UTN

Technische Universität Nürnberg

Climate Action Plan

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NATIONALE KLIMASCHUTZ INITIATIVE

Legal notice

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Preface

Dear reader,

The University of Technology Nuremberg (UTN) sees itself as a learning organisation with a special responsibility to contribute to overcoming current ecological and social challenges. Sustainability and climate action play a special role in our research, teaching and learning activities, as well as in our transfer activities and in the development of our campus, and are equally important in the technical sciences, humanities and social sciences. For us, scientific excellence and social responsibility go hand in hand at all levels.

With the UTN Climate Action Plan, we are taking another important step on our path to becoming a sustainable and climate-neutral university. Our Plan builds on existing measures, but also aims to provide new impetus for more efficient processes, resource-saving practices and a fundamental rethink in research, teaching and administration. We hope to further develop our university not only as a place of academic excellence, but also position it as a model for sustainable transformation.

We can achieve these goals only by working together. With the support of our committed university community, we want to become a pioneer in university climate Action and thus make an effective contribution to overcoming the global climate crisis. I would like to thank everyone who contributed to the development of the UTN Climate Action Plan, especially my colleagues from the Sustainability department, the participating departments and all the committed members of our university community.

Together, we will put UTN on a more sustainable path and face the challenges of the future. Let us tackle this task with determination and with our combined strength.

Prof. Dr. Michael Huth
Founding President of the University

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AfA	Depreciation for wear and tear (*Absetzung für Abnutzung*)
AI	artificial intelligence
Bafa	Federal Office of Economics and Export Control (*Bundesamt für Wirtschaft und Ausfuhrkontrolle*)
BayCalc	Bavarian GHG accounting tool for universities
BayHIG	Bavarian Higher Education Innovation Act (*Bayerisches Hochschulinnovationsgesetz*)
BayKlimaG	Bavarian Climate Protection Act (*Bayerisches Klimaschutzgesetz*)
BayZeN	Centre for Higher Education and Sustainability Bavaria
BEV	Battery electric vehicle
BMWK	Federal Ministry for Economic Affairs and Climate Action (*Bundesministerium für Wirtschaft und Klimaschutz*)
BNB	Sustainable Building Assessment System (*Bewertunsgssystem Nachhaltiges Bauen*)
CO_2	Carbon dioxide
CO_2e	CO_2 equivalents
DB	Deutsche Bahn (German railway company)
EMAS	Eco-Management and Audit Scheme
GEMIS	Global emissions model for integrated systems
GHG	greenhouse gas
GHG Protocol	Greenhouse Gas Protocol
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
HIS-HE	Institute for Higher Education Development (*Institut für Hochschulentwicklung*)
IT	Information Technology
KSG	Climate Action Act (Germany) (*Klimaschutzgesetz*)

kWh	kilowatt hour
LENK	State Agency for Energy and Climate Action (*Landesagentur für Energie und Klimaschutz*)
LfF	State Office for Finance (Bavaria) (*Landesamt für Finanzen*)
MDM	Mobile Device Management
MPT	motorised private transport
ÖKOBAUDAT	Ecological building materials database of the Federal Ministry of Housing, Urban Development and Building
ÖPNV	local public transport
PV	photovoltaic
Pkm	passenger kilometres
RE	regional express
RRZE	Erlangen Regional Data Centre (*Regionales Rechenzentrum Erlangen)*
StMWK	State Ministry of Science and the Arts (*Staatsministerium für Wissenschaft und Kunst*)
t	tonne
UTN	University of Technology Nuremberg
WRI	World Resources Institute
WBCSD	World Business Council for Sustainable Development

1 Summary

The Climate Action Plan of the University of Technology Nuremberg (UTN) forms the strategic basis for a systematic reduction of greenhouse gas emissions (GHG emissions) in the university context. It was developed against the backdrop of national and Bavarian climate action targets (BayKlimaG, 2020) (KSG, 2021) and also takes into account the special conditions of a university that is still in the process of being established.

The central starting point was the creation of a comprehensive energy balance and greenhouse gas inventory for the year 2023. The following findings were obtained:

- The net results show that initial climate-related measures have already been implemented, such as the use of green electricity, paper-based administrative processes and the consistent focus on sustainability criteria in the construction of the first new building (BMI, 2019).
- The analysis also shows that the majority of greenhouse gas emissions fall within Scope 3 – caused in particular by construction activities, procurement and commuting (Greenhouse Gas Protocol, 2013). Scope 3 is, alongside Scope 1 & 2, the third and most comprehensive scope for emissions accounting according to the Greenhouse Gas (GHG) Protocol. It covers all indirect greenhouse gas emissions from sources that we as UTN do not own or directly control.

Although the reduction of Scope 3 emissions has not yet been explicitly required in federal or state targets, UTN has decided to actively include this area in its objectives and to strive for climate neutrality in Scope 1-3 of the Greenhouse Gas (GHG) Protocol by 2040 at the latest. This decision is in line with the university's self-image as a public institution that sets an example, but it is also based on strategic considerations: early investment in climate-friendly infrastructure creates ecological benefits and economic security – for example, in view of future increases in carbon dioxide (CO_2) prices or expanded reporting requirements.

Based on realistic growth assumptions, two development paths for climate action at the UTN were then modelled up to 2050: a climate action scenario and a reference scenario. The climate action scenario specifically integrates ambitious measures to reduce emissions. The aim was to depict only those effects in the climate action scenario that result from the active commitment of the UTN. By contrast, the reference scenario describes developments without additional climate action measures, and is based on realistic assumptions and does not assume any further political or institutional intervention.

The scenarios show that the developments at UTN to date are not sufficient to achieve the targeted climate neutrality in Scope 1 and 2 by 2028 and in Scope 3 by 2040 at the latest.

Based on the results of the scenarios, the areas with the greatest potential for reduction were then examined, particularly those where UTN has a direct or indirect influence. These include electricity supply, campus design, commuter traffic and business travel.

Targets and corresponding measures were developed in various participation formats to reduce emissions in the areas analysed.

The measures developed to achieve these goals cover a broad spectrum: from so-called quick wins, which can be implemented quickly and with little effort, such as flowering meadows on undeveloped land, to strategic objectives that require longer-term planning, investment or structural changes, such as a sustainable criteria catalogue for procurement.

No prioritisation of the objectives and measures in terms of a ranking has been carried out to date, but those approaches that are expected to be particularly effective have been identified.

The UTN Climate Action Plan is designed to be a dynamic tool. It provides a solid foundation for strategic management and is regularly reviewed and adapted to changing conditions. Strategic control is achieved through systematic monitoring of the defined indicators and values, annual updating of the energy balance and greenhouse gas inventory, and structural organisational anchoring at the UTN.

Close integration with the emerging sustainability strategy ensures that climate action is an integral part of the University's sustainable development.

Active and continuous communication of the UTN's commitment to climate action, which is an important part of the Plan, can become a strategic success factor: positioning itself as a responsible, sustainable university increases the UTN's attractiveness in the competition for talent, third-party funding and partners. Climate action can thus become a visible profile feature of a future-oriented university.

2 Introduction

In order to effectively combat the climate crisis, a significant reduction in global greenhouse gas emissions is required. The University of Technology Nuremberg (UTN) recognises its responsibility as a 21st century institution for teaching, research and knowledge transfer and is actively committed to sustainable transformation. This Climate Action Plan serves as a strategic planning and decision-making basis on the path to climate neutrality.

With the Federal Climate Action Act (KSG, 2021), Germany has set itself the goal of becoming greenhouse gas neutral by 2045. In doing so, the country is contributing to the Paris Climate Agreement, which aims to limit global warming to well below 2°C – preferably to 1.5°C (BMWK, 2022). The Free State of Bavaria is going one step further and is already pursuing the goal of climate neutrality by 2040 (BayKlimaG, 2020).

In view of the increasing impact of climate change, a rapid and profound reduction in emissions is necessary in all areas of our society. The Bavarian Higher Education Innovation Act (BayHIG) of 2022 (BayHIG, 2022) enshrines sustainability as a central guiding principle and emphasises the responsibility of higher education institutions for future social issues. This means that institutions such as the UTN not only have the opportunity, but also the responsibility to set an example through their own actions and contribute to climate action with innovative and practical approaches.

Within the framework of BayHIG, strategic target agreements have been concluded between the Bavarian State Ministry and the universities (BayHIG, 2023). For the UTN, this means that it will be developed as an urban, sustainable campus university. The move into the founding buildings will create a space that facilitates interdisciplinary, international and digital learning, teaching, research and work.

A key component is the campus's energy supply. From the outset, the aim is to rely largely on renewable energies with the goal of making the university's operations climate-neutral. To achieve this goal, a comprehensive energy concept has been developed for the UTN campus. The implementation of this Plan is expected to reduce CO_2 emissions by approximately 88% compared to a conventional energy supply.

