports and the 2023 balance were calculated using provisional emission factors.

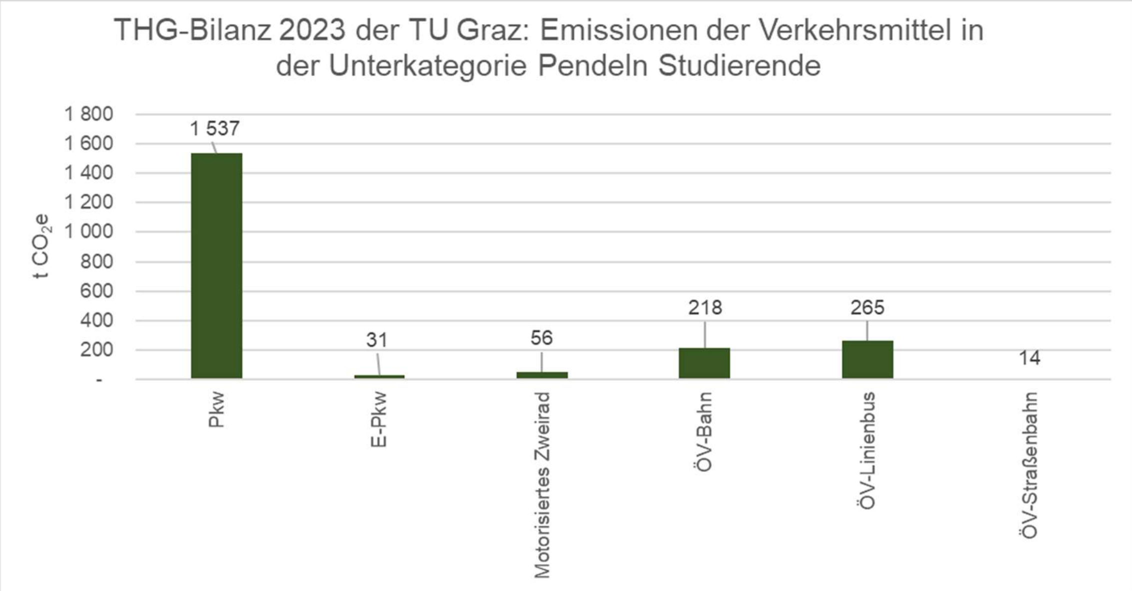

Figure 17: TU Graz 2023 GHG balance – Emissions from transport in the student commuting subcategory

Table10 : Comparison of students commuting in 2017 and 2020–2023

Comparison of students commuting in 2017 and 2020–2023			
	Passenger kilometres (pkm)	Emission factor in kg CO_2e/km	Emissions in tonnes CO_2e
2023			
Car	7,019,021	0.219	1,537
E-car	325,613	0.095	31
Motorised two-wheeler	385,072	0.145	56
Public transport railway	16,787,322	0.013	218
Public transport bus	4,899,827	0.054	265
Public transport tram	2,713,294	0.005	14
Total	**32,130,148**		**2,120**
2022			
Car	4,498,298	0.217	976
E-car	9,503	0.088	1
Motorised two-wheeler	586,584	0.145	85
Public transport railway	7,201,424	0.013	94

Public transport bus	3,219,735	0.06	193
Public transport tram	1,999,916	0.005	10
Total	**17,515,460**		**1,359**
2021			
Car	1,622,585	0.217	352
E-car	3,428	0.088	0
			(= 0.03)
Motorised two-wheeler	211,587	0.145	31
Public transport railway	2,597,632	0.013	34
Public transport bus	1,161,393	0.06	70
Public transport tram	721,391	0.005	4
Total	**6,318,016**		**490**
2020			
Car	1,661,249	0.218	362
E-car	3,509	0.094	0
			(= 0.03)
Motorised two-wheeler	216,629	0.145	31
Public transport railway	2,659,529	0.019	51
Public transport bus	1,189,067	0.06	71
Public transport tram	738,581	0.005	4
Total	**6,468,564**		**519**
2017			
Car	4,525,112	0.1777	804
E-car	-	Not in *ClimCalc 2017*	-
Motorised two-wheeler	590,081	0.1356	80
Public transport railway	7,244,350	0.014	101
Public transport bus	3,238,927	0.0479	155
Public transport tram	2,011,837	0.0265	53
Total	**17,610,307**		**1,194**

Increase/decrease in % *Commuting students* from 2022 to 2023			
Car	Plus 56%	Plus 1%	Plus 57%
E-car	Plus 3.326%	Plus 8%	Plus 2.993%
Motorised two-wheeler	Minus 34%	0%	Minus 34%
Public transport railway	Plus 133%	0%	Plus 132%
Public transport bus	Plus 52%	Minus 10%	Plus 37%
Public transport tram	Plus 36%	0%	Plus 36%
Total	**Plus 83%**		**Plus 56%**

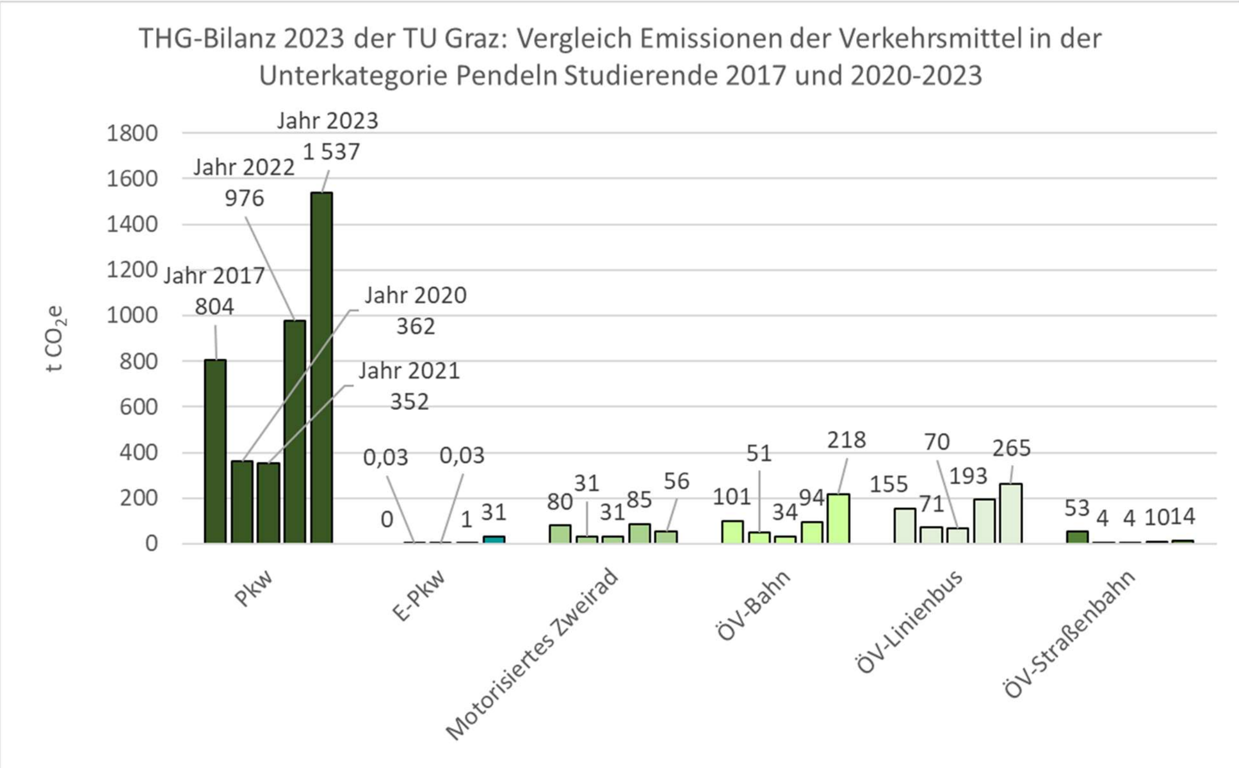

Figure 18: TU Graz 2023 GHG balance – Comparison of emissions from transport in the student commuting subcategory in 2017 and 2020–2023

A comparison of emissions in the *student commuting* subcategory shows that emissions rose sharply in 2023. The increase in car emissions is particularly obvious.

2.3.3 Business trips

Data for the subcategory of *business trips*[3] were recorded for **the first time** in 2022 using the **CO_2e monitoring tool** developed at TU Graz. In 2023, around 60% of CO_2e-relevant trips were entered digitally by travellers using the CO_2e tool. Data for the remaining 40% were calculated proportionally.
This methodology was tested in 2022 (Häller, 2024) as part of a bachelor's thesis (Cehajic, 2023). The methodology used in the bachelor's thesis applied to data obtained from the HR department, however, required too many assumptions to be made, and the uncertainties were too high. For this reason, the CO_2 monitoring tool continues to be the most accurate and best source for recording emissions from business trips.

Please note, however, that trips taken in 2023 could still be entered into the CO_2e tool until the middle of the following year (2024). This means that the datapoints fluctuate slightly depending on when they were retrieved from the system. The data presented here on mileage and GHG emissions in 2023 refer to the **status as of 03.04.2024**.

Please note that the 2021 and 2022 GHG monitoring reports and the 2023 balance were calculated using provisional emission factors.

As the following graph shows, most emissions in the business trip subcategory are caused by travelling by plane (overall), followed by travelling by medium-/long-haul flights, short-haul flights, the car, and finally the train and long-distance bus.

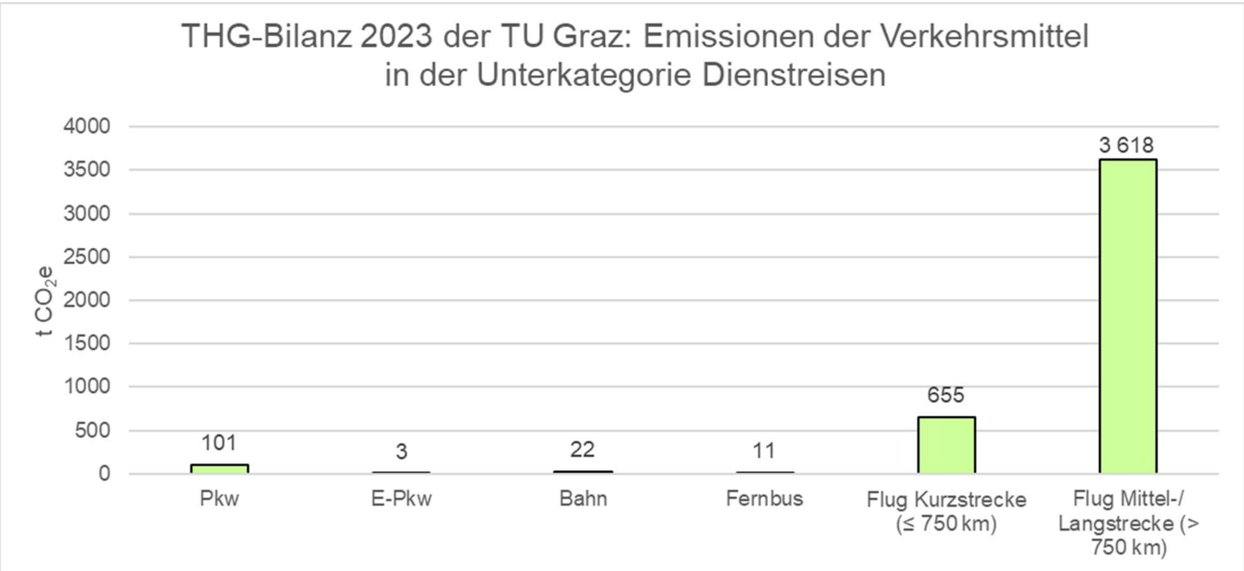

Figure 19: TU Graz 2023 GHG balance – Emissions from modes of transport in the business trips subcategory

[3] The *business trips* category also includes trips taken during a leave of absence (up to one month), but only if more than 50% of the travel costs were financed by TU Graz.

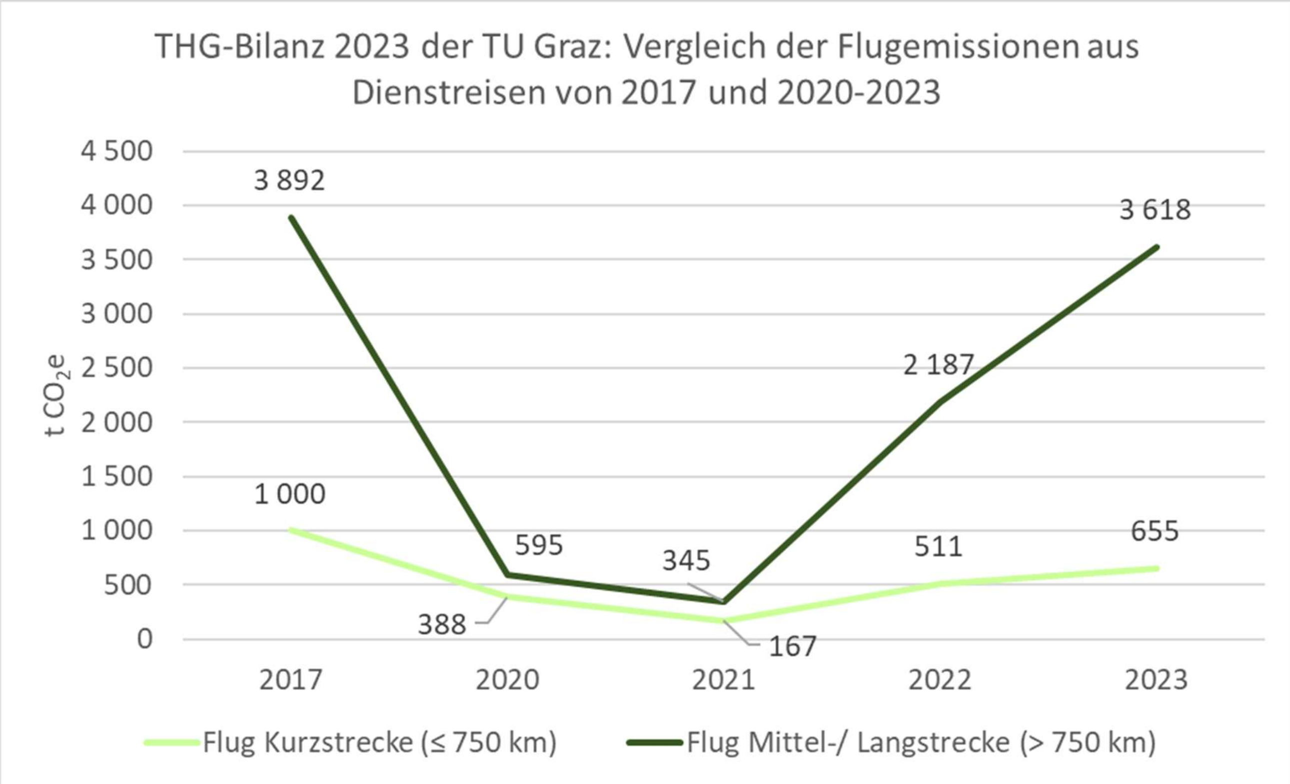

Figure 20: TU Graz 2023 GHG balance – Comparison of flight emissions from business trips taken in 2017 and 2020–2023

In the *business trips* subcategory, both passenger kilometres and emissions increased sharply in 2023. The strongest increase here was recorded for medium-/long-haul flights (> 750 km), an up 65% increase in passenger kilometres and emissions compared to 2022. However, a sharp increase is also observed in *rail and long-distance bus* travel in 2023 as compared to 2022 (long-distance bus travel: 44% increase in passenger kilometres and 54% increase in emissions; railway travel: 32% increase in passenger kilometres and 28% increase in emissions). Figure 20 illustrates the development in GHG emissions from flights for business trips in detail. Here, you can see clearly how emissions from medium-/long-haul flights have almost returned to the level seen in 2017, while the increase in emissions from short-haul flights is not as drastic. This can presumably be attributed to measures taken by TU Graz to reduce the number of short-haul flights. The climate contribution (*Klimabeitrag*) has also been in place since 1 May 2024: This increases the cost of flights within Europe by € 100 and outside Europe by € 200, providing a financial climate contribution for bus and train trips amounting to 50% of the ticket costs. It is hoped that this will lead to a reduction in flight emissions. The effects of this will be anlalysed in autumn 2024 (Häller 2024).