2.1 Development of the Climate Action Plan

The challenges posed by climate change require a holistic and strategically planned approach. Against this backdrop, the University of Technology Nuremberg decided in 2022 to develop an integrated climate Action Plan.

To implement this project, funds were requested from the Federal Ministry for Economic Affairs and Climate Action (BMWK) under the municipal guidelines (funding priority 4.1.8 a). The funding was approved in December 2022.

The climate action manager took up her post at the UTN in January 2024. In organisational terms, climate action management is anchored in the Real Estate Unit but works closely with other departments. The climate action manager is responsible for coordinating and developing concepts.

Since May 2024, the external consulting firm plant values has been supporting the creation process. In particular, it has provided assistance with the greenhouse gas inventory, potential analysis, scenario development, as well as the design and implementation of participation formats.

In order to promote broad acceptance and active participation, the greenhouse gas inventory and initial scenarios were first presented to all employees. They had the opportunity to contribute ideas and suggestions both directly at the event and afterwards by email.

Based on the goal of climate neutrality and defined sub-goals in the individual areas, a workshop was held in which employees from the relevant areas, units and departments (Real Estate, Procurement, IT, etc.) participated. In this format, concrete proposals were developed and priorities for further action were defined under the guidance of the climate action manager.

2.2 Content of the Climate Action Plan

The Climate Action Plan of the University of Technology Nuremberg serves as a strategic basis for decision-making and planning for the next ten to fifteen years. The aim is to significantly reduce per capita greenhouse gas emissions with a view to achieving climate neutrality and to permanently embed sustainable thinking within the University community.

The Plan is based on a comprehensive and systematic approach. It begins with an overview of developments to date and measures already implemented at the UTN. The focus is on a detailed assessment of energy consumption and greenhouse gas emissions for 2023, which serves as a data-based foundation for all further considerations.

The next step will be to develop various scenarios that outline possible development paths up to 2050. These will serve to highlight opportunities and challenges for a climate-neutral future. Based on these scenarios, the technical and economic potential for reducing emissions in ongoing University operations will be identified and evaluated.

At the heart of the Plan are concrete objectives and a package of measures that includes both short-term steps and long-term structural changes. The focus is on a sustainable transformation process that goes beyond individual measures and involves the entire University as a contributor to climate action.

A sustainability and controlling concept ensures that the measures are implemented effectively and that the UTN's climate targets are consistently pursued. In addition, a communication strategy ensures that all members of the University, from students to researchers and teachers to the administration, are informed, sensitised and actively involved in the process.

Particular emphasis is placed on the involvement of a wide range of stakeholders on campus: students and staff have actively participated in shaping the Plan. This broad participation creates a shared understanding of climate action that goes beyond individual measures.

This Plan represents the UTN's first comprehensive strategy in the area of institutional climate action. It focuses on climate and resource protection in day-to-day operations. The Plan is to be reviewed from time to time and, if necessary, updated with a view to future developments. A more comprehensive sustainability strategy that also integrates social and economic aspects is currently being developed and is expected to be published in early 2026.

3 Initial situation

3.1 Establishment of the UTN

Founded in 2021, the University of Technology Nuremberg (UTN) is the first new state university to be established in Bavaria since 1978. The UTN sees itself as a living laboratory for shaping a university for the age of AI and rapidly advancing changes in technology, business and society. The UTN aims to become an important regional driving force in research, teaching and transfer, as well as a leading international university of the 21st century with regional roots and a global outlook. The 37-hectare sustainable UTN campus will form the centre of the new Lichtenreuth district in Nuremberg, close to the historic city centre. It will accommodate around 6,000 students, 200 professors and at least 2,000 employees. Study programmes will integrate aspects of technology, liberal arts, social sciences and natural sciences to ideally prepare students for the interdisciplinary requirements of the new world of work.

3.2 Previous locations of the UTN

The UTN sites are currently located in the south of Nuremberg. The first site was leased in 2021 in the 'The Plant' building complex on Ulmenstrasse. In 2023, four information containers – called Experience Cubes – were erected on the southern part of the future campus to provide information about the UTN concept. In October 2024, parts of the UTN moved into its first purpose-built building, Cube One. This is located along Dr.-Luise-Herzberg-Strasse, also in the southern part of the new campus.

The departments, student areas and part of the administration are currently located on Ulmenstrasse. The Executive Board and most of the administration are now based in Cube One.

The move into another building in Nordostpark is planned for autumn 2025. Parts of the departments will be housed there, creating space for teaching and learning. The leases will remain in place at least until the founding building on campus is ready for occupancy, which is currently planned for the period between 2029 and 2031.

3.3 Structural development of the UTN

Construction of the UTN will begin in the south of the campus along Dr.-Luise-Herzberg-Strasse. Next to Cube One, another building will be constructed, which, together with Cube One and the rented premises, will ensure the operation of the UTN in the first few years. The Learning HUB, another building, will go into operation at the end of 2027. The further development of the campus will begin in the north and then extend southwards. This is based on the structural plan from 2021, which has been converted into a framework plan and is currently being implemented in a development plan. A defining feature of the framework plan is the park-like green centre around which the buildings are grouped. In the first phase, the first four of the founding buildings are to be constructed

by 2029 as part of Development Stage 01. These buildings will provide teaching and learning spaces as well as areas for research and central functions such as a cafeteria, a maker space and offices for the University management. To ensure that the buildings are operational, an energy centre with seasonal heat storage, a logistics building with central workshops and a multi-storey car park will also be constructed by the end of 2029. In parallel with the construction of the buildings, the entire infrastructure, including supply and disposal lines, roads and paths, must be newly built. By 2029, the first part of the park-like Green Centre will also be completed, along with other landscaped and horticulturally designed outdoor facilities. The outdoor facilities will also include infrastructure for alternative modes of transport such as bicycles, rental bikes and rental scooters. In addition, a new student residence built by the student union will be ready for occupancy by the end of 2029. By around 2031, a fifth building with teaching and research facilities is to be constructed as the last building in Development Stage 01. Further construction of the campus will take place over the coming decades, depending on demand and the availability of funding, from north to south. In addition to teaching/learning areas and research facilities, these planned buildings will also include central facilities such as a sports centre, a canteen and event spaces. In addition, accommodation for students will be created. The western arm, which borders the main campus to the west, is to be developed over the next few decades as an area for third-party research facilities. When completed, the campus will be designed to accommodate 6,000 students (see Figure 1).

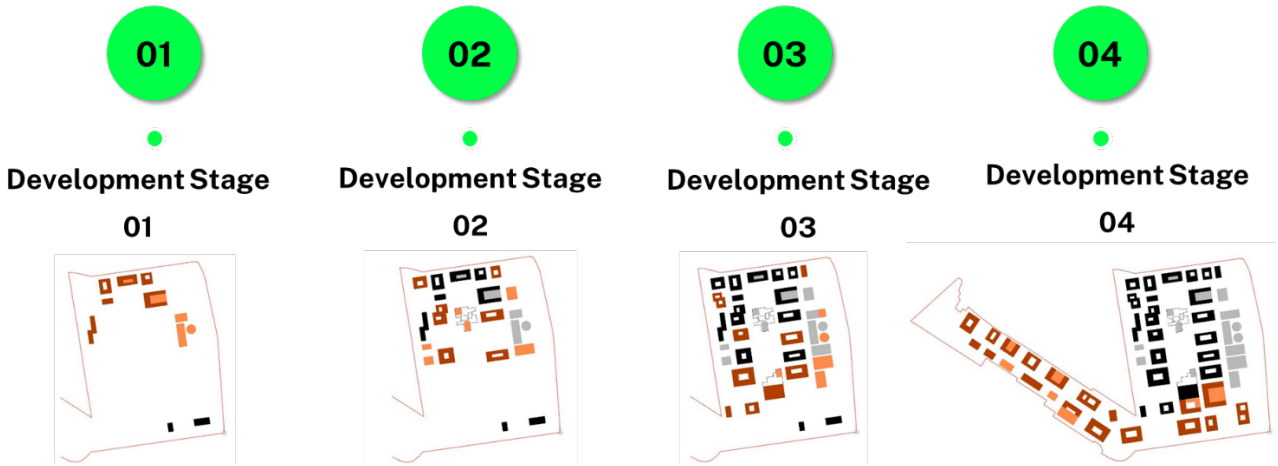

Figure 1: Development stages of the UTN (UTN representation)

3.4. The UTN's climate action activities to date

Climate action is an important guiding principle at the UTN and was already taken into account when the first building, Cube One, was constructed. The new building, which was completed in October 2024, is constructed using environmentally friendly building materials such as recycled concrete and wood. It has a photovoltaic system (PV system) on the roof for generating its own electricity, as well as extensive green roofing and green facades, which improve the microclimate.

The UTN is also committed to energy-efficient solutions and already uses green electricity. As part of the ongoing campus development, there are plans to expand the energy centre in order to further increase energy efficiency and minimize CO_2 emissions (Erlangen-Nuremberg State Building Authority, 2022).

The UTN also relies on sustainable concepts for mobility. In addition to electric service vehicles, various bicycles with and without electric drives are already available, and an electric cargo bike will soon be available for short, emission-free business trips. Further vehicles for operational use are in the planning stage.

The administration is almost paperless, which significantly reduces resource consumption.

In addition, the use of flexible workplaces and mobile working is being promoted in order to reduce the need for floor space and commuting, thereby actively contributing to a reduction in energy consumption.

The UTN is an active member of networks for climate action and sustainability at BayZeN (Centre for Higher Education and Sustainability). This platform serves to promote inter-institutional cooperation, professional exchange and the joint implementation of sustainability and climate action strategies in higher education.

4 Energy balance and greenhouse gas inventory

A fundamental prerequisite for effective climate action at the UTN is detailed accounting of its own contribution to climate change through GHG emissions. This accounting includes a comprehensive analysis of energy consumption and energy sources, as well as the recording of GHG emissions caused by the UTN. This analysis allows us to identify specific areas for improvement and develop appropriate measures to reduce GHG emissions.

The energy budget considers both the energy emission and consumption.

In contrast, greenhouse gas accounting is the process of measuring and documenting the greenhouse gas emissions caused by an activity, organisation or area. The aim is to gain a better understanding of the climate impact of the entity in question.

This process comprises:

1. Identification of emission sources and sinks
2. Measurement and quantification
3. Classification into scopes (categories))

The accounting then serves as a basis for reporting and developing strategies to reduce emissions.

4.1 Methodology

The UTN's energy balance and GHG inventories are based on the internationally recognised standards of DIN EN ISO 14064-1 and the Greenhouse Gas Protocol (GHG Protocol) (WRI & WBCSD, 2004). The protocol was developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). This methodology forms the basis of the present accounting and reporting.

Accounting and reporting tool

Since the GHG Protocol is primarily designed for companies, the university-specific accounting tool 'BayCalc' (version 1.6 dated 8 May 2023) including the associated BayCalc guideline (Sargl et al., 2023) was originally used as a reference. This Excel-based tool was developed for Bavarian colleges and universities and ensures a uniform methodology and comparable results through standardised emission factors. It is also the officially designated instrument for the annual GHG report to be submitted to the State Ministry. During the accounting process, however, it became apparent that BayCalc version 1.6 was outdated and that an updated version was not yet available at the time of internal accounting at the UTN. The UTN therefore decided to use the calculation tool from plant values for its internal GHG inventory. This tool offers a modern methodology based on the standards mentioned above and allows the UTN to analyse its emissions data more accurately and in a more user-friendly way.

4.2 CO_2e emission factors

The concept of CO_2 equivalents (CO_2e or CO_2eq) serves to make the climate impact of different greenhouse gases comparable. It takes into account how strongly and for how long a gas contributes to global warming – in comparison to CO_2. The greenhouse potential (global warming potential, GWP) indicates how much a gas contributes to global warming, usually over a period of 100 years (IPCC, 2021). Methane, for example, has a GWP of around 25, meaning that 1 kg of methane has the same effect as 25 kg of CO_2 and is therefore accounted for as 25 kg of CO_2e. The Greenhouse Gas Protocol (WRI & WBSCD, 2004) provides the methodological framework for measuring and evaluating greenhouse gas emissions based on these indicators.

In order to enable comparison of GHG inventories between Bavarian universities, the emission factors from BayCalc Version 1.6 and the test version 2.0 were harmonised in October 2024 and adjusted accordingly in the plant values tool (see Appendix B). For the most part, emission factors stored in the BayCalc accounting tool were used. In some cases, it was necessary to refer to the following recognised databases and data sources:

- GEMIS ProBas (Process data basis for environmental management instruments, Federal Environment Agency) (Probas-UBA, 2024)
- Information sheet on CO_2 factors Federal Office for Economic Affairs and Export Control (BAFA, 2024)
- ÖKOBAUDAT (Federal Ministry of Housing, Urban Development and Building) (ÖKOBAUDAT, 2024)

4.3. System boundaries

Definition of the system boundaries for GHG emissions at the UTN

The UTN's greenhouse gas emissions result both directly and indirectly from building operations and from the activities of employees and students. The first step was to define the system boundaries for recording these emissions. The control approach described in the GHG Protocol (WRI & WBSCD, 2004) was applied: all processes and services over which the UTN exercises operational control or significant influence are included in the accounting.

This approach also includes rented properties and emissions caused by employees and students, even if their actions can be controlled only to a limited extent.

Table 1 provides an overview of the net floor space and the number of university members. Based on this basic data, the specific consumption of electricity and heat is presented in Section 4.5.

Key figures	Area/number	Date of revision
Net floor space	3488 m^2	December 2023
University members	118	December 2023
Students	10	December 2023
Employees	108	December 2023

Table 1: Key data at the UTN – area and number of people (December 2023)

Classification of emissions according to scopes

GHG emissions are divided into three categories ('scopes') in accordance with internationally recognised standards:

- Scope 1: Direct emissions resulting from the combustion of natural gas, fuels or other energy sources.
- Scope 2: Indirect emissions from purchased energy such as electricity or district heating.
- Scope 3: Other indirect emissions arising along the upstream and downstream value chains, for example through business travel, procurement of goods and services, or logistics.

Figure 2 shows the operational boundaries of the UTN and indicates which emissions are included in the greenhouse gas inventory.

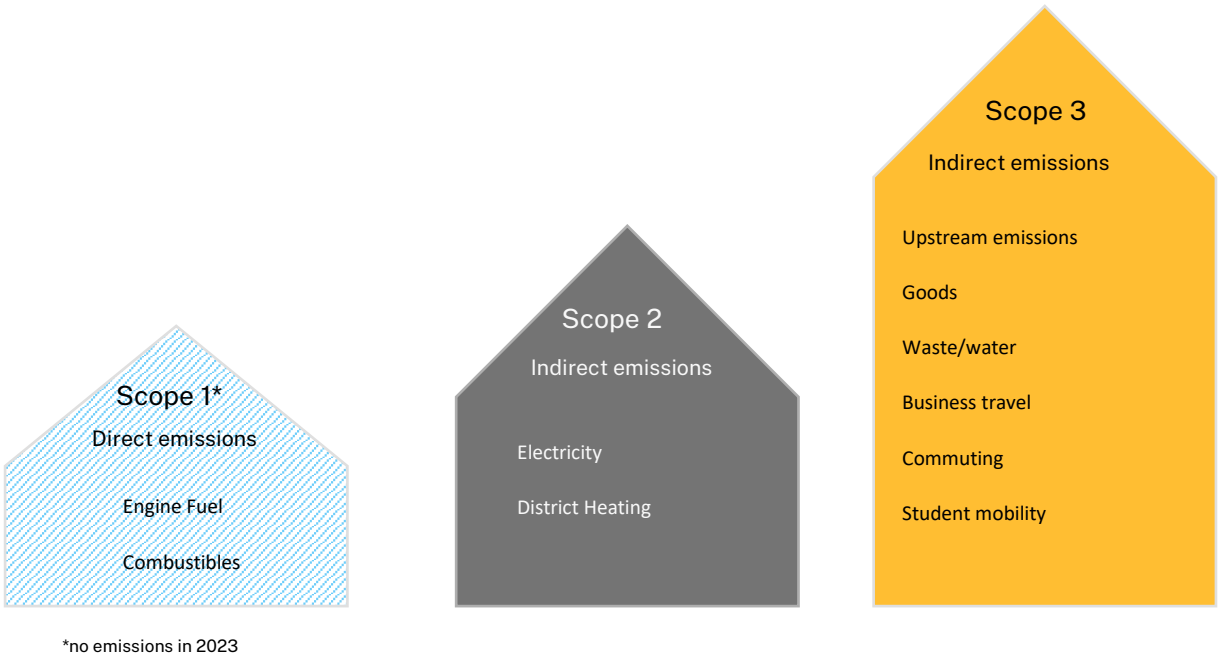

Figure 2: Overview of system boundaries at the UTN (our own representation)

Reporting year 2023 – Scope of coverage

The current accounting refers to the year 2023. No emission data was recorded for Scope 1, as there were no relevant emission sources on campus during that reporting period.

4.4 Data collection

The data were collected in close cooperation with employees from the Buildings & Infrastructure, Technical Services, Estate Services, Procurement, Information Technology Service (IT Service) and Finance & Controlling departments. An online survey was conducted to collect the mobility data.