The following table shows the passenger kilometres, emission factors, and 2023 emissions compared to those in 2022, 2021, 2020, and 2017.

This shows, for example, that more passenger kilometres were travelled by train than by short-haul flights, but that the emissions from short-haul flights are many times higher due to the significantly higher emission factor. Another similar example shows the emissions from kilometres travelled by car compared to those travelled by railway. Here, only slightly more than one-third of the kilometres were covered by car, but the resulting emissions are almost five times as high.

Table11 : Comparison of business trips in 2017 and 2020-2023

Comparison of business trips in 2017 and 2020–2023			
	Passenger kilometres (pkm)	Emission factor in kg CO_2e/km	Emissions in tonnes CO_2e
2023			
Car	462,915	0.219	101
E-car	31,622	0.095	3
Railway	1,671,148	0.013	22
Long-distance bus	219,476	0.049	11
Short-haul flight	678,806	0.965	655
Medium-/long-haul flight (> 750 km)	9,158,863	0.395	3,618
Total	**12,222,830**		**4,410**
2022			
Car	497,461	0.217	123
E-car	26,218	0.088	3
Railway	1,270,200	0.013	17
Long-distance bus	152,064	0.049	7
Short-haul flight	529,383	0.965	511
Medium-/long-haul flight (> 750 km)	5,537,806	0.395	2,187
Total	**8.013,132**		**2,848**
2021			
Car	272,092	0.217	59
E-car	-	-	-
Railway	214,505	0.013	3
Long-distance bus	19,116	0.049	1
Short-haul flight (≤ 750 km)	172,838	0.965	167
Medium-/long-haul flight (> 750 km)	872,380	0.395	345
Total	**1,550,930**		**574**
2020			
Car	305,596	0.218	67
E-car	-	-	-
Railway	240,918	0.019	5
Long-distance bus	21,470	0.051	1
Short-haul flight (≤ 750 km)	194,120	1.998	388

Medium-/long-haul flight (> 750 km)	979,800	0.607	595
Total	**1,741,904**		**1,055**
2017			
Car	826,954	0.1777	147
E-car	-	-	-
Railway	1.760,801	0.014	25
Long-distance bus	352,202	0.0521	18
Short-haul flight (≤ 750 km)	1,304,408	0.7669	1,000
Medium-/long-haul flight (> 750 km)	9,972,138	0.3903	3,892
Total	**14,216,503**		**5,082**
Increase/decrease in % (2022 to 2023)			
Car	Minus 7%	Plus 1%	Minus 18%
E-car	Plus 21%	Plus 8%	0%
Railway	Plus 32%	Same EF used	Plus 28%
Long-distance bus	Plus 44%	Same EF used	Plus 54%
Short-haul flight (≤ 750 km)	Plus 28%	Same EF used	Plus 28%
Medium-/long-haul flight (> 750 km)	Plus 65%	Same EF used	Plus 65%
Total	**Plus 53%**		**Plus 55%**

2.3.4 Staff member stays abroad

Data assigned to the *stays abroad (staff and students)* subcategories were fully and accurately recorded from 2021 onwards. The following tables show the passenger kilometres, emission factors, and emissions, allowing a comparison of results for the years of 2022, 2021, 2020, and 2017. **Please note that the 2021 and 2022 GHG monitoring reports and the 2023 balance were calculated using provisional emission factors.**

Please note that the modes of transport were not surveyed until 2020, but the allocation is based on estimates (up to 750 km → long-distance bus, from 750 km → flight). Only from 2021 onwards were the modes of transport determined by means of performing a survey using a questionnaire sent out after the stay abroad; this is why precise data are available from 2021 onwards. These results show that long-distance buses are rarely used as a mode of transport.
Medium- and long-haul flights (> 750 km) were predominantly used to reach more distant destinations, and these have by far the greatest impact on emissions in this subcategory.

The large difference between emissions from rail and bus transport and emissions from air travel is also evident when examining data for stays abroad. Although railway travel was used for 28% of the trips when staff conducted stays abroad, this has little to no impact on the emissions for the entire category. Long- and medium-haul flights were only used for around 44% of the trips, but account for more than 90% of emissions in this subcategory.

ClimCalc currently uses the national value for the railway in Austria as the emission factor for the railway. This seems appropriate, as railway use in connection with stays abroad usually involves travelling to nearby countries, mostly on electrified routes.

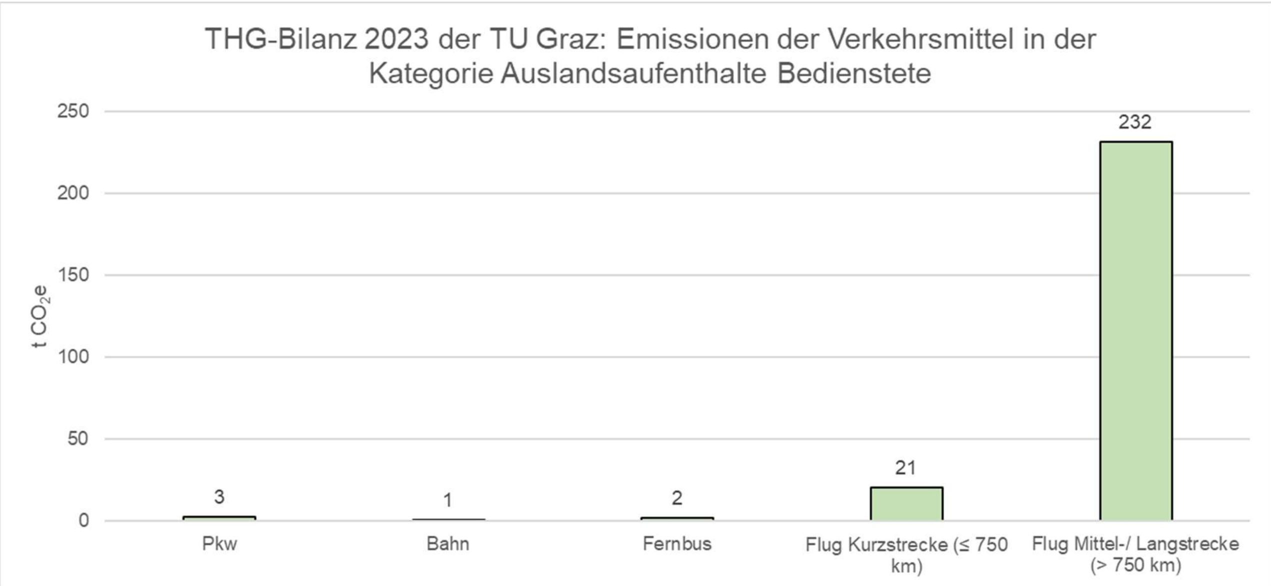

Figure 21: TU Graz 2023 GHG balance – Emissions from transport in the staff stays abroad subcategory

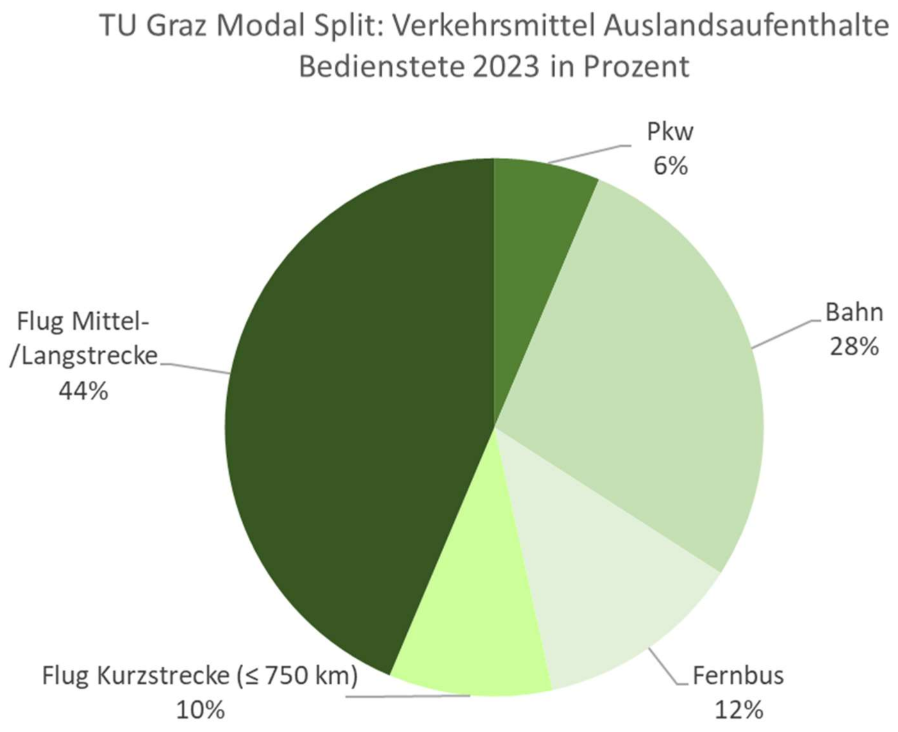

Figure 22: TU Graz modal split – Modes of transport used for staff stays abroad in 2023 in %

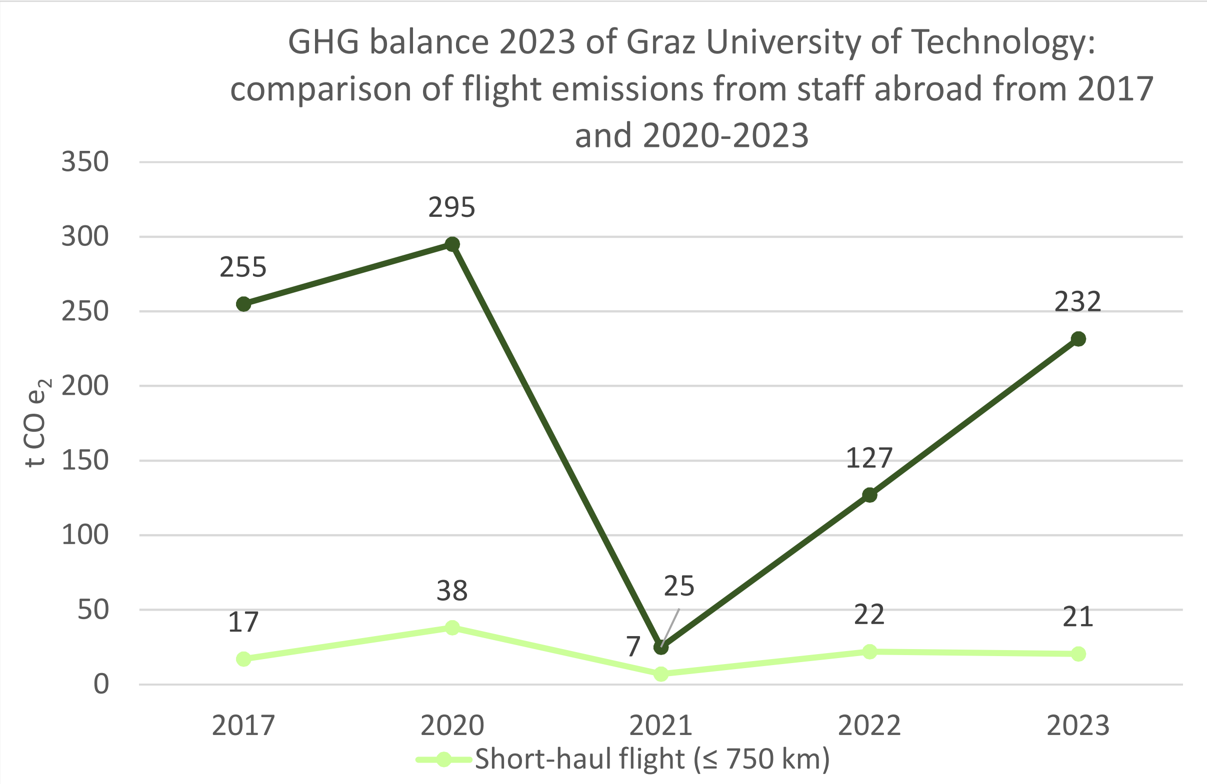

Figure 23: TU Graz 2023 GHG balance – Comparison of flight emissions from staff stays abroad in 2017 and 2020–2023

However, the development in flight emissions for the *staff stays abroad* subcategory shows an improvement in terms of short-haul flights. Emissions from short-haul flights even dropped by 7% in this category, although the total emissions rose by 64%. Passenger kilometres and emissions from cars were also 63% lower in 2023. The increased use of long-distance buses is particularly obvious in 2023. This amounts to a 2.235% increase in terms of the kilometres travelled as compared to 2022

Table 12: Comparison of staff stays abroad in 2017 and 2020–2023

Comparison of staff stays abroad in 2017 and 2020–2023			
	Passenger kilometres (pkm)	Emission factor in kg CO_2e/km	Emissions in tonnes CO_2e
2023			
Car	13,360	0.219	3
Railway	80,230	0.013	1
Long-distance bus	47,400	0.049	2
Short-haul flight (≤ 750 km)	21,280	0.965	21
Medium-/long-haul flight (> 750 km)	586,440	0.395	232
Total	**748,710**		**258**
2022			
Car	35,688	0.217	8
Railway	48,570	0.013	1
Long-distance bus	2,030	0.049	(0.099) = 0
Short-haul flight (≤ 750 km)	22,483	0.965	22
Medium-/long-haul flight (> 750 km)	322,520	0.395	127
Total	**431,219**		**158**
2021			
Car	6,960	0.217	2
Railway	3,056	0.013	(0.04) = 0
Long-distance bus	0	0.049	0
Short-haul flight (≤ 750 km)	7,540	0.965	7
Medium-/long-haul flight (> 750 km)	63,780	0.395	25
Total	**81,336**		**34**
2020			
Long-distance bus	39,218	0.051	2
Short-haul flight (≤ 750 km)	19,040	1.998	38
Medium-/long-haul flight (> 750 km)	485,260	0.607	295
Total	**543,518**		**335**

2017			
Long-distance bus	47,640	0.0521	2
Short-haul flight (≤ 750 km)	21,978	0.7669	17
Medium-/long-haul flight (> 750 km)	654,509	0.3903	255
Total	**724,127**		**274**
Increase/decrease in % (2022 to 2023)			
Car	Minus 63%	Plus 1%	Minus 63%
Railway	Plus 65%	Same EF used	Plus 4%
Long-distance bus	Plus 2.235%	Same EF used	Plus 2.246%
Short-haul flight (≤ 750 km)	Minus 5%	Same EF used	Minus 7%
Medium-/long-haul flight (> 750 km)	Plus 82%	Same EF used	Plus 82%
Total	**Plus 74%**		**Plus 64%**

2.3.5 Student stays abroad

The predominance of medium- and long-haul flight use is even more obvious when examining data from student stays abroad than for staff stays abroad. In this subcategory, these flights account for almost 98% of total emissions, although they were the mode of transport of choice for only 68% of the trips. However, please note that students are increasingly opting for an alternative to flying when they spend their semester abroad in Europe. This is also reflected by the sharp increase in the use of trains, buses, and cars. It is important to emphasise that only eight out of all the trips involved a short-haul flight.