4.4.1 Data collection Scope 1

There is no consumption data available in Scope 1, as the UTN does not use fossil fuels and its vehicle fleet is entirely electric. The cooling systems are serviced annually by an external company and checked for leaks. Refrigerant is refilled as required. However, no refilling was necessary in the base year and therefore no refrigerant was consumed.

4.4.2 Data collection Scope 2

Table 2 shows the electricity consumption and district heating consumption for the buildings in 2023 according to the UTN. Electricity consumption was determined by evaluating the corresponding meter readings. The calculation of the communal electricity and district heating was carried out by means of an extrapolation based on the operating cost statement. The charging station receipts were used to determine the electricity consumption of company vehicles on business trips. The charging of vehicles at the UTN was not recorded separately and is included in the total electricity consumption. Although a logbook is available, it does not contain any information about the kilometres travelled using internally or externally charged electricity.

Category	Quantity	Unit
Electricity consumption in office space on Ulmenstrasse	24,046	kWh
Electricity consumption in communal areas on Ulmenstrasse (stairwells, etc.)	14,350	kWh
District heating consumption on Ulmenstrasse	177,439	kWh
Electricity consumption for vehicle fleet outside the UTN	324	kWh

Table 2: Energy consumption at the UTN (2023)

4.4.3 Data collection Scope 3

Scope 3 consists of different items and the associated information such as quantities, volumes, masses or distances. This chapter focuses on these values; the CO_2 equivalents are presented in Section 4.6.

Purchased goods and services

Table 3 shows the quantities procured in the IT area. As no SAP system was available in 2023, the data were recorded on the basis of invoices, customer portals and order overviews. Mice, keyboards and headsets were not included as these are not yet recorded in BayCalc's Tool 1.6.

For external computing services, the IT department was consulted to identify the most frequently used programmes and estimate their data volumes. The majority of computing services are provided by the RRZE (Regional Computing Centre Erlangen).

Category	Quantity	Unit
IT		
Desktop PCs	10	unit
Monitors	98	unit
Notebooks and laptop s	39	unit
Smartphones	16	unit
Multifunction printers	6	unit
Printers (laser or inkjet)	2	unit
Toner	24	unit
Docking stations	47	unit
Beamers	3	unit
Outsourced services provided by the RRZE data centre	10,000	Gross pay/year
Outsourced services provided by the data centre Other	136	Gross pay/year
Furniture		
Desk	114	unit
Office chair/swivel chair	146	unit
Cleaning/hygiene		
Paper towels (recycled)	19	kg
Toilet paper (recycled)	174	kg
PU cleaner	82	kg
Paper		
Paper	139	kg
Recycling paper	634	kg

Table 3: Number of goods and services purchased (2023)

Capital goods

In 2023, only the Experience Cubes were constructed. The quantity calculations, shown in Table 4, were provided by the commissioned planning office.

Category	Quantity	Unit
Steel (converter steel)	2.30	t
Wood	0.91	m^3
Glass (flat glass)	0.48	t

Table 4: Quantity of capital goods (2023)

Visitor mobility

The Finance & Controlling team systematically recorded visitors' arrival and departure routes. The report documents include both the departure locations and the means of transport used. The travel distances were calculated manually based on the specified departure points. The results are listed in Table 5.

Since no information was available on the types of fuel used by the vehicles, diesel fuel was assumed for taxi journeys. For other passenger car traffic, gasoline fuel was assumed, as this accounts for the largest share of the national vehicle fleet according to the Federal Motor Transport Authority (KBA, 2024).

Further differentiation according to drive types would have been possible in principle, but was not pursued due to the high cost involved and the overall insignificance of the distances travelled for total emissions.

Means of transportation	Total distance [km]
Passenger car (diesel)	62
Passenger car (gasoline)	2,350
Local public transport	520
Rail (long-distance, ICE)	24,617
Rail (regional, RE)	277
Long-haul flights (> 3,500 km)	13,435

Table 5: Activity data for visitor mobility (2023)

Business trips

The data for business trips are based on the evaluations of mileage allowances (LfF, 2024b) and travel expenses (LfF, 2024a) by the Bavarian State Office for Finance (LfF) for the year 2023. These data provide information on the kilometres travelled and the number of trips per mode of transport that were billed via Travel Expenses for the UTN. In addition, Deutsche Bahn's (DB) environmental balance sheet for the UTN 2023 (DB, 2024) serves as the basis for rail travel, which includes all tickets booked via the UTN account at bahn.business. In combination with the travel costs of the LfF, an estimate of the passenger kilometres in local and long-distance DB transport was made, see Table 6.

Air travel emissions are calculated based on mandatory reports submitted by the UTN to the State Ministry of Science and the Arts (StMWK) or the State Agency for Energy and Climate Protection (LENK) and the resulting flight list (StMWK, 2024). Business trips with UTN vehicles are included in Scope 2.

Means of transportation	Total distance [km]
Passenger car (diesel)	1,273
Passenger car (gasoline)	3,605
Local public transport	212
Rail (long-distance, ICE)	151,687
Rail (regional, RE)	13,190
Medium-haul flights (500–3,500 km)	6,966
Long-haul flights (> 3,500 km)	119,931

Table 6: Activity data for business trips (2023)

Commuter mobility

Commuter traffic was recorded using the mobility survey. Information was collected on the distance between home and work, the type of transport used, and the number of working days. Respondents were also asked how often and by what means of transport they travel this route on average. According to the survey, none of the respondents owned an electric vehicle.
Further details can be found in Table 7.

Means of transportation	Total distance [km]
Passenger car (diesel)	94,293
Passenger car (gasoline)	174,652
Local public transport	535,161
On foot	4,271
Bicycle	27,984
E-bike	11,891

Table 7: Activity data for commuting (2023)

Waste

The quantities of waste and wastewater were determined on the basis of the operating cost statement by means of an extrapolation. As can be seen in Table 8, no glass waste was generated, as this was disposed of independently by the employees. IT waste was also not recorded during the survey period.

Designation	Weight [kg]
Paper and cardboard waste (recycling)	3,794
Household waste (incineration)	1,518
Biowaste (composting)	345
Plastic (recycling)	190
Wastewater	738,060

Table 8: Waste quantities (2023)

4.5 Results of the energy balance

In the 2023 financial year, the final energy consumption of the University of Technology Nuremberg totalled 235,835 kWh. Of this, approximately 24% was electricity and 76% was heat. The specific final energy consumption per university member was therefore approximately 1,980 kWh per year.

The energy used at the UTN is used for heating, hot water, IT infrastructure, lighting, and charging electric vehicles.

Table 9 shows the energy sources used and their distribution overall, as well as in the areas of electricity and heat. Electricity accounts for 24.12% of consumption (56,396 kWh), of which 74.55% (42,046 kWh) comes from renewable energies and 24.45% (14,350 kWh) from the local electricity mix. The heat demand of 177,439 kWh (75.88% of total consumption) is covered entirely by district heating.

Energy sources	Activity data [kWh]	Proportion	Proportion by area
Total	**233,835**	**100.00 %**	
Electricity	**56,396**	**24.12 %**	**100.00 %**
Electricity from renewable energies	42,046	17.98 %	74.55 %
Electricity from local electricity mix	14,350	6.14 %	25.45 %
Heat	**177,439**	**75.88 %**	**100.00 %**
District heating	177,439	75.88 %	100.00 %

Table 9: Energy quantities and their proportions (2023)

Figure 3 shows the distribution of total final energy consumption by energy source. Renewable energies account for 18% (shown in red) and non-renewable energies for 82% (shown in blue).

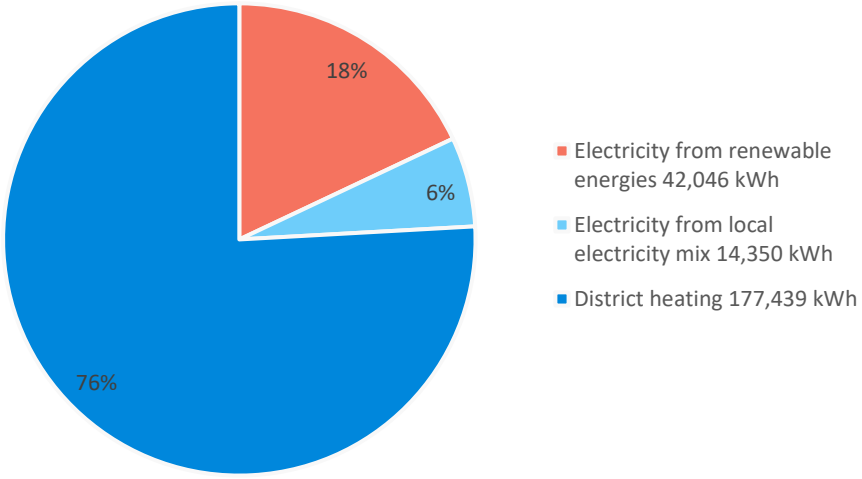

Figure 3: Distribution of energy consumption at the UTN in kWh (2023)

Table 10 shows the final energy consumption based on various indicators. The consumption for students is also listed, although this figure is relatively high as only ten students were enrolled in 2023. This results in a final energy consumption of 23,383.50 kWh per person.

A total of 67.61 kWh of energy is consumed per square meter of net floor space – 16.17 kWh/m² of electricity and 50.87 kWh/m² of heat.

Indicators		**Unit**
Electricity and heat consumption per m²	67.04	kWh/m²
Electricity consumption per m²	16.17	kWh/m²
Heat consumption per m²	50.87	kWh/m²
Final energy consumption per university member	1,981.65	kWh/person
Final energy consumption per student	23,383.50	kWh/person

Table 10: Indicators for energy consumption (2023)

Energy indicators compared with other universities

A comparison with other Bavarian universities shows that electricity consumption per square metre is low at the UTN. Heat consumption is average. There are significant differences between the UTN and other universities in terms of key figures per student and per university member, which is mainly due to the dynamic growth of the UTN. These arise primarily from the fact that the UTN is still under construction. This means that buildings and spaces are already being operated and heated, even though there are still relatively few employees and students.

4.6 Results of the greenhouse gas assessment

In the 2023 financial year, a total of 258,930 kg CO_2e was generated by the UTN. This corresponds to 2,1492.32 kg CO_2e per person, with a total of 108 employees and 10 students (see Table 11).

The majority of GHG emissions, just under 87%, are attributable to Scope 3. Scope 2 accounts for around 13%, while Scope 1 does not generate any emissions.

Commuting within the university community accounts for approximately 40% of total emissions, followed by purchased goods and services at around 30% and business travel at approximately 11%. District heating and electricity contribute approximately 11% and 3% respectively. All other categories, such as capital goods, energy-related emissions, visitor mobility and waste, are below 2% and therefore have only a minor impact on the overall result.

The following figures refer to the market-based approach, which means that the green electricity purchased from UTN is taken into account. Dual reporting, which also includes the location-based approach – i.e. electricity purchased from local suppliers – is presented in Section 4.6.4.

Category	Scope 1 [kg]	Scope 2 [kg]	Scope 3 [kg]	Total [kg]	Share of total emissions
Electricity		6,369			2.46 %
District heating		27,326			10.55 %
Purchased goods and services			77,143		29.79 %
Capital goods			4,707		1.82 %
Fuel and energy-related emissions			3,261		1.26 %
Mobility of visitors			3,803		1.47 %
Waste			4,835		1.87 %
Business travel			28,671		11.07 %
Commuting			102,815		39.71 %
Total		**33,695**	**225,235**	**258,930**	**100.0 %**
CO_2e per University member		285.55	1,908.77	2,194.32	
Share of total emissions		**13.01 %**	**86.99 %**		

Table 11: Emissions contributions for Scopes 1-3 (2023)

Figure 4 shows Scope 2 and 3 emissions, highlighting the areas that account for the largest share of total CO_2e emissions.

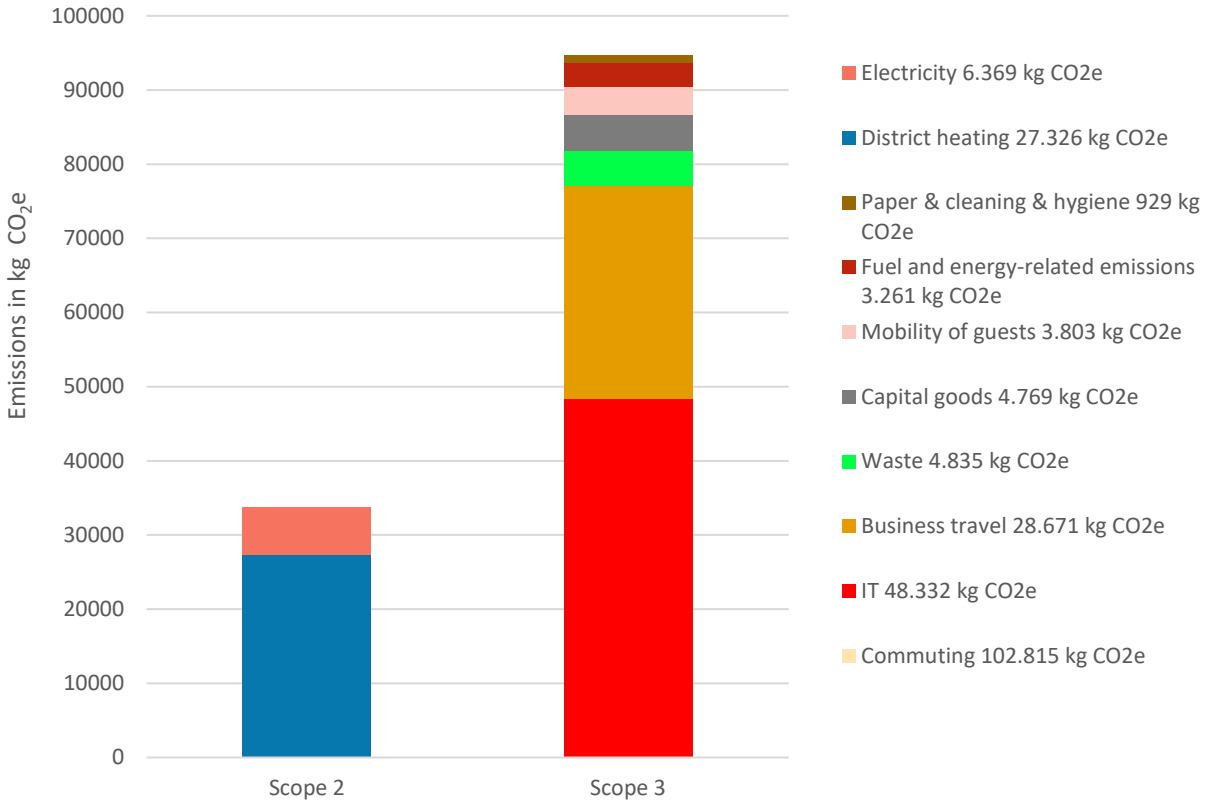

Figure 4: Overview of emissions, CO_2e

4.6.1 GHG emissions for Scope 1

Scope 1 includes direct emissions from the University's own or controlled sources, such as the operation of vehicles or boilers. There are no Scope 1 emissions in 2023, as the UTN does not use fossil fuels and its vehicle fleet is fully electric.

4.6.2 GHG emissions for Scope 2

Scope 2 refers to indirect emissions from the purchase of energy, such as electricity or district heating. The UTN uses only green electricity to supply the rented space in the Ulmenstrasse building complex, which means that no emissions are generated in these areas. However, the shared areas, such as the stairwell, are supplied with conventional electricity by the landlord. This results

in 6,369 kg of CO_2e emissions. 27,326 kg of CO_2e emissions are generated by the consumption of district heating, which covers both the space rented by UTN and the shared areas. Figure 5 shows the CO_2e emissions.

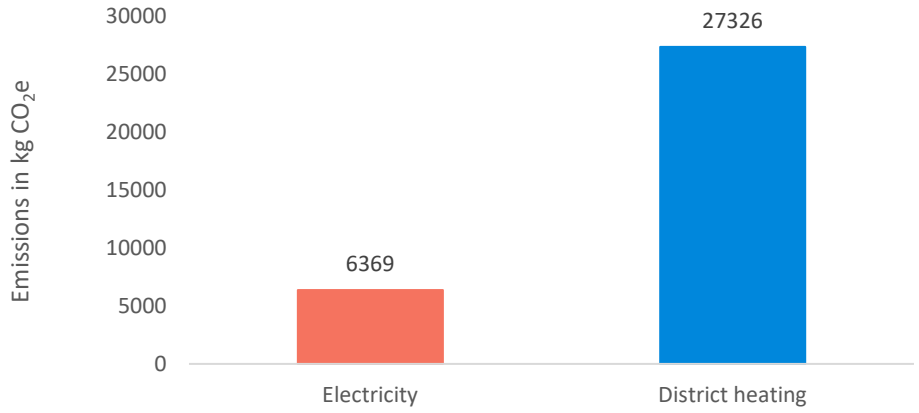

Figure 5: CO_2e emissions for Scope 2 (2023)

4.6.3 GHG emissions for Scope 3

Goods and services

Due to the large differences in emission values, two separate graphs (Figure *6* & Figure 7) are used.

Figure 6 shows the categories paper, hygiene products and cleaning agents. Overall, consumption in these areas is relatively low. Particularly noteworthy is the area of paper, where the use of recycled paper for printing accounts for the largest share of emissions at 535 kg CO_2e. This is encouraging overall, as recycled printer paper is significantly more climate-friendly than virgin fibre paper.