Emissions from medium- and long-haul flights increased by 48% in 2023 as compared to 2022, meaning that the total emissions in this subcategory also increased by 48%. Emissions from medium- and long-haul flights in 2023, therefore, are even higher than in 2017.

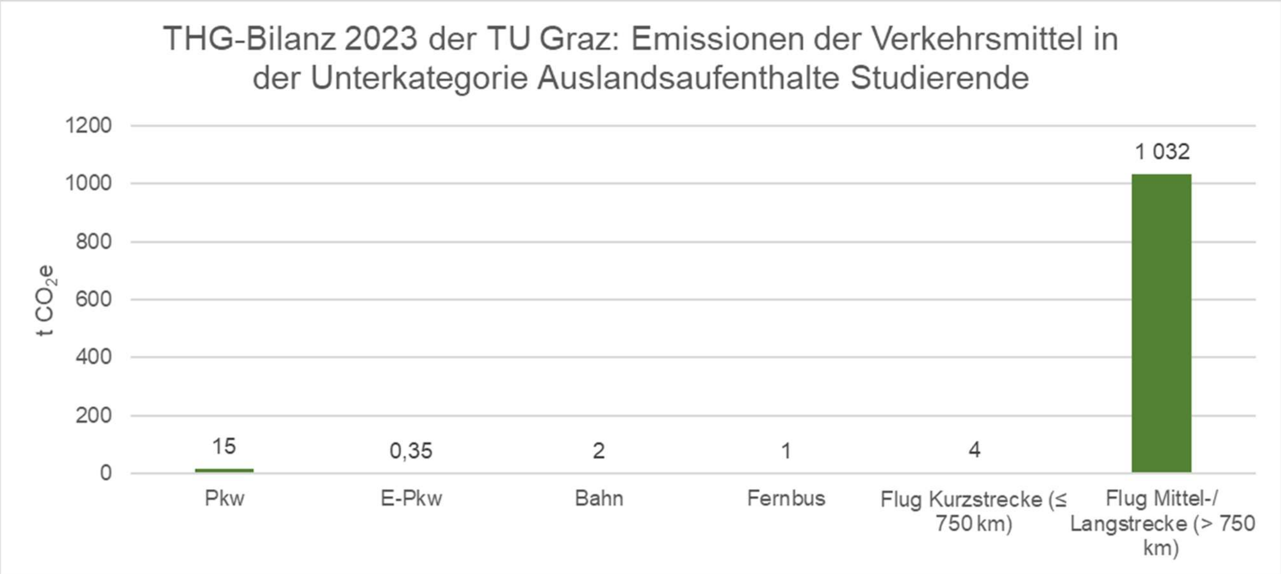

Figure 24: TU Graz 2023 GHG balance – Emissions from transport in the student stays abroad subcategory

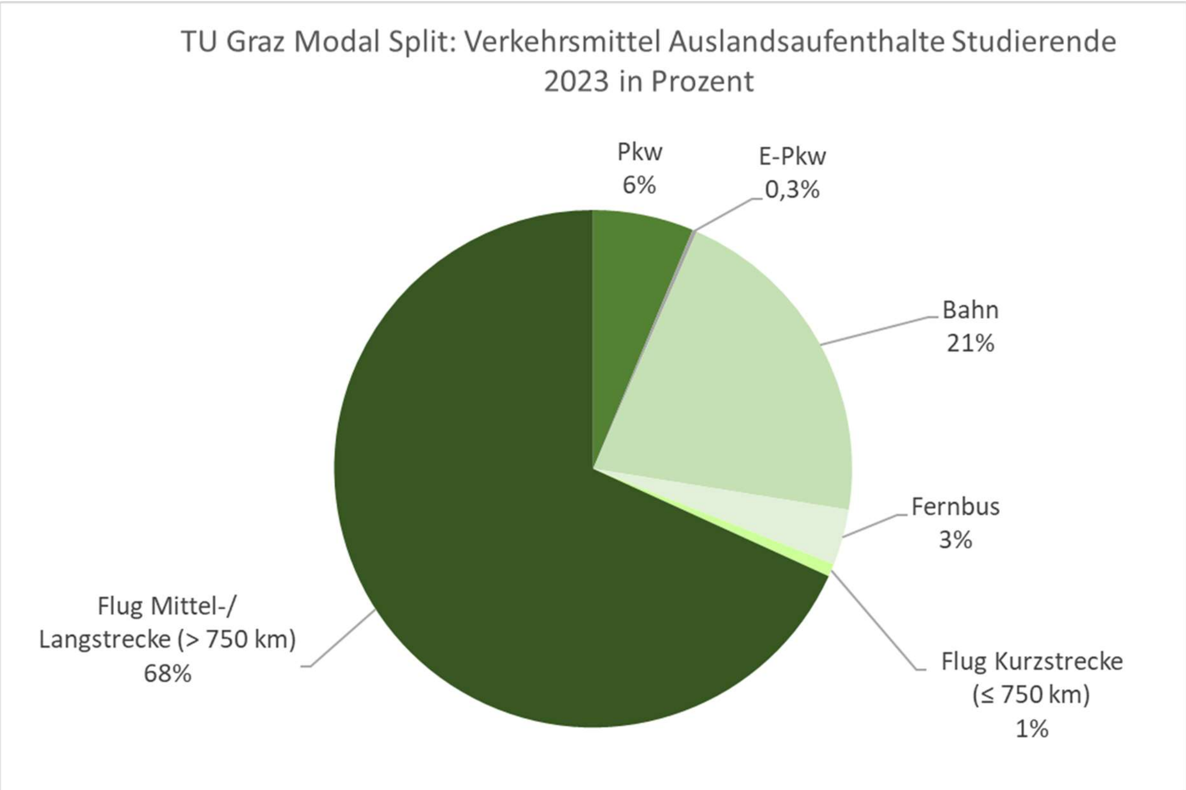

Figure 25: TU Graz modal split – Modes of transport used for student stays abroad in 2023 in %

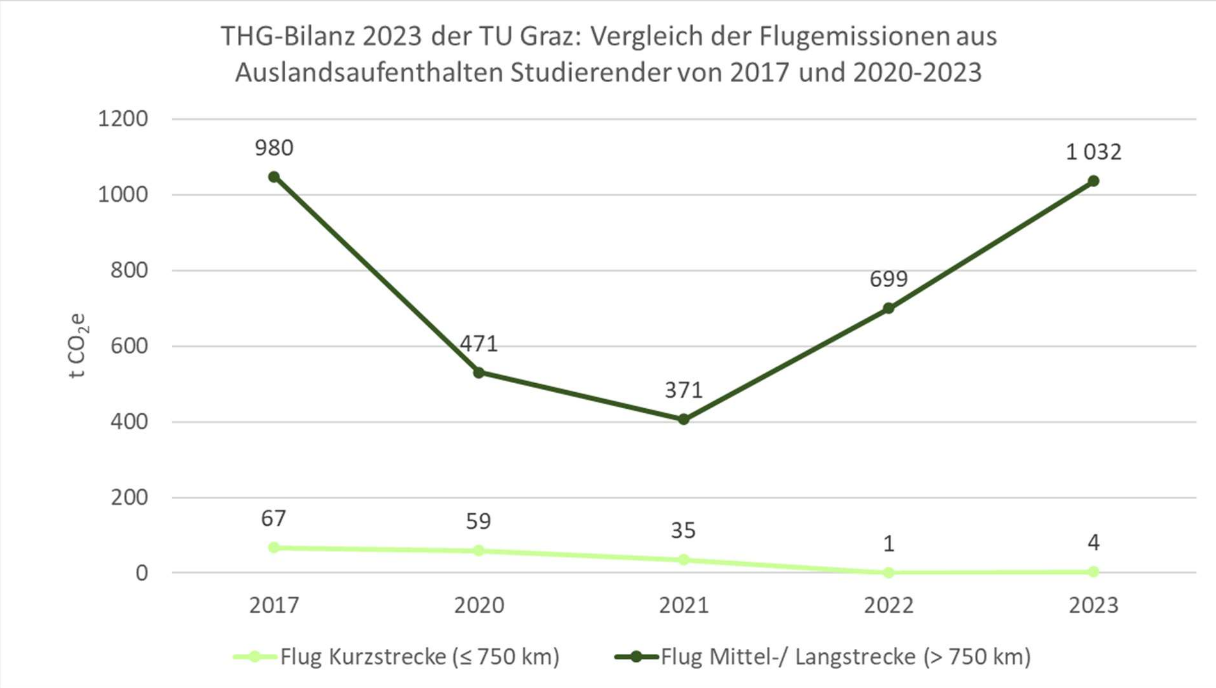

Figure 26: TU Graz 2023 GHG balance – Comparison of flight emissions for student stays abroad in 2017 and 2020–2023

Table 13: Comparison of student stays abroad in 2017 and 2020–2023

Comparison of student stays abroad in 2017 and 2020–2023			
	Passenger kilometres (pkm)	Emission factor in kg CO_2e/km	Emissions in tonnes CO_2e
2023			
Car	66,490	0.219	15
E-car	3,700	0.095	0,35
Railway	189,950	0.013	2
Long-distance bus	21,640	0.049	1
Short-haul flight (≤ 750 km)	3,880	0.965	4
Medium-/long-haul flight (> 750 km)	2,612,775	0.395	1.032
Total	**2,898,435**		**1.054**
2022			
Car	35,630	0.217	8
Railway	138,390	0.013	2
Long-distance bus	26,590	0.049	1
Short-haul flight (≤ 750 km)	1,460	0.965	1
Medium-/long-haul flight (> 750 km)	1,769,090	0.395	699
Total	**1,971,160**		**711**

2021			
Car	53,674	0.217	12
Railway	35,400	0.013	(0,46) = 0
Long-distance bus	3,740	0.049	(0,18) = 0
Short-haul flight (≤ 750 km)	36,080	0.965	35
Medium-/long-haul flight (> 750 km)	940,370	0.395	371
Total	**1,069,264**		**419**
2020			
Long-distance bus	31,832	0.051	2
Short-haul flight (≤ 750 km)	29,680	1.998	59
Medium-/long-haul flight (> 750 km)	776,360	0.607	471
Total	**837,872**		**532**
2017			
Long-distance bus	93,537	0.0521	5
Short-haul flight (≤ 750 km)	87,043	0.7669	67
Medium-/long-haul flight (> 750 km)	2,510,470	0.3903	980
Total	**2,691,050**		**1.052**
Increase/decrease in % (2022 to 2023)			
Car	Plus 87%	Plus 1%	Plus 82%
E-car	No data in 2022		No data in 2022
Railway	Plus 37%	Same EF used	Plus 23%
Long-distance bus	Minus 19%	Same EF used	Plus 6%
Short-haul flight (≤ 750 km)	Plus 166%	Same EF used	Plus 274%
Medium-/long-haul flight (> 750 km)	Plus 48%	Same EF used	Plus 48%
Total	**Plus 47%**		**Plus 48%**

2.3.6 Total flights

As previously mentioned, TU Graz's goal is to reduce flight emissions by 50% by 2030 based on the 2017 reference balance (and using the emission factors valid in 2017). This includes **flight emissions from business trips, stays abroad by staff, and stays abroad by students**.

The following graph shows the target path, the resulting maximum annual emissions, and the actual GHG emissions caused by air travel per year. These GHG emissions were calculated using the **2017 emission factors**; a target of "minus 50%" was set with 2017 as the base year, and the emission factors remained the same. This means that, for example, changes in emission factors related to the coronavirus pandemic or efficiency are not taken into account.

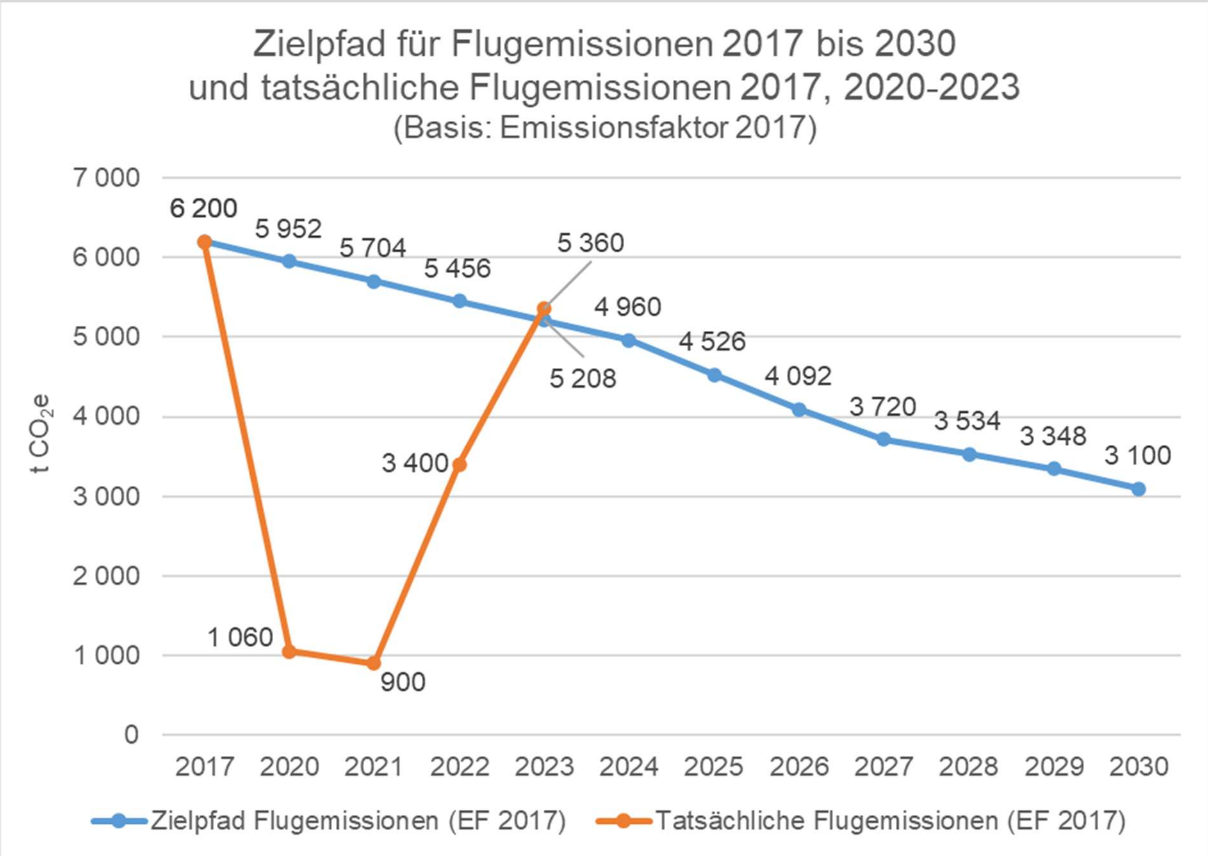

Figure 27: Target path for flight emissions from 2017 to 2030 and actual flight emissions in 2017, 2020–2023

As you can clearly see, the flight emissions in 2023 exceed the emissions budget. As a result, TU Graz must take measures as quickly as possible to reduce flight emissions as planned, since the measures implemented have not been sufficient. The introduction of the climate contribution on 1 May 2024 is one step that has been taken in this direction.