According to an article by the German Federal Environment Agency (Reichert, 2022), the average office worker consumes around 50 sheets of paper per day, with only a small proportion of this being recycled paper. With an average paper weight of five grams, this corresponds to an annual consumption of approximately 91 kg of paper and around 87 kg of CO_2e emissions per employee per year.

In comparison, the UTN is extremely low with only 5 kg CO_2e emissions per employee per year.

Other areas of consumption, such as hygiene products and cleaning agents, cause only very low emissions in comparison.

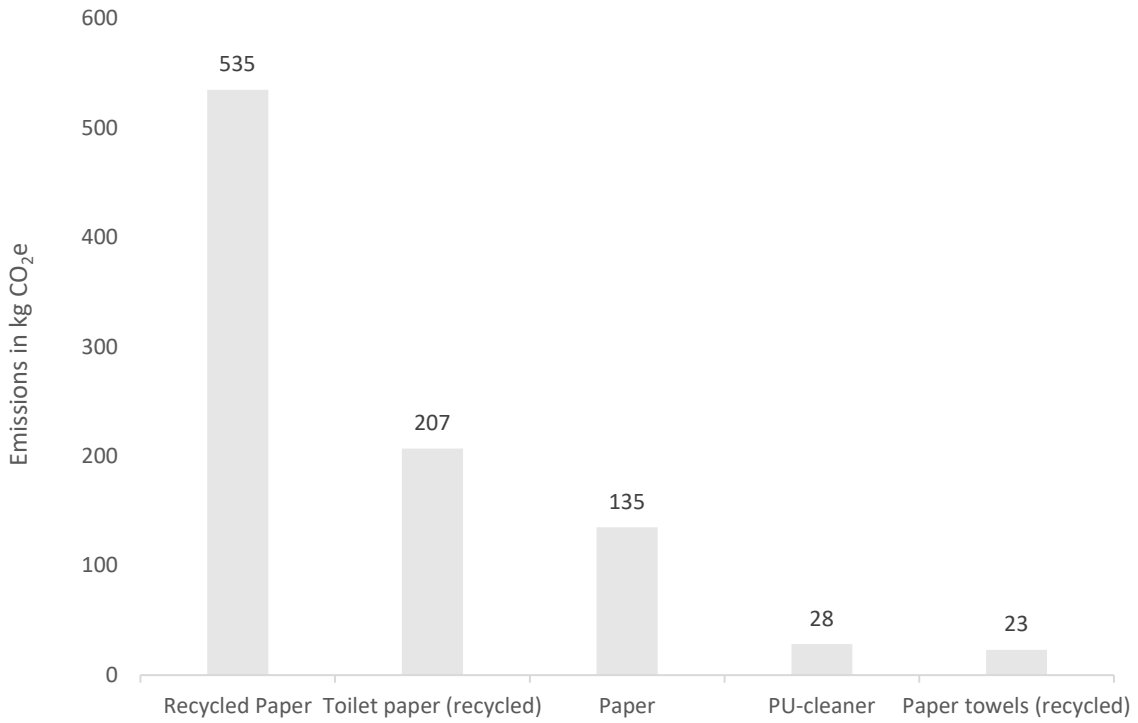

Figure 6: CO_2e emissions for paper and cleaning agents (2023)

Figure 7 shows the areas of IT and furniture procurement, represented by red bars for IT and blue bars for furniture procurement.

The purchase of monitors is the largest single source of emissions, accounting for 34,300 kg CO_2e. Laptops follow with 6,708 kg CO_2e emissions, and desktop PCs with 2,260 kg CO_2e emissions. The remaining IT components account for around 5,000 kg of CO_2e emissions. Very low emissions (17 kg CO2e) are generated by the outsourced services of the data centre. As the majority of these services were not included in the assessment – in particular because the RRZE is powered by green electricity – the corresponding CO_2 value is very low. According to the Öko-Institut's 'Digital CO_2 Footprint' data collection, 'greenhouse gas emissions from online storage only take into account energy consumption during the usage phase, but not the manufacture of hard drives and data centre components' (Öko-Institut e.V., 2020). For this reason, externally sourced computing power from the RRZE is not taken into account.

When purchasing furniture, shelves and chairs in particular cause high emissions, with around 12,240 kg and 10,512 kg of CO_2e emissions respectively. Desks cause 5,130 kg of CO_2e emissions.

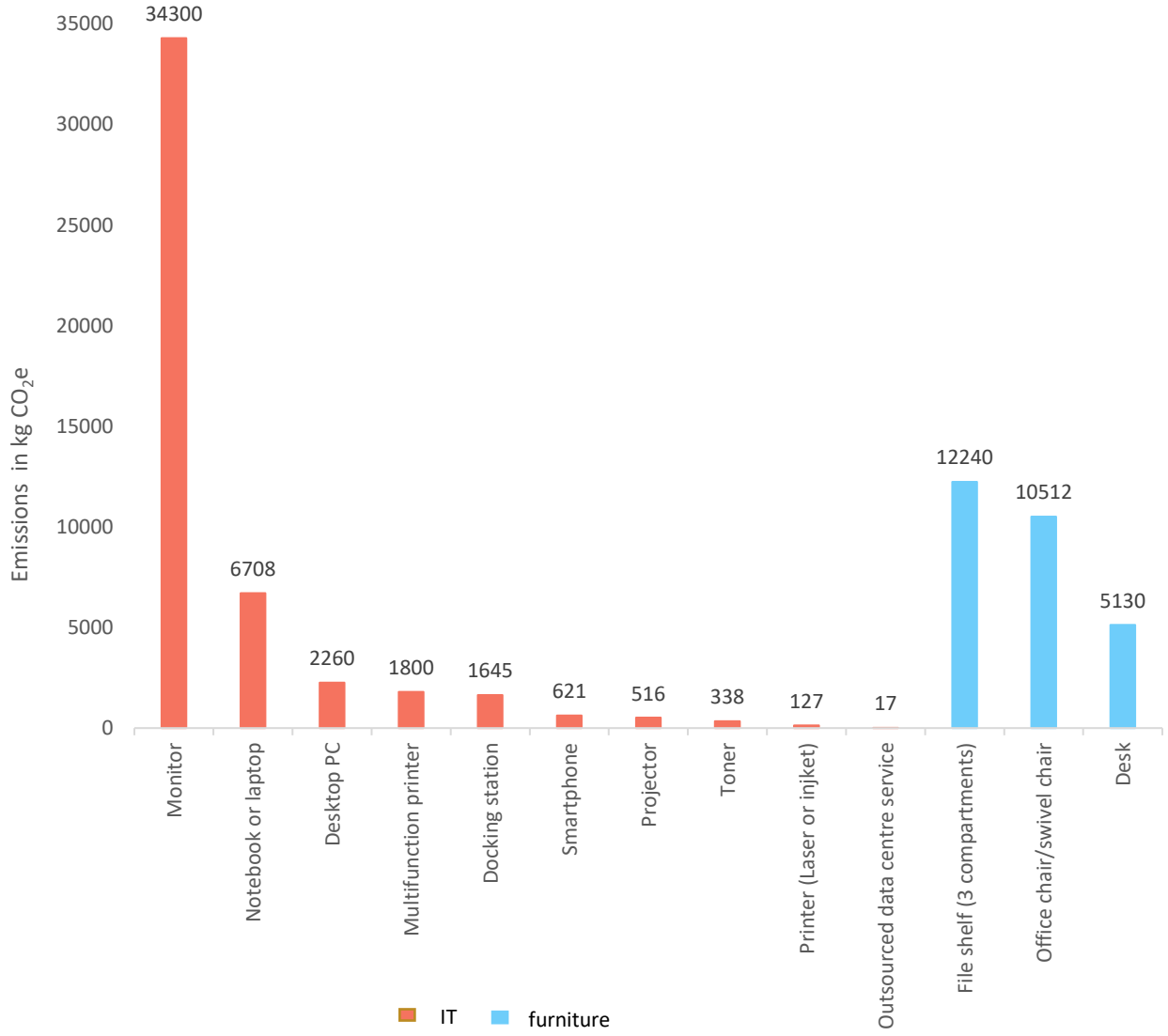

Figure 7: CO_2e emissions from office furniture and IT (2023)

Capital goods

The emissions from capital goods will be caused by the construction of the Experience Cubes in 2023. Steel accounts for the largest share with 4,787 CO_2e emissions. Glass and concrete contribute only to a small extent to emissions in comparison (Figure 8). The use of solid wood even results in negative emissions, as trees bind CO_2, which is then stored in the wood, resulting in a negative CO_2 equivalent value.

In accordance with the BayCalc system specifications, only construction phases A1 to A3 were taken into account in the assessment, in line with the cradle-to-gate approach (i.e. analysis of a product's environmental impact from raw material extraction to the point at which it leaves the manufacturing company's factory gates). If downstream life cycle phases were also included, the climate advantage of wood would be reduced.

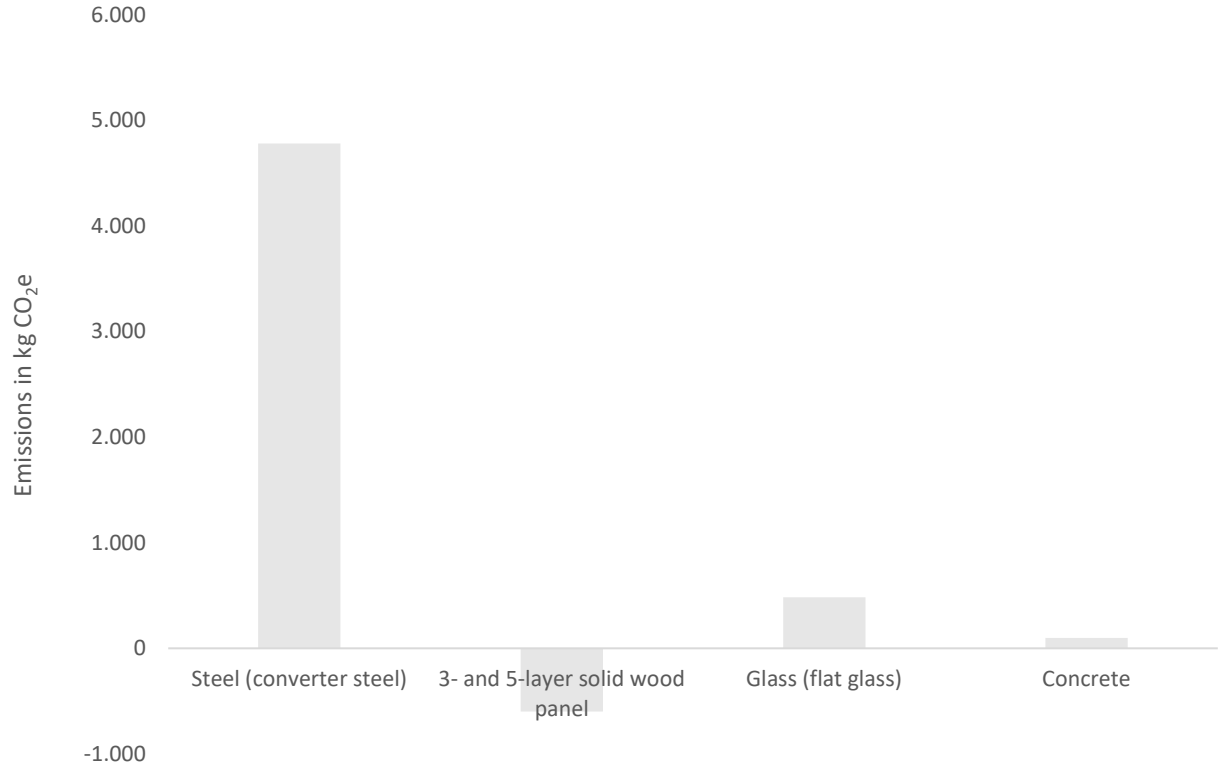

Figure 8: CO_2e emissions from capital goods (2023)

Upstream emissions

The upstream emissions in 2023 are generated at the UTN through electricity consumption. The purchase of green electricity causes 1,889 kg CO_2e, electricity mix 1,372 kg CO_2e (see Figure 9). The differences result from the fact that in 2023, the UTN purchased more green electricity than electricity mix overall.

District heating was not taken into account in this analysis, as it is already fully accounted for in Scope 2.

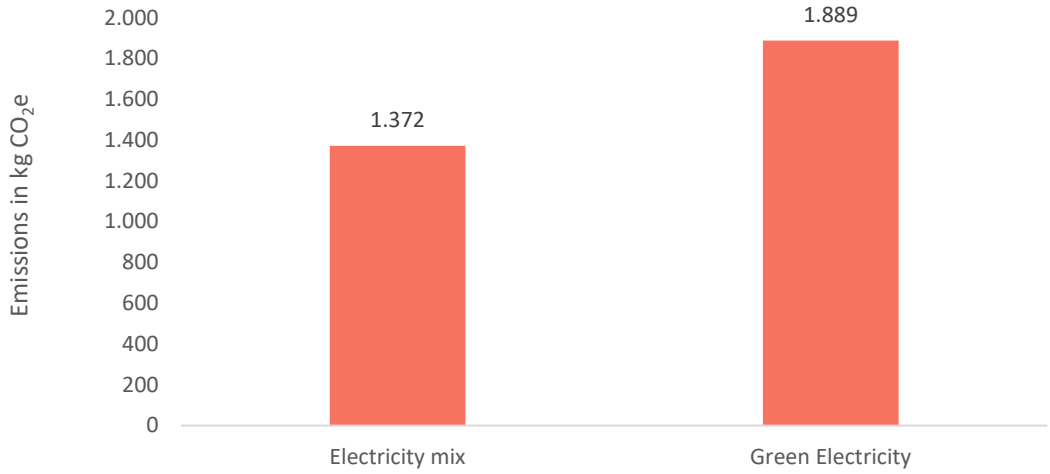

Figure 9: CO_2e emissions upstream (2023)

Mobility of visitors

As can be seen in Figure 10 , the largest share of CO_2e emissions, at 54%, is attributable to long-haul flights, followed by rail and public transport (31%). Car traffic accounts for 15% of CO_2e emissions. The share of electric vehicles (battery electric vehicles, or BEVs) is so small that their contribution to CO_2e emissions is negligible and therefore not shown in Figure 10.

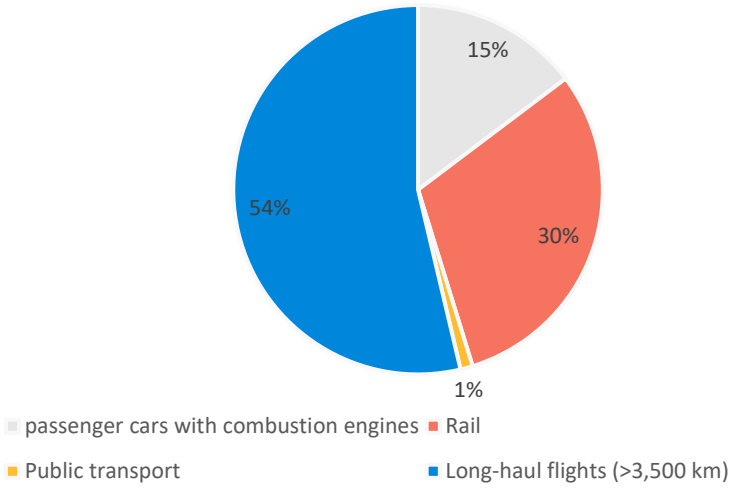

Figure 10: CO_2e emissions from mobility of visitors (2023)

Business travel

When it comes to business travel, long-haul flights account for the largest share of emissions, at 64% of CO_2e emissions (see Figure 11). This is due to international cooperation with other universities. Medium-haul flights, on the other hand, play only a minor role. 28% of emissions are attributable to rail travel.

Passenger car traffic includes only trips made with private vehicles, as all other business trips are made with the UTN's own vehicles and are already accounted for in the electricity consumption. The share of private passenger cars is very low overall; that of electric vehicles (BEVs) is negligible and therefore not shown in the figure.

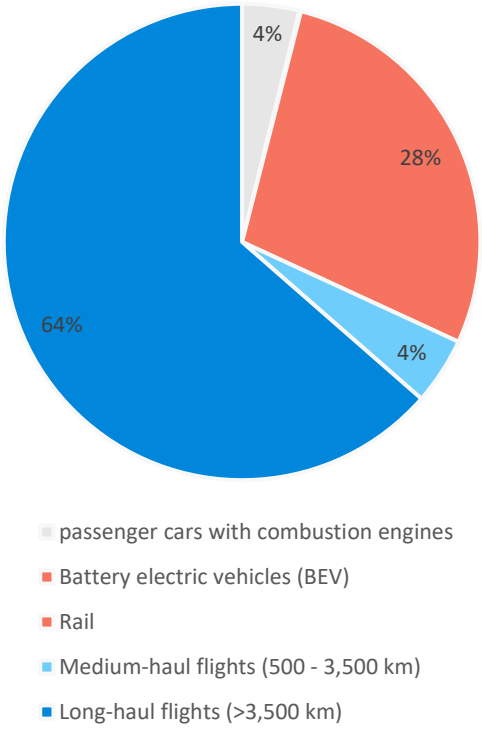

Figure 11: CO_2e emissions from business travel (2023)

Mobility of employees

The majority of CO_2e emissions from commuter mobility (59%) are attributable to cars with combustion engines, while 41% are attributable to local public transport. The share of bicycles and e-bikes is so small in the overall picture that they have almost no measurable impact on total emissions (see Figure 12).