2.3.7 Own vehicle fleet

The *own vehicle fleet* subcategory is the only subcategory in the *Mobility* category that does not display any increase in emissions. While the total emissions in this subcategory have not increased compared to 2020, strong fluctuations have been observed within the subcategory. In 2017, only diesel vehicles were surveyed, and passenger cars, electric cars, and light commercial vehicles (< 3.5 tonnes) were additionally surveyed from 2020 onwards. Emissions from the latter mode of transport increased significantly in 2023 (plus 209%), while emissions from diesel vehicles dropped by 50%
Company vehicles were surveyed at the following institutes and organisational units

- Buildings and Technical Support
- Institute for Technology and Testing of Construction Materials with affiliated TVFA for strength and materials testing
- Institute for Rock Mechanics and Tunnelling
- Institute of Applied Geosciences
- Urban Water Management and Landscape Water Engineering
- Thermodynamics and Sustainable Propulsion
- Automotive Engineering
- Vehicle Safety
- Central Information Technology

The vehicles financed by TU Graz can be found in Appendix 2 according to the 2023 vehicle inventory list (*Finance and Accounting*). However, some vehicles are not owned by TU Graz and therefore do not appear in this list. These vehicles are used by the respective institutes as part of cooperation agreements with external companies.

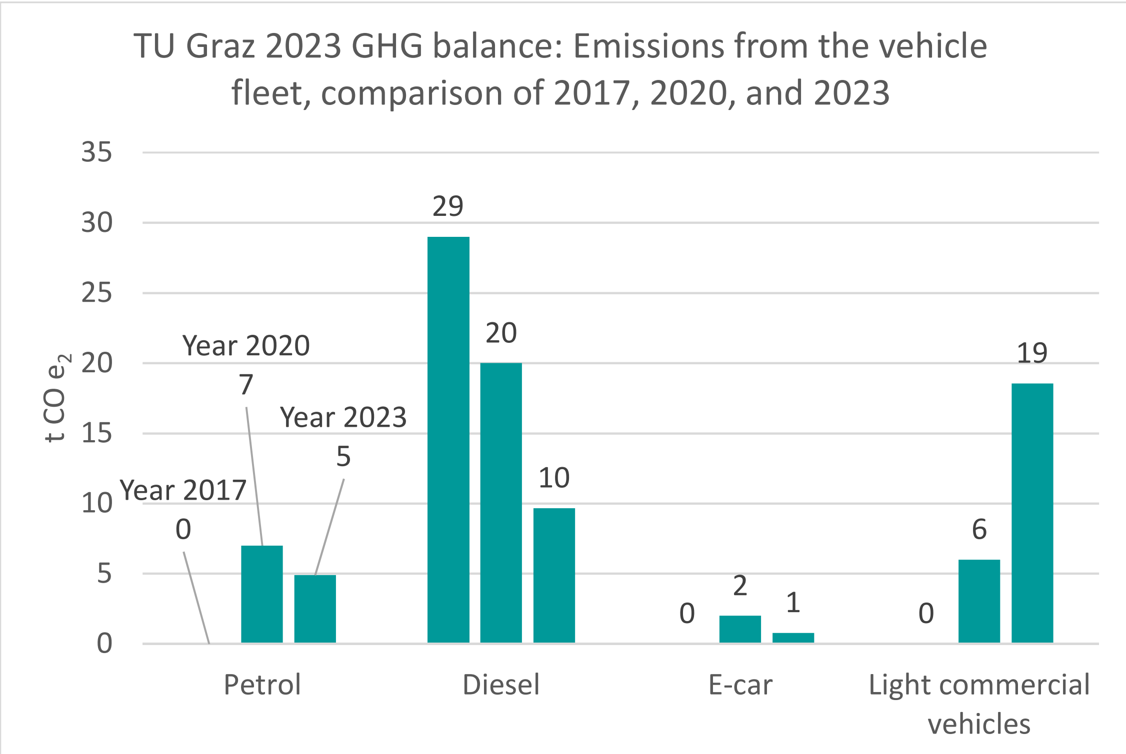

Figure 28: TU Graz 2023 GHG balance – Emissions from the vehicle fleet, comparison of 2017, 2020 and 2023

Table 14: Vehicle fleet – Comparison of 2023 with 2017 and 2020

Vehicle fleet - Comparison of 2023 with 2017 and 2020			
	Vehicle kilometres (Fzkm)	Emission factor in kg CO_2e/vehicle kilometre	Emissions in tonnes CO_2e
2023			
Petrol	18,887	0.259	5
Diesel	38,820	0.249	10
E-car	7,183	0.108	1
Light commercial vehicles	60,035	0.309	19
Total	**124,925**		**34**
2020			
Petrol	27,875	0.256	7
Diesel	79,676	0.247	20
E-car	15,004	0.107	2
Light commercial vehicles	18,107	0.311	6
Total	**142,319**		**34**
2017			
Diesel (= **total**)	**141,203**	0.2023	**29**
Increase/decrease in % 2023 to 2020			
Petrol	Minus 32%	1%	Minus 30%
Diesel	Minus 51%	1%	Minus 52%
E-car	Minus 52%	1%	Minus 61%
Light commercial vehicles	Plus 232%	-1%	Plus 209%
Total	**Minus 12%**		**0%**

2.4 Material use

In the *Material use* category, data assigned to the *paper*, *refrigerants,* and *IT equipment* subcategories are collected at TU Graz. For this purpose, data were provided by the *Purchasing Services, Finance and Accounting, Buildings and Technical Support, Communication and Marketing, Verlag*, as well as by the external units *Printkulture (HTU Copyshops),* and *Harnisch Gebäudeservice Graz* organisational units. Emissions in the *Material use* category totalled 454 tonnes in 2023. Emissions in all subcategories range from 136 to 165 tonnes of CO_2e, with each accounting for around one-third of the emissions in this category.

Please note that the 2021 and 2022 GHG monitoring reports and the 2023 balance were calculated using provisional emission factors.

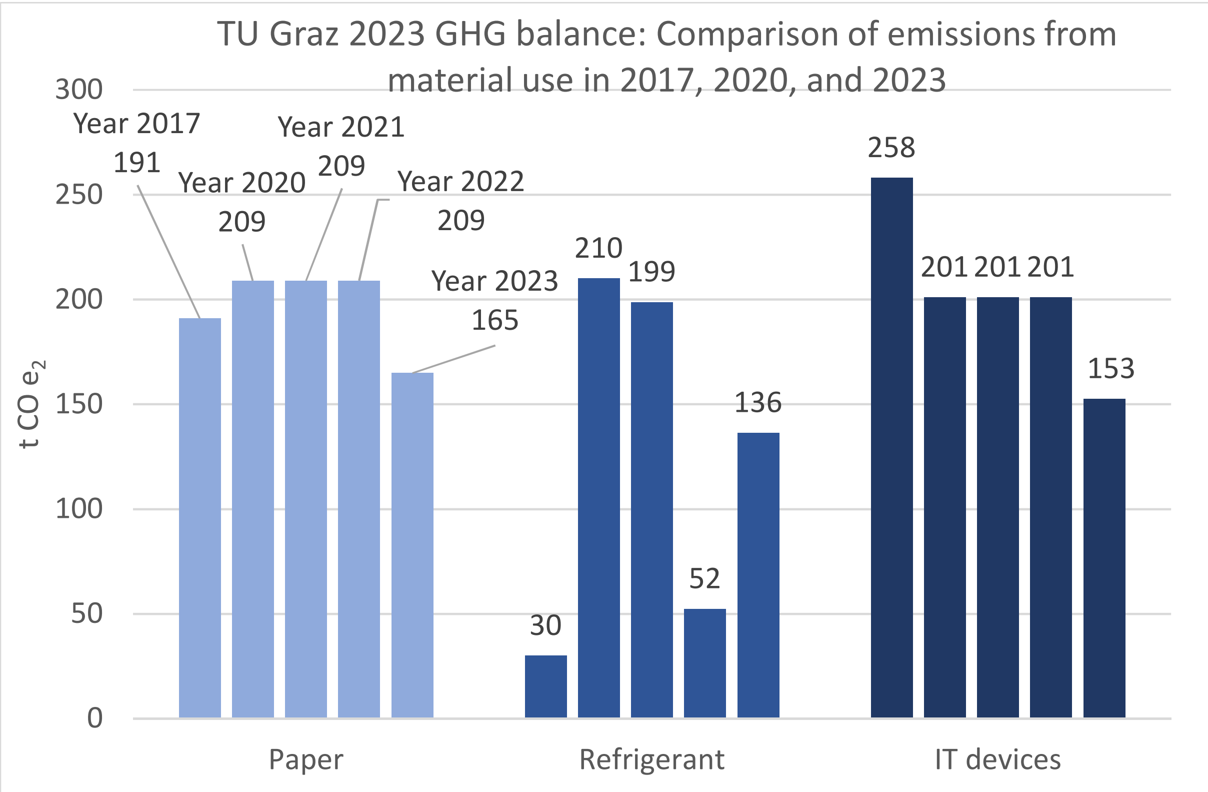

Figure 29: TU Graz 2023 GHG balance – Comparison of emissions from material use in 2017, 2020 and 2023

2.4.1 Paper

In the case of *paper*, the consumption of copy paper and the production of printed products decreased in 2023 compared to 2020 (the use of copy paper dropped by 39% and of printed products by 54%). According to the Purchasing Service, this reduction can be explained by the fact that many processes have been digitalised due to the pandemic. The slight decrease in the use of sanitary paper (paper towels) – despite an increase in the number of staff and

students compared to the periodic pandemic-related absences in 2020 – could indicate that the increase in hand washing as a hygienic measure during the pandemic has disappeared again in 2023. The slight increase in sanitary paper (toilet) consumption corresponds well with the slight increase in the numbers of staff and students.
Overall, 21% fewer emissions were recorded in the *paper* subcategory in 2023 than in 2020.

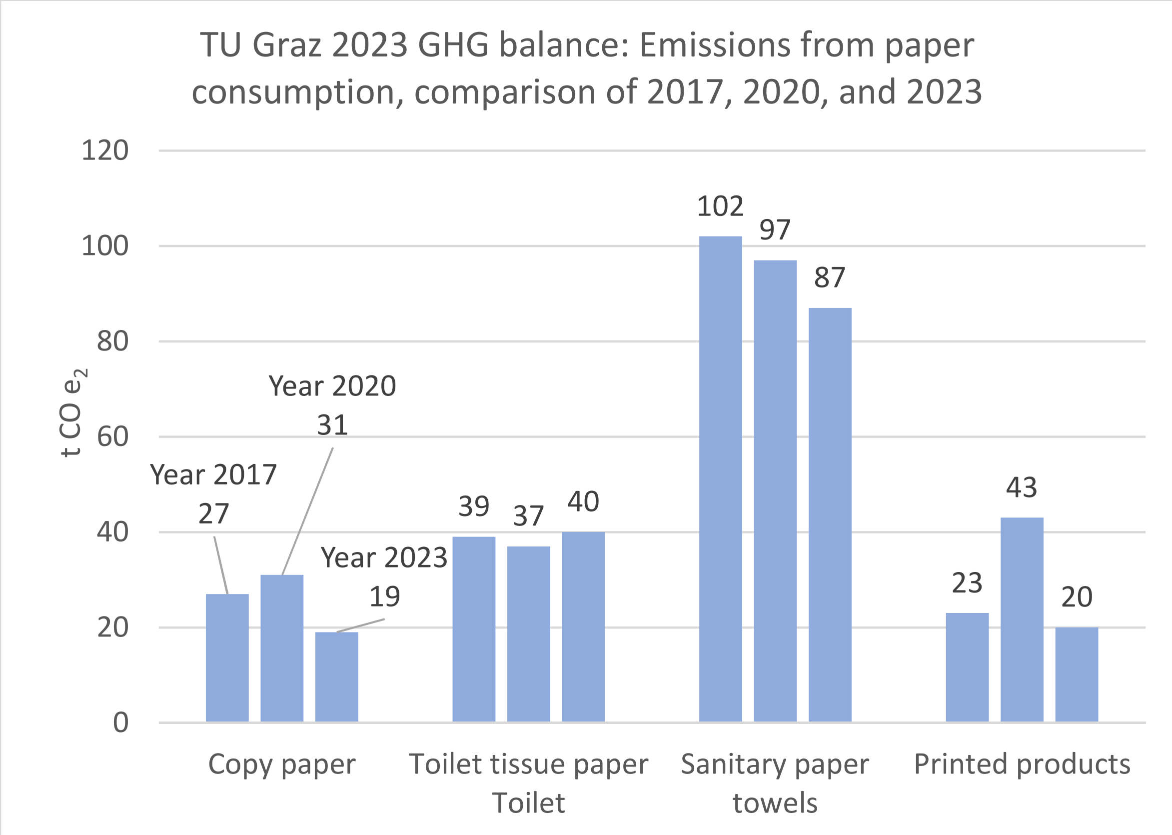

Figure30 : GHG balance 2023 of Graz University of Technology: emissions from paper consumption, comparison 2017, 2020 and 2023

Table 15: Comparison of paper use in 2023 with use in 2017 and 2020

Comparison of paper use in 2023 with use in 2017 and 2020			
	Consumption in kg	Emission factor in kg CO_2e/kg	Emissions in tonnes of CO_2e
2023			
Copy paper	18,785	1	19
Sanitary paper (toilet tissue)	13,212	3	40
Sanitary paper (paper towels)	28,960	3	87
Printed products	17,329	1.13	20
Total	**78,286**		**165**

2020			
Copy paper	31,383	1	31
Sanitary paper (toilet tissue)	12,194	3	37
Sanitary paper (paper towels)	32,267	3	97
Printed products	38,036	1.13	43
Total	**113,880**		**208**
2017			
Copy paper	25,827	1.0461	27
Sanitary paper (toilet tissue)	12,611	3.1088	39
Sanitary paper (paper towels)	32,894	3.1088	102
Printed products	20,315	1.1109	23
Total	**91,647**		**191**
Increase/decrease in %			
Copy paper	Minus 40%	Same EF used	Minus 39%
Sanitary paper (toilet tissue)	Plus 8%	Same EF used	Plus 7%
Sanitary paper (paper towels)	Minus 10%	Same EF used	Minus 10%
Printed products	Minus 54%	Same EF used	Minus 54%
Total	**Minus 31%**		**Minus 21%**

2.4.2 Refrigerant

The consumption of *refrigerants* increased sharply in 2023, from a total of 15 kg in 2022 to 50 kg in 2023, resulting in a 162% increase in emissions for this subcategory compared to 2022.

Table 16: Comparison of refrigerants use in 2023 with use in 2017 and 2020–2022

Comparison of refrigerants use in 2023 with use in 2017 and 2020–2022			
	Consumption in kg	Emission factor in kg CO_2e/kg	Emissions in tonnes CO_2e
2023			
R410A	33	2,102.5	69
R404a	17	3,936.6	67

Total	**50**		**136**
2022			
R407c	3	1,773.8500	5
R404a	12	3,922	47
Total	**15**		**52**
2021			
R410A	3	2,087.5000	6
R407c	108,5	1,773.8500	193
Total	**111,5**		**199**
2020			
R410A	17	2,102.5000	36
R407c	74	1,788.8500	132
R404a	11	3,936.6000	43
Total	**102**		**211**
2017			
R410A	1	2,087.5000	2
R404a	7	3,922.0000	27
Total	**8**		**30**
Increase/decrease in % (2022 to 2023)			
R404a	Plus 42%	Plus 0.4%	Plus 42%
Total	**Plus 233%**		**Plus 162%**

2.4.3 IT equipment

The reduction in GHG emissions in the *IT equipment* subcategory is mainly due to the fact that fewer notebooks, toner for laser and inkjet printers, and internal servers and screens were purchased and put into operation in 2023; in turn, this could also be due to a longer period of use. The decrease in the use of toner for laser and inkjet printers could have the same reason as the decrease in paper purchases, namely increasing digitalisation. Overall, the emissions in the *IT equipment* subcategory dropped by 22%.

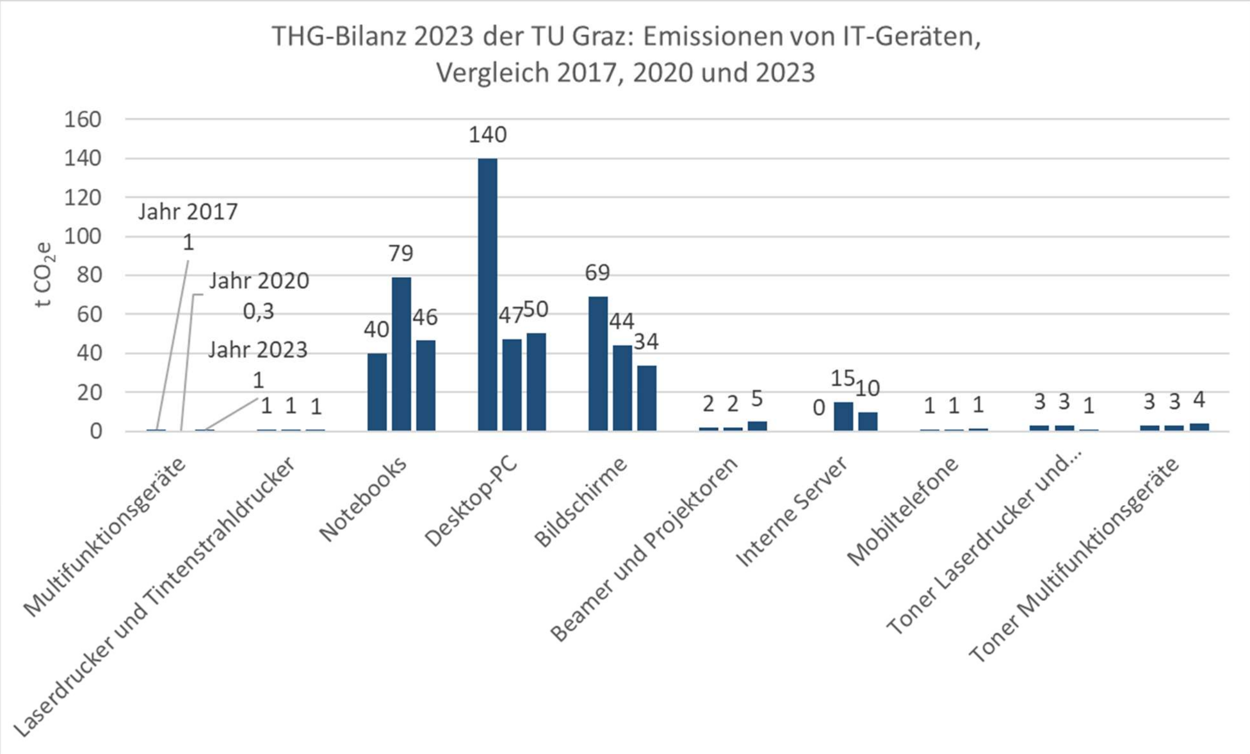

Figure 31: TU Graz 2023 GHG balance – Emissions from IT equipment, comparison of 2017, 2020, and 2023

Table 17: Comparison of IT equipment use in 2023 with use in 2017 and 2020

Comparison of IT equipment use in 2023 with use in 2017 and 2020			
	Purchase in pieces	Emission factor in kg CO_2e/pieces	Emissions in tonnes of CO_2e
2023			
Multifunctional devices	2	300	1
Laser printers and inkjet printers	10	63.6	1
Notebooks	270	172	46
Desktop PCs	223	226	50
Screens	96	350	34
Beamers and projectors	28	172	5
Internal servers	44	226	10
Mobile phones	35	38.8	1
Laser printers with toner and inkjet printers	66	14.1	1
Multifunctional devices with toner	270	14.1	4

Total	**1.044**		**153**
2020			
Multifunctional devices	1	300	0,3
Laser printers and inkjet printers	11	63.6	1
Notebooks	458	172	79
Desktop PCs	209	226	47
Screens	127	350	44
Beamers and projectors	12	172	2
Internal servers	65	226	15
Mobile phones	36	38.8	1
Laser printers with toner and inkjet printers	198	14.1	3
Multifunctional devices with toner	198	14.1	3
Total	**1.315**		**195**
2017			
Multifunctional devices	2	313.96	1
Laser printers and inkjet printers	8	62.792	1
Notebooks	280	141.37	40
Desktop PCs	517	270.22	140
Screens	204	336.39	69
Beamers and projectors	38	62.792	2
Internal servers	Included in desktop PC -		
Mobile phones	49	16	1
Laser printers with toner and inkjet printers	313	10.015	3
Multifunctional devices with toner	313	10.015	3
Total	**1,724**		**258**
Increase/decrease in %			
Multifunctional devices	Plus 100%	Same EF used	Plus 100%
Laser printers and inkjet printers	Minus 9%	Same EF used	Minus 36%
Notebooks	Minus 41%	Same EF used	Minus 41%
Desktop PCs	Plus 7%	Same EF used	Plus 7%
Screens	Minus 24%	Same EF used	Minus 24%
Beamers and projectors	Plus 133%	Same EF used	Plus 141%
Internal servers	Minus 32%	Same EF used	Minus 34%
Mobile phones	Minus 3%	Same EF used	Plus 36%

Laser printers with toner and inkjet printers	Minus 67%	Same EF used	Minus 69%
Multifunctional devices with toner	Plus 36%	Same EF used	Plus 27%
Total	**Minus 21%**		**Minus 22%**

2.5 Canteen

The *Canteen* category at TU Graz is divided into the *electricity*, *district heating,* and *food* subcategories. The data for this category were provided by the *Buildings and Technical Support* organisational unit (electricity, district heating) and the *Österreichische Mensen Betriebsgesellschaft mbH* (food). The total emissions amount to 287 tonnes of CO_2e for 2023, with the highest percentage of emissions coming from the *food* subcategory *(62%)*, followed by *electricity* (23%), and finally *district heating (15%)*.

Please note that the 2021 and 2022 GHG monitoring reports and the 2023 balance were calculated using the provisional emission factors.

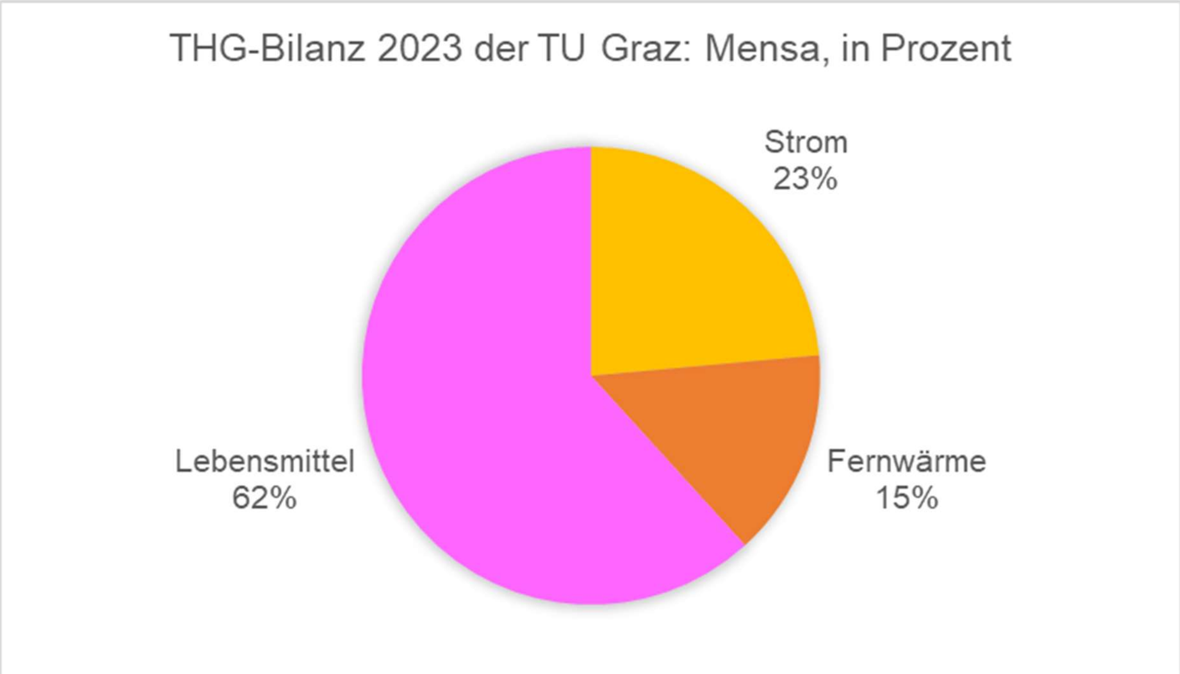

Figure 32: TU Graz 2023 GHG balance: Canteen, in %

Emissions from electricity consumption were higher in 2023 than in 2022, although the canteen on the Neue Technik campus is supplied with UZ 46-certified electricity. The GHG emissions calculated using the location-based EF are highlighted in light grey in Table 18 below. The increase in emissions can be explained by the fact that a new Mensen GesmbH location at Sandgasse 34 started operation in 2023; therefore, data for this location are included in a TU Graz balance for the first time. As Sandgasse is part of the Inffeldgasse campus and no UZ46 electricity has been purchased there yet, the impact is significant.

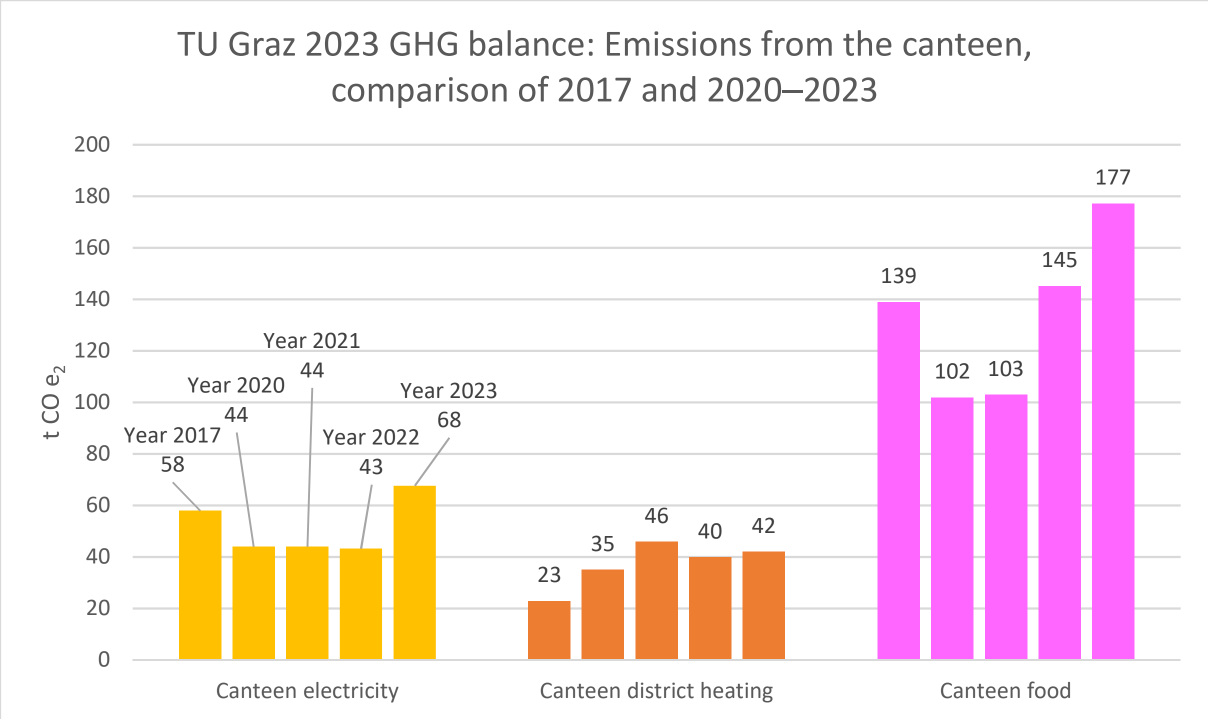

Figure 33: TU Graz 2023 GHG balance – Emissions from the canteen, comparison of 2017 and 2020–2023

Table 18: Comparison of canteen electricity in 2017 and 2020–2023

Comparison of canteen electricity in 2017 and 2020–2023			
	Consumption in kWh	Emission factor in kg CO_2e/kWh	Emissions in tonnes CO_2e
2023			
Electricity **without** UZ 46 certification (location-based EF)	294,310	0.226	67
Electricity **with** UZ 46 certification (market-based EF)[4]	94,661	0.012	1

[4] market-based = calculation of GHG emissions by purchase (UZ 46 is considered);

Total electricity (location-based)[5]	388,971	0.226	88
Total	**388,971**		**68**
2022			
Electricity **without** UZ 46 certification (location-based EF)	192,266	0.2190	42
Electricity **with** UZ 46 certification (market-based)	84,436	0.0140	1
Total electricity (location-based)	276,692	0.2190	61
Total	**276,692**		**43**
2021	199,342	0.2190	**44**
2020	202,984	0.2030	**41**
2017	225,000	0.2573	**58**
Increase/decrease in % (2022 to 2023) electricity **incl.** UZ 46 certification	**Plus 41%**		**Plus 57%**

Table 19: Comparison of canteen district heating in 2017 and 2020–2023

Comparison of canteen district heating in 2017 and 2020–2023			
	Consumption in kWh	Emission factor in kg CO_2e/kWh	Emissions in tonnes CO_2e
2023	168,720	0.25	42
2022	131,240	0.3079	40
2021	149,000	0.3079	46
2020	112,471	0.309	35

[5] location-based = calculation of GHG emissions by location (UZ 46 is not considered)

2017	66,000	0.3487	23
Increase/decrease in % (2021 to 2022)			
	Plus 29%	**Minus 19%**	**Plus 5%**

Emissions from district heating also increased by 5% in 2023 compared to 2022 due to the new canteen location. This small increase can be explained by the lower emission factor (minus 19%) for district heating.

The picture is similar for food. Here, consumption increased by 24% in 2023, while emissions were 22% in 2023 than 2022. Despite the new location, it is important to mention that the consumption of beef was 8% lower in 2023 than in 2022. This is an important aspect, because beef has by far the largest emission factor among the reported foods.

Table 20: Comparison of canteen food in 2017 and 2020–2023

Comparison of canteen food in 2017 and 2020–2023			
	Consumption in kg	Emission factor in kg CO_2e/kg	Emissions in tonnes CO_2e
2023			
Beef	1,713	13.5	23
Pork	10,725	5	54
Poultry	7,690	2.5	19
Fish	4,470	6.5	29
Fats and oils	8,700	6	52
Total	**33,298**		**177**
2022			
Beef	1,868	13.3	25
Pork	5,470	5.5	30
Poultry	9,724	3.2	31
Fish	2,980	6.5	19
Fats and oils	6,911	5.7592	40
Total	**26,953**		**145**
2021			
Beef	2,088	13.3	28
Pork	3,585	5.5	20
Poultry	4,838	3.2	15
Fish	2,340	6.5	15
Fats and oils	4,280	5.7592	25
Total	**17,131**		**103**
2020			
Beef	1,813	13.5	24
Pork	1,768	5	9
Poultry	9,834	3.5	34

Fish	2,092	6.5	14
Fats and oils	3,948	6	24
Total	**19,455**		**105**
2017			
Beef	2,799	13.3	37
Pork	5,063	5.5	28
Poultry	6,616	3.2	21
Fish	3,295	6.5	21
Fats and oils	5,447	5.7592	31
Total	**23,220**		**139**
Increase/decrease in % (2021 to 2022)			
Beef	Minus 8%	Plus 2%	Minus 8%
Pork	Plus 96%	Minus 9%	Plus 79%
Poultry	Minus 21%	Minus 22%	Minus 38%
Fish	Plus 50%	Same EF used	Plus 53%
Fats and oils	Plus 26%	Plus 4%	Plus 31%
Total	**Plus 24%**		**Plus 22%**

2.6 New buildings/renovations

There were no significant new buildings or renovations in 2023.

3 Key figures

Depending on their significance, the key figures were rounded up to one or two decimal places or to one decimal place. The following table shows a general comparison of the key figures for the years 2017 and 2020–2023.

Please note that the 2021 and 2022 GHG monitoring reports and the 2023 balance were calculated using provisional emission factors.

Staff categories (see p.5+6):
A: According to the respective intellectual capital report
B: Shareholdings/competence centres
C: External companies with rental agreements and with use of the campus car parks
D: External companies with rental agreements and without use of the campus car parks

3.1 Key figures for energy and total emissions

1. TU Graz electricity consumption (excl. heat pumps + charging stations, incl. PV + canteen) per staff member (individual: A+B+C+D)		
2023	**5,675**	kWh per individual
2022	**6,552**	kWh per individual
2021	**6,306**	kWh per individual
2020	**6,050**	kWh per individual
2017	**8,240**	kWh per individual

2. TU Graz electricity consumption (excl. heat pumps + charging stations, incl. PV + canteen) per staff member (FTE: A+B+C+D)		
2023	**8.161**	kWh per FTE
2022	**9.400**	kWh per FTE
2021	**9.224**	kWh per FTE
2020	**9.076**	kWh per FTE
2017	**12.130**	kWh per FTE

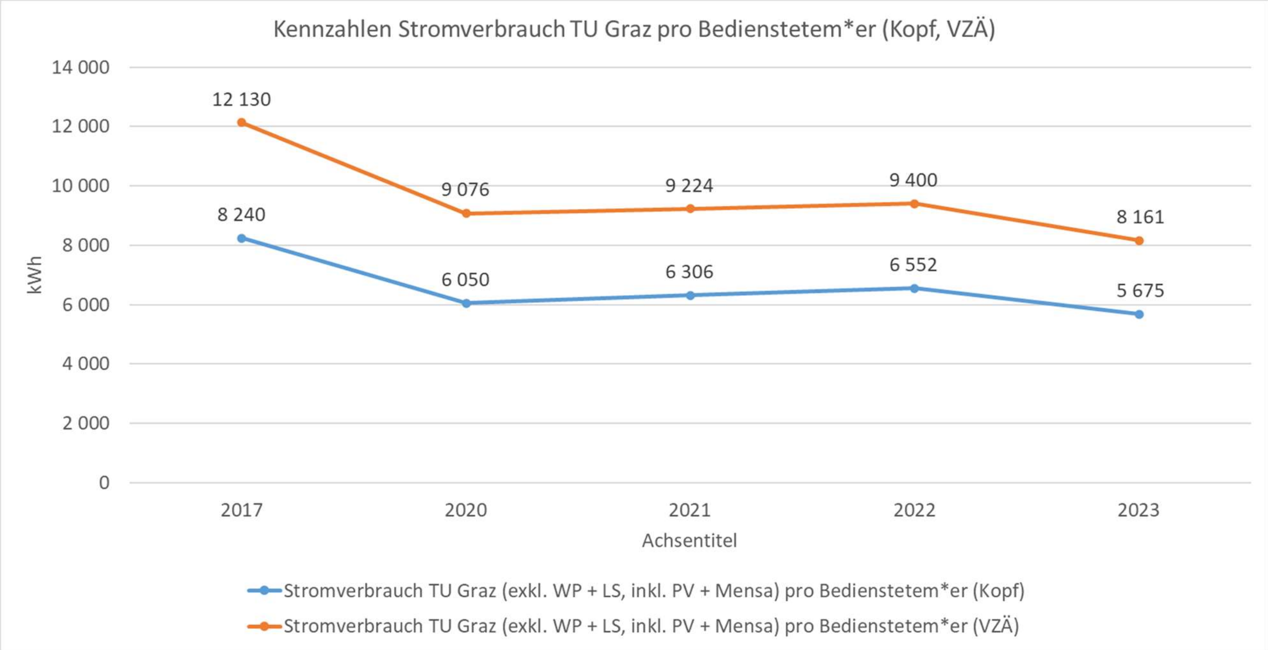

Figure 34: Key figures for electricity consumption at TU Graz per staff member (individual, FTE)

3. TU Graz electricity consumption (excl. electricity consumption heat pumps + charging stations, incl. PV + canteen) per m^2 total net floor area		
2023	**107**	kWh per m^2
2022	**111**	kWh per m^2
2021	**121**	kWh per m^2
2020	**116**	kWh per m^2
2017	**127**	kWh per m^2

4. TU Graz heat consumption (incl. electricity consumption heat pumps and canteen) per m^2 net floor area heated		
2023	**57**	kWh per m^2
2022	**65**	kWh per m^2
2021	**85**[6]	kWh per m^2
2020	**75**	kWh per m^2
2017	**91**	kWh per m^2

[6] This value has changed, as the heat consumption of the canteen was not added to the total heat requirement in the provisional 2021 balance.

4.a TU Graz district heating consumption per m² of net floor area heated with district heating, adjusted by heating degree day number (3,635.48 = mean value 2011–2019, 15/23 °C)[7]			Heating degree day number
2023	**70.6**	kWh per m²	3,482
2022	**81.6**	kWh per m²	3,558
2021	**87.9**	kWh per m²	3,949
2020	**84.6**	kWh per m²	3,627
2019	**85.3**	kWh per m²	3,467
2018	**92.3**	kWh per m²	3,467
2017	**87.5**	kWh per m²	3,853
2016	**90.5**	kWh per m²	3,719
2015	**91.0**	kWh per m²	3,581
2014	**90.5**	kWh per m²	3,336
2013	**98.9**	kWh per m²	3,880

[7] The calculation of the adjusted heating degree day key figure for district heating consumption was carried out as follows at TU Graz in the years 2013–2023: If the average daily temperature was below 15 °C, heating was provided at TU Graz at 23 °C. Depending on how many degrees the average daily temperature was below 15 °C, a higher or lower heating degree day figure was entered for that day (23 °C minus the average daily temperature). These figures were totaled for an entire year to form an average value for the years 2011–2019. Using this mean value and the following calculation, "Heating degree day number of the year divided by the mean value, multiplied by the current district heating consumption in kWh", the district heating consumption for the current year can be adjusted according to the number of heating degree days. To obtain the key figure, this value is then divided by the m² net floor area that was heated with district heating in the respective year.

Figure 35: Heating demand (district heating) at TU Graz from 2013–2021 and target value 2030

5. TU Graz electricity generation via PV (= electricity consumption PV), per staff member (FTE: A+B+C+D)		
2023	**211**	kWh per FTE
2022	**153**	kWh per FTE
2021	**132**	kWh per FTE
2020	**165**	kWh per FTE
2017	**52**	kWh per FTE

6. Emissions from electricity consumption at TU Graz (excl. electricity consumed by heat pumps, incl. PV + canteen) per staff member (FTE: A+B+C+D)		
2023	**1,149**	kg CO_2e per FTE
2022	**1,217**	kg CO_2e per FTE
2021	**2,010**	kg CO_2e per FTE
2020	**1,806**	kg CO_2e per FTE
2017	**3,120**	kg CO_2e per FTE

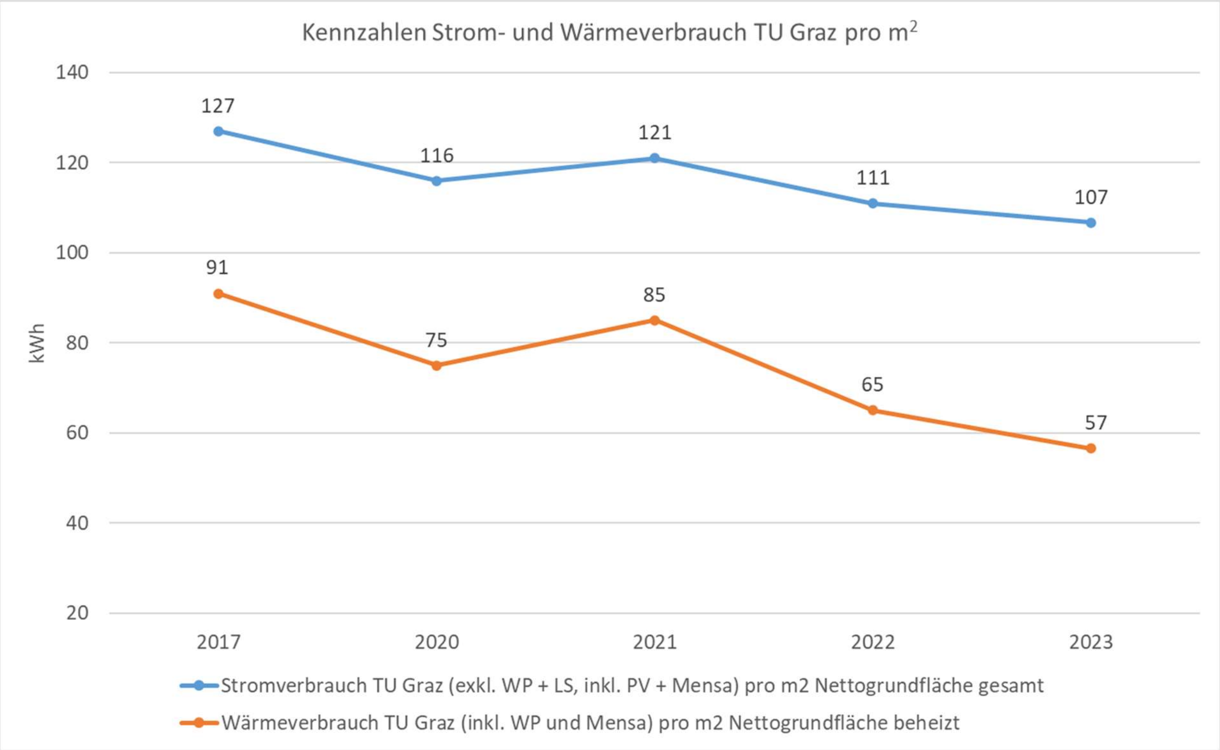

Figure 36: Key figures for electricity and heat consumption at TU Graz per m²

7. Emissions from heat consumption (district heating, natural gas, heat pumps) at TU Graz per m² net floor area heated		
2023	**14**	kg CO_2e per m²
2022	**20**	kg CO_2e per m²
2021	**25**	kg CO_2e per m²
2020	**23**	kg CO_2e per m²
2017	**21**	kg CO_2e per m²

8. Total emissions at TU Graz per student		
2023	**1,149**	kg CO_2e per individual
2022	**1,399**	kg CO_2e per individual

2021	**1,015**	kg CO_2e per individual
2020	**1,065**	kg CO_2e per individual
2017	**1,630**	kg CO_2e per individual

9. Total emissions at TU Graz per staff member (individual: A+B+C+D)		
2023	**3.632**	kg CO_2e per individual
2022	**4.728**	kg CO_2e per individual
2021	**3.328**	kg CO_2e per individual
2020	**3.285**	kg CO_2e per individual
2017	**7.390**	kg CO_2e per individual

10. Total emissions at TU Graz per staff member (FTE: A+B+C+D)		
2023	**5.225**	kg CO_2e per FTE
2022	**6.783**	kg CO_2e per FTE
2021	**4.868**	kg CO_2e per FTE
2020	**4.928**	kg CO_2e per FTE
2017	**10.880**	kg CO_2e per FTE

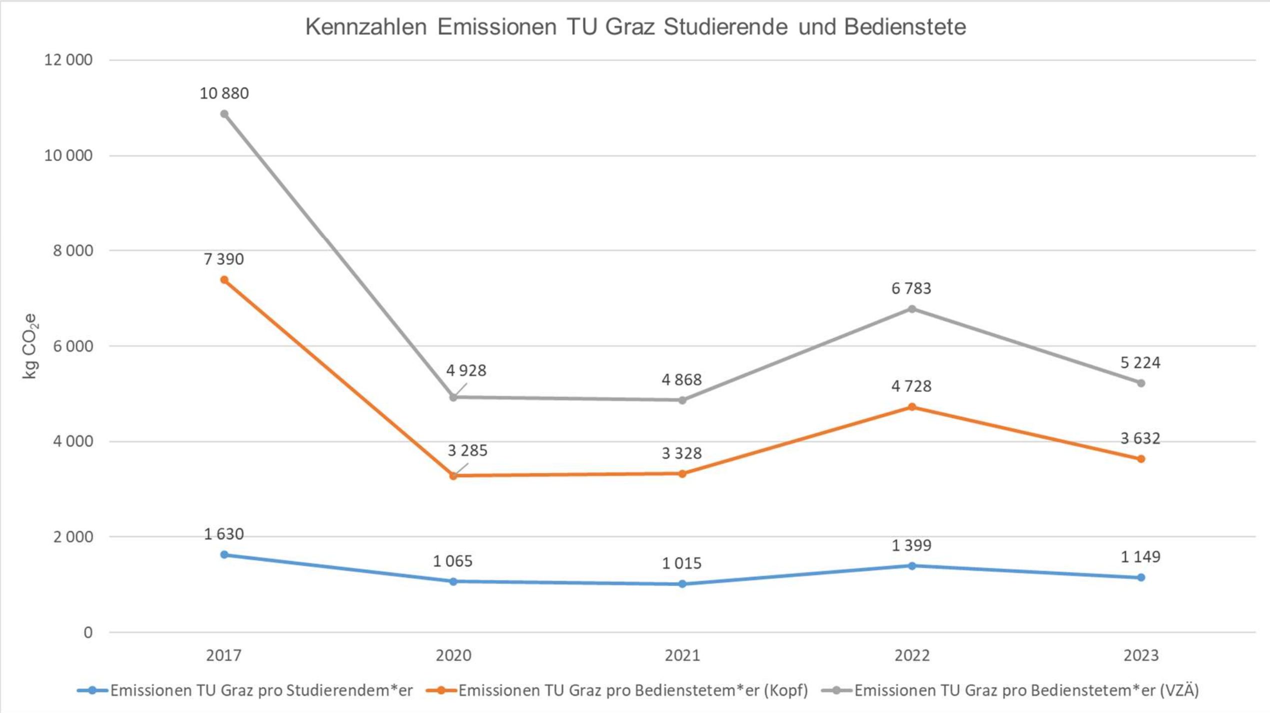

Figure 37: Key emissions figures at TU Graz for students and staff

11. Total TU Graz emissions per m^2 total net floor area		
2023	**68**	kg CO_2e per m^2
2022	**80**	kg CO_2e per m^2
2021	**64**	kg CO_2e per m^2
2020	**62**	kg CO_2e per m^2
2017	**114**	kg CO_2e per m^2

12. Total TU Graz emissions per m^2 net floor area heated		
2023	**76**	kg CO_2e per m^2
2022	**89**	kg CO_2e per m^2
2021	**70**	kg CO_2e per m^2
2020	**68**	kg CO_2e per m^2
2017	**126**	kg CO_2e per m^2

13. Total TU Graz emissions per € 1,000 turnover		
2023	**62**	kg CO_2e per T-EUR
2022	**79**	kg CO_2e per T-EUR
2021	**60**	kg CO_2e per T-EUR
2020	**59**	kg CO_2e per T-EUR
2017	**108**	kg CO_2e per T-EUR

3.2 Key figures for mobility

1. Modal split for TU Graz staff commuting (A+B) in 2024, local and inbound commuters, main modes of transport (Herry 2024)		
On foot	**12**	%
Bicycle	**44**	%
Motorised individual vehicle (MIV)	**18**	%
Public transport (ÖPNV)	**25**	%

1a. For comparison: Modal split for TU Graz staff commuting (A+B) in 2019, local and inbound commuters, main modes of transport (Forstner 2021)		
On foot	**13**	%
Bicycle	**46**	%
Motorised individual vehicle (MIV)	**21**	%
Public transport (ÖPNV)	**20**	%

1b. For comparison: Modal split for work commuters to the city of Graz in 2013/14, local and inbound commuters, main modes of transport (Forstner 2021, Österreich unterwegs 2013/14)		
On foot	**7**	%
Bicycle	**15**	%
Motorised individual vehicle (MIV)	**56**	%
Public transport (ÖPNV)	**22**	%

2. Modal split for TU Graz staff commuting (A+B) in 2024, local commuters, main modes of transport (Herry 2024)		
On foot	**16**	%
Bicycle	**58**	%
Motorised individual vehicle (MIV)	**7**	%
Public transport (ÖPNV)	**18**	%

2a. For comparison: Modal split commuting of employees (A+B) TU Graz 2019, internal commuters, main means of transport (Forstner 2021)		
On foot	**17**	%
Bicycle	**59**	%
Motorised individual vehicle (MIV)	**9**	%
Public transport (ÖPNV)	**14**	%

2b. For comparison: Modal split for work commuters to the city of Graz in 2021, local commuters, main modes of transport (City of Graz 2022)		
On foot	**10**	%
Bicycle	**28**	%
Motorised individual vehicle (MIV)	**42**	%
Public transport (ÖPNV)	**20**	%

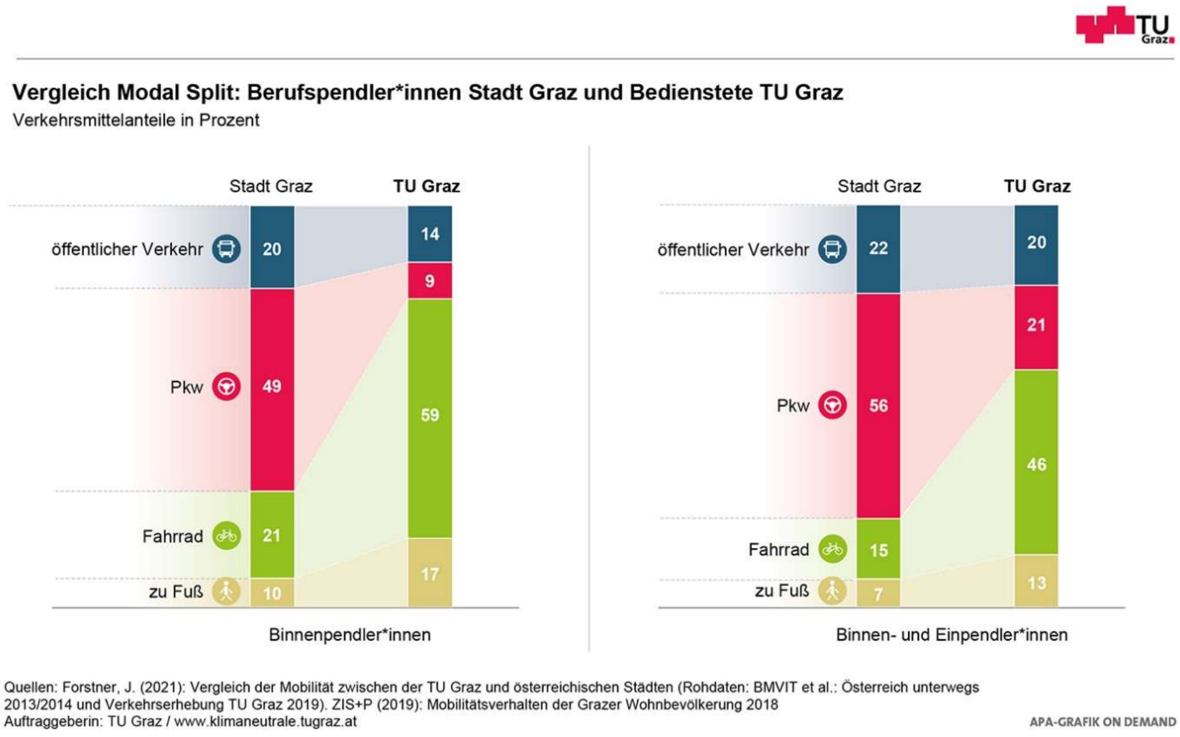

Figure 38: Comparison of modal split – City of Graz and TU Graz staff commuters (2019)

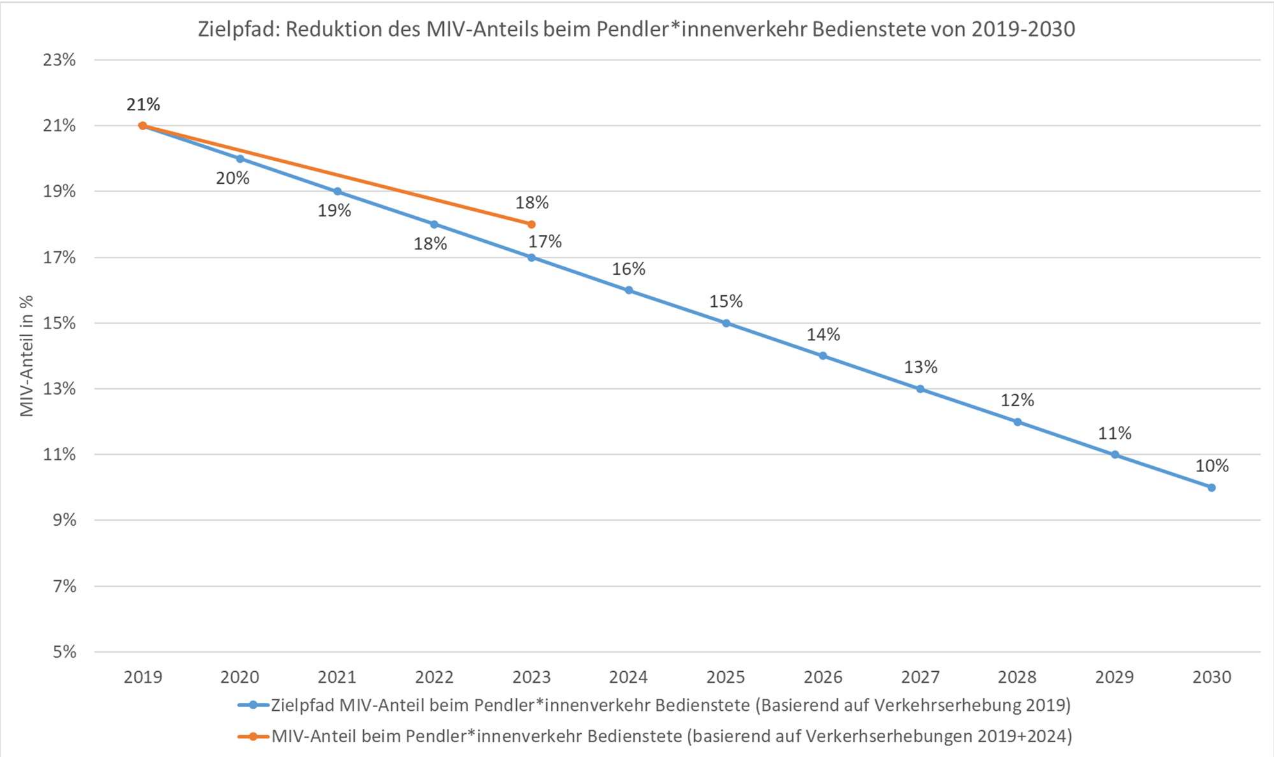

Figure 39: Target path – Reduction in the proportion of commuter traffic by staff using private cars from 2019 to 2030

3. Modal split for TU Graz students commuting in 2024, local and inbound commuters, main modes of transport (Herry 2024)		
On foot	**16**	%
Bicycle	**39**	%
Motorised individual vehicle (MIV)	**8**	%
Public transport (ÖPNV)	**38**	%

3a. For comparison: Modal split for TU Graz students commuting in 2019, inbound and outbound commuters, main modes of transport (Forstner 2021)		
On foot	**19**	%
Bicycle	**52**	%
Motorised individual vehicle (MIV)	**7**	%
Public transport (ÖPNV)	**22**	%

3b. For comparison: Modal split for those commuting to educational institutions in the city of Graz in 2013/14, local and inbound commuters, main modes of transport (Forstner 2021, Österreich unterwegs 2013/14)		
On foot	**11**	%
Bicycle	**19**	%
Motorised individual vehicle (MIV)	**22**	%
Public transport (ÖPNV)	**48**	%

4. Modal split for TU Graz students commuting in 2024, local commuters, main modes of transport (Herry 2024)		
On foot	**20**	%
Bicycle	**48**	%
Motorised individual vehicle (MIV)	**2**	%
Public transport (ÖPNV)	**30**	%

4a. For comparison: Modal split for TU Graz students commuting in 2019, local commuters, main modes of transport (Forstner 2021)		
On foot	**21**	%
Bicycle	**60**	%
Motorised individual vehicle (MIV)	**3**	%
Public transport (ÖPNV)	**16**	%

4b. For comparison: Modal split for those commuting to educational institutions in the city of Graz in 2013/14, local commuters, main modes of transport (Forstner 2021, Österreich unterwegs 2013/14)		
On foot	**16**	%
Bicycle	**26**	%
Motorised individual vehicle (MIV)	**14**	%
Public transport (ÖPNV)	**44**	%

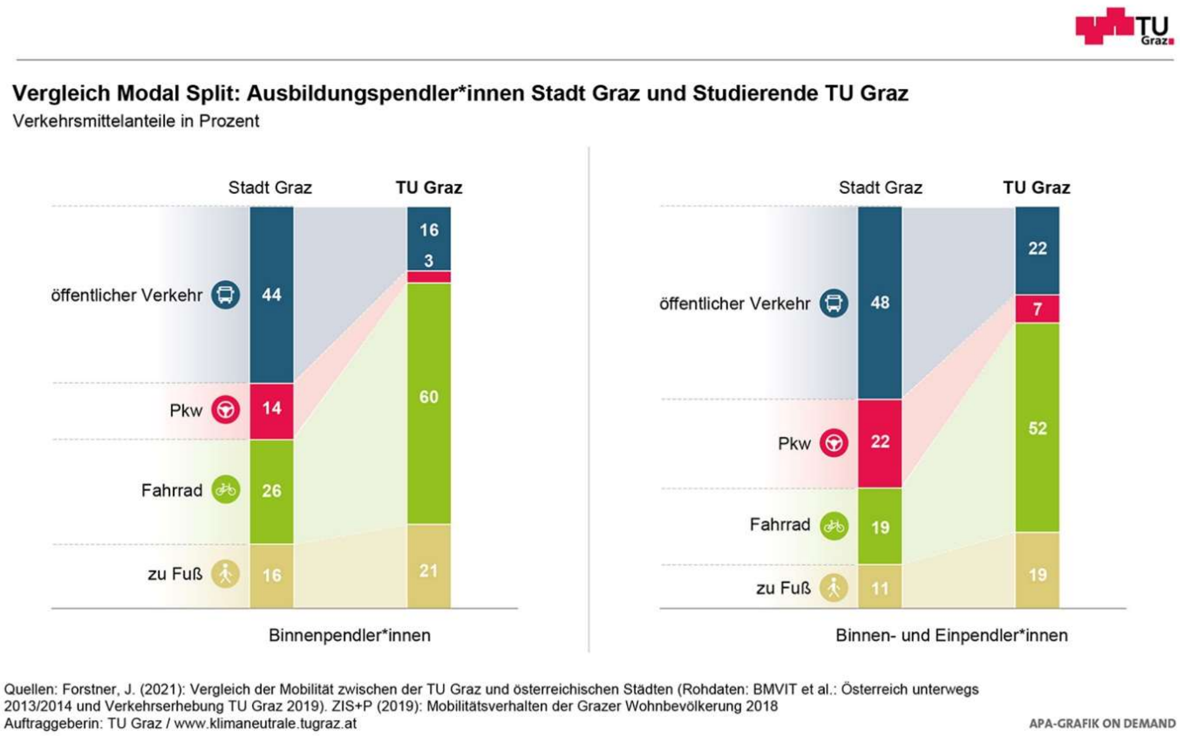

Figure 40: Comparison of modal split - City of Graz and TU Graz students commuting to educational institutions (2019)

5. Modal split for staff business trips (A) by total kilometres travelled		
2023 Motorised individual vehicle (MIV) Public transport (ÖPNV) Aeroplane	**6** **14** **79**	% % %
2022 Motorised individual vehicle (MIV) Public transport (ÖPNV) Aeroplane	**6** **18** **76**	% % %
2021 Motorised individual vehicle (MIV) Public transport (ÖPNV) Aeroplane	**18** **15** **67**	% % %
2020 Motorised individual vehicle (MIV) Public transport (ÖPNV) Aeroplane	**18** **15** **67**	% % %
2017 Motorised individual vehicle (MIV) Public transport (ÖPNV) Aeroplane	**6** **15** **79**	% % %

6. Modal split for staff business trips (A) by main mode of transport		
2023 Motorised individual vehicle (MIV) Public transport (ÖPNV) Aeroplane	**27** **39** **34**	% % %
2022 Motorised individual vehicle (MIV) Public transport (ÖPNV) Aeroplane	**37** **35** **28**	% % %

7. Modal split for staff stays abroad (A) by main mode of transport		
2023 Motorised individual vehicle (MIV) Public transport (ÖPNV) Aeroplane	 **6** **40** **53**	 % % %
2022 Motorised individual vehicle (MIV) Public transport (ÖPNV) Aeroplane	 **16** **24** **60**	 % % %

8. Flight emissions of staff (stays abroad and business trips) per staff member (individual: A)[8]		
2023	**1,150**	kg CO_2e per individual
2022	**739**	kg CO_2e per individual
2021	**139**	kg CO_2e per individual
2020	**341**	kg CO_2e per individual
2017	**1,554**	kg CO_2e per individual

[8] All values for this key figure have updated due to an incorrect assumption. Until now, the number of staff (headcount: A+B) was used to obtain this key figure. However, as the flight emissions from business trips and stays abroad were only recorded for category A staff, the key figures for 2017–2022 had to be recalculated.

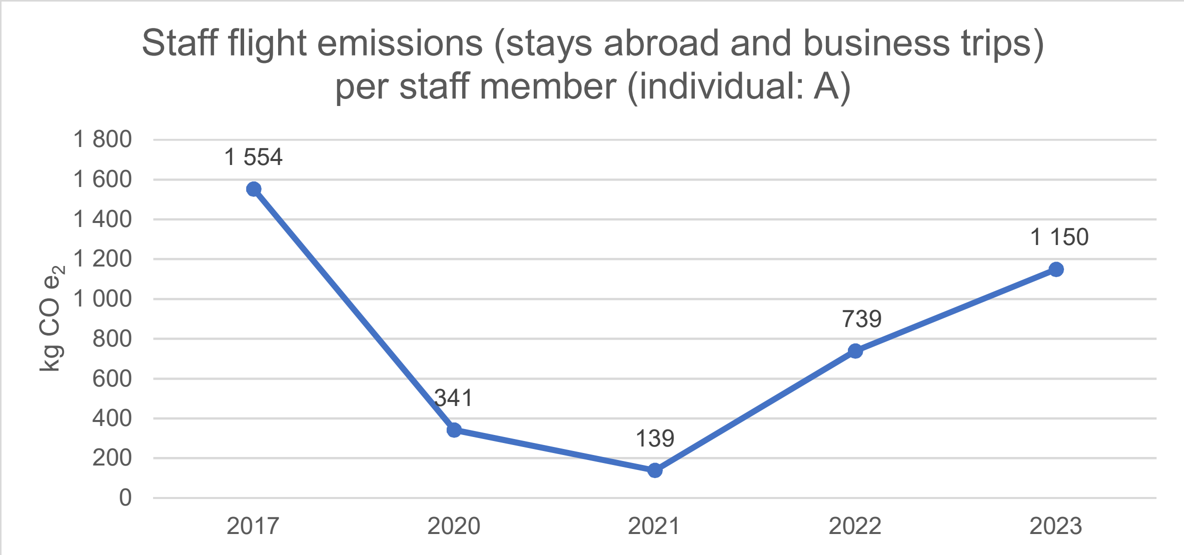

Figure 41: Staff flight emissions (stays abroad and business trips) per staff member (individual: A)

9. Parking spaces per staff member (individual: A+B+C		
2023 (614 parking spaces)[9]	**0.12**	Parking spaces per individual
2022 (614 parking spaces)	**0.13**	Parking spaces per individual
2021 (614 parking spaces)	**0.13**	Parking spaces per individual
2020 (614 parking spaces)	**0.13**	Parking spaces per individual
2017 (632 parking spaces)	**0.17**	Parking spaces per individual

[9] Number of parking spaces taken from Nagy 2024

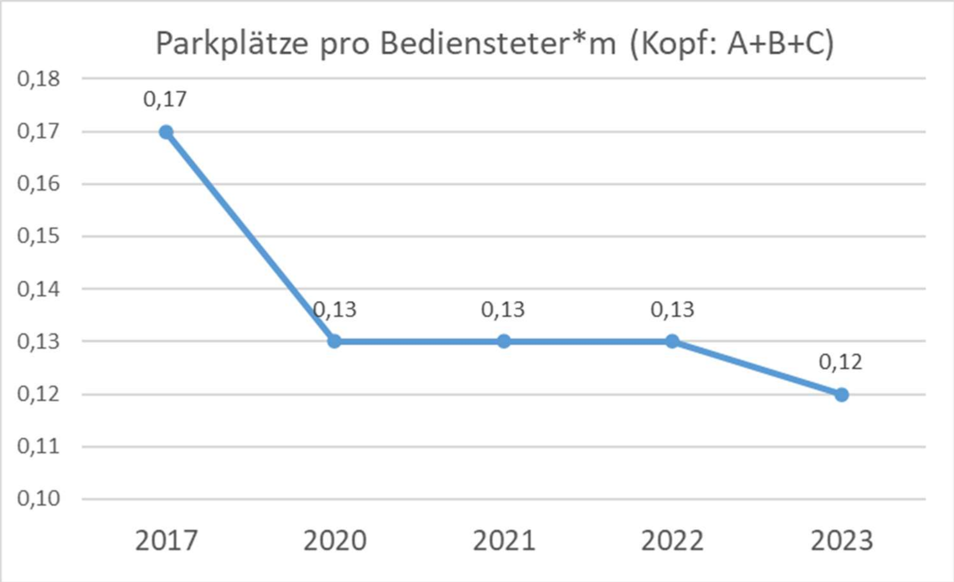

Figure 42: Parking spaces per staff member (individual: A+B+C)

3.3 Key figures for food

1. Emissions from beef per individual (students and staff (A+B+C+D))		
2023	**1,1**	kg CO_2e per individual
2022	**1,2**	kg CO_2e per individual
2021	**1,3**	kg CO_2e per individual
2020	**1,1**	kg CO_2e per individual
2017	**1,8**	kg CO_2e per individual

4 Recommendations

1. **Precise analysis of journeys within Europe**

Due to the very high emissions in the area of staff mobility, particularly for business trips and stays abroad, a detailed analysis of all trips taken within Europe should be carried out in 2024. A central element of the analysis is the identification of frequent destinations and the modes of transport used. This enables the determination of whether the trips could also be made using more environmentally friendly modes of transport. A special focus should be placed on short- and medium-haul flights, which could be replaced by train or bus travel, leading to significant reductions in emissions.
Based on this analysis, stricter travel guidelines can be formulated that include clear requirements for the choice of environmentally friendly modes of transport and the use of virtual means of communication. In addition, further incentive programmes for sustainable travel can be implemented. These measures will not only help to reduce GHG emissions, but also to promote awareness of sustainable behaviour at the university.

2. **Further reduction in the proportion of commuter traffic by private motorised vehicle**

In addition to cycling and walking, public transport is the most attractive alternative to using a private car for the daily commute. The approximately 700 staff members (Nagy 2024, as of 2023) at TU Graz who still commute to work by car are being offered an important incentive to switch to public transport, namely through the promotion of the Styrian Climate Ticket and the Austrian Climate Ticket (*Klimatickets*). Criteria for receiving this award are "no parking permit", "no bicycle subsidy in the last 3 years", and "more than 10 hours/week of employment". Both variants of the climate ticket have been subsidised by TU Graz with € 150 each since 1.1.2022. A target pathway for reducing private transport was defined (see *Figure 39*). In order to comply with this target pathway, further measures should be adopted and implemented:

(1) Increase charges for parking in the car park
(2) Extend the "exclusion zone" to 4 km
(3) Improve bicycle paths to and between the campuses (especially the Inffeldgasse–Opera route)
(4) Create more traffic-calmed zones (pedestrian zones, meeting zones) within and around the campuses (especially in the Inffeldgasse, Rechbauerstraße)
(5) Establish a blue parking zone around the Inffeldgasse campus

3. **Reduction of "grey GHG emissions" caused by new buildings and renovations**

New buildings and the renovation of buildings at TU Graz create considerable GHG emissions. An urgent recommendation is made to define measures that can be taken to significantly reduce emissions associated with the next buildings in planning.

5 List of figures and tables

List of figures

List of tables

6 List of sources

Allianz Nachhaltige Universitäten in Österreich 2022. Arbeitsgruppe Klimaneutrale Universitäten & Hochschulen. Website of the Alliance of Sustainable Universities in Austria. Available online: https://nachhaltigeuniversitaeten.at/arbeitsgruppen/co2-neutrale-universitaeten/ Accessed on: 14.07.23

Alliance of Sustainable Universities in Austria 2022 *ClimCalc,* version climcalc_v2.1_EF2019. Website of the Alliance of Sustainable Universities in Austria. Available online: https://nachhaltigeuniversitaeten.at/arbeitsgruppen/co2-neutrale-universitaeten/ Accessed on: 01.05.24

Alliance of Sustainable Universities in Austria 2022 *ClimCalc,* version climcalc_v2.5_EF2017. Website of the Alliance of Sustainable Universities in Austria. Available online: https://nachhaltigeuniversitaeten.at/arbeitsgruppen/co2-neutrale-universitaeten/ Accessed on: 01.05.24

Alliance of Sustainable Universities in Austria 2022 *ClimCalc,* Version climcalc_v3.1.3_EF2020. Website of the Alliance of Sustainable Universities in Austria. Available online: https://nachhaltigeuniversitaeten.at/arbeitsgruppen/co2-neutrale-universitaeten/ Accessed on: 01.05.24

Alliance of Sustainable Universities in Austria 2022 *ClimCalc,* Version climcalc_v3.2_EF2021. Website of the Alliance of Sustainable Universities in Austria. Available online: https://nachhaltigeuniversitaeten.at/arbeitsgruppen/co2-neutrale-universitaeten/ Accessed on: 01.05.24

Cehajic, Adelisa 2023. Klimafreundliches Mobilitätsmanagement an der TU Graz unter besonderer Berücksichtigung der Dienstreisen. Bachelor's thesis submitted to TU Graz for the Bachelor's Degree Programme in Environmental Systems Science / Natural Sciences Technology

Eder, Brigitte and Getzinger, Günter 2024. Methode zur Schnellbilanzierung der „grauen" Emissionen universitärer Neubauten. Am Beispiel des Gebäudekomplexes DH/SAL der TU Graz, in print

Forstner, Jürgen 2021. Comparison of mobility between Graz University of Technology and Austrian cities. Master's thesis submitted to the Institute of Road and Transport Engineering at TU Graz.

Getzinger, Günter 2021: Roadmap Climate Neutral TU Graz 2030 - First progress report to the Rectorate of TU Graz

Häller, Franziska, Ensbacher, Florian and Getzinger, Günter 2024. Treibhausgasbilanz 2020 der TU Graz: und Vergleich mit dem Jahr 2017, final version. STS Unit TU Graz.

Häller, Franziska, Ensbacher,Florian, Zieser, Isabella and Getzinger, Günter 2024. Vorläufiges Treibhausgas-Monitoring 2022 der TU Graz: und Vergleich mit den THG-

Bilanzen 2017 und 2020 und mit dem Monitoring 2021. Preliminary version. STS Unit TU Graz.

Häller, Franziska and Getzinger, Günter 2022. Vorläufiges Treibhausgas-Monitoring 2021 der TU Graz: und Vergleich mit den THG-Bilanzen 2017 und 2020. Preliminary version. STS Unit TU Graz. Available online: https://graz.elsevierpure.com/de/publications/vorl%C3%A4ufiges-treibhausgas-monitoring-2021-der-tu-graz-und-vergleic Retrieved on: 28.11.23

Häller, Franziska, Günter Getzinger 2023: Roadmap Klimaneutrale TU Graz 2030 - second progress report to the TU Graz Rectorate

Häller, Franziska, Lilia Yang, Günter Getzinger 2024: Roadmap Klimaneutrale TU Graz 2030 - third progress report on the year 2023 to the TU Graz Rectorate

Herry Consult 2024: TU Graz: Mobility survey at Styrian universities

Nagy, Lukas 2024. Mobilitätsmanagement der Technischen Universität Graz - Einrichtung eines Dashboards. Bachelor thesis submitted to the TU Graz, in print

Österreich Unterwegs 2013/14. "Österreich unterwegs 2013/2014: Methodenbericht zum Arbeitspaket 'Datenverarbeitung, Hochrechnung und Analyse'" Available online: https://www.bmk.gv.at/dam/jcr:106bc97e-b03f-4e38-9c6b-bf57680616dc/oeu_2013-2014_Methodenbericht_AP_Datenverarbeitung-Hochrechnung-Analyse.pdf Accessed on: 14.07.23

Passer, Alexander and Maier, Stephan 2020. Treibhausgasbilanz der TU Graz 2017, finale Version. *THG-Bilanz TU Graz 2017*. TU Graz Sustainable Construction Working Group. Available online: https://graz.elsevierpure.com/en/publications/treibhausgasbilanz-der-tu-graz-2017-thg-bilanz-tu-graz-2017 Retrieved on: 28.11.23

City of Graz 2019. "Mobilitätsverhalten der Grazer Wohnbevölkerung 2018". Department of Transport Planning, City of Graz