The survey on employee mobility was conducted for all university members, as the survey results on student mobility behaviour could not be considered representative due to the small number of respondents. However, a separate, differentiated evaluation of this target group is planned for the coming years.

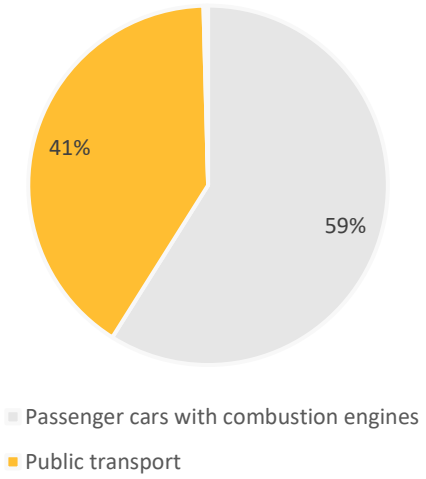

Figure 12: CO_2e emissions from commuter mobility (2023)

Waste

Figure 13 shows that the largest share of emissions, at just under 3,800 kg CO_2e, is attributable to paper and cardboard waste. The CO_2e emissions from the remaining waste categories are significantly lower in comparison.

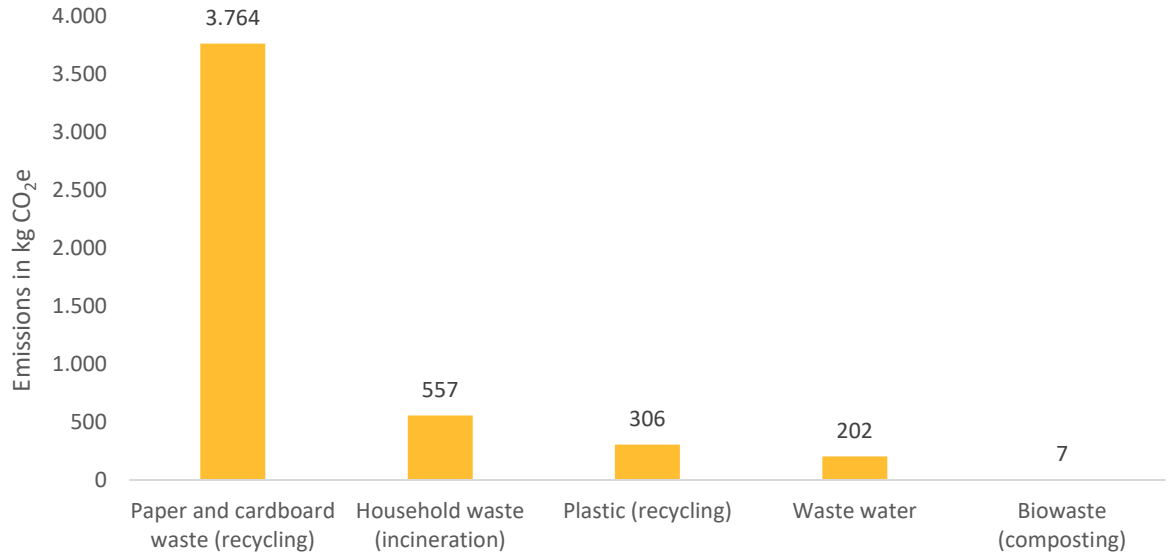

Figure 13: CO_2e emissions from waste (2023)

4.6.4 Dual reporting

Since the UTN obtains electricity from renewable sources, double accounting must be carried out in accordance with the BayCalc system. This dual reporting method includes not only a market-based assessment of the green electricity tariff, but also a location-based assessment of electricity consumption. If GHG accounting follows a market-based approach, contractual instruments such as electricity supply contracts serve as the basis for determining the emission factor. In the location-based variant, energy consumption and the resulting emission factor are calculated on the basis of the average electricity mix in Germany.

The use of dual reporting enables a transparent presentation of the reductions in CO_2e emissions achieved through individually agreed green electricity supplies. In the case of the UTN, the purchase of electricity from renewable energies results in avoided emissions of 20,290 kg CO_2 equivalents compared to the use of the regular nationwide electricity mix (see Figure 14). The figure includes only the portion of electricity that was directly purchased by the UTN and covered by green electricity, as the electricity consumption for the shared areas is subject to the general electricity mix and cannot be influenced by the UTN.

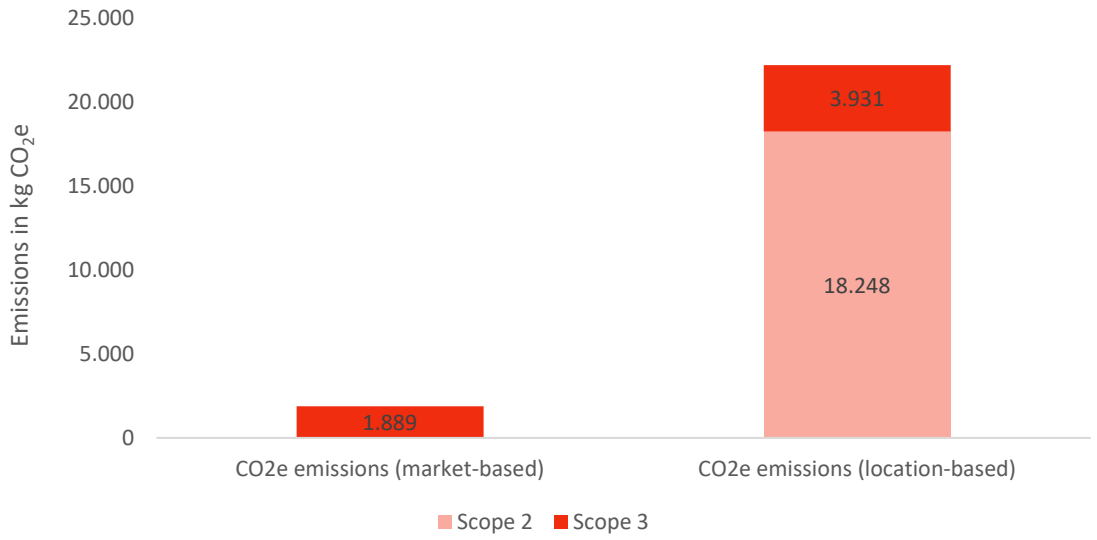

Figure 14: Comparison of market-based vs. location-based electricity consumption

4.7 Summary of the energy balance and greenhouse gas inventory

The UTN's GHG inventory sheet clearly shows that numerous measures to reduce resource consumption have already been implemented. Particularly noteworthy are the use of green electricity, the consistent use of electric vehicles in the vehicle fleet and the largely paperless office with a high proportion of recycled paper. These measures demonstrate that switching to climate-friendly alternatives is already an integral part of everyday operations.

However, it is also clear that the University's growth is accompanied by a significant increase in resource requirements. High emissions are generated particularly in the area of procurement, especially for IT and furniture. There is great potential for reducing emissions here, for example through the targeted selection of durable, resource-efficient and certified products, as well as through increased reuse and sharing concepts.

A significant proportion of emissions are attributable to the mobility sector, in particular commuting by employees, visitor mobility and air travel for business travel. These areas offer potential for reducing CO_2e emissions. The UTN has only limited influence on the individual choice of transport used by its employees, but there is some scope for manoeuvre when it comes to business travel and mobility of visitors. This makes it all the more important to create incentives for sustainable mobility, for example through good connections to public transport or the cycle path network.

Overall, the GHG inventory sheet provides a solid basis for further developing targeted measures to reduce emissions. It clearly shows where successes have already been achieved and where there is still room for improvement. The challenge now is to align the dynamic development of the UTN with the ambitious climate targets.

5 Potential analysis & scenario development

5.1 Basic assumptions

As the UTN is currently under construction, it is not feasible to identify potential for the GHG inventory in 2023. After all, the University is expected to have many times more members and space by 2045. A static view of the status quo is therefore insufficient and cannot adequately reflect the dynamic development process of the University.

For this reason, two scenarios were initially considered in order to examine future emissions trends under different conditions. The projections for both scenarios, the reference scenario and the climate action scenario, were made in 5-year increments up to 2050.

The reference scenario describes developments without additional climate action measures, is based on realistic assumptions and does not assume any additional political or institutional interventions, such as a mobility policy.

In contrast, the climate action scenario specifically integrates ambitious measures to reduce emissions, such as the introduction of climate-friendly building standards. The aim was to show only the effects that would result from the active commitment of the UTN in the climate action scenario.

5.2 Results of the scenario analysis

Methodology

To extrapolate the scenarios, either the development of the space used or the projected number of university members was used as a reference value, depending on the context. In both scenarios, the activity data was first forecast in 5-year increments. The reference values for area, number of employees and number of students were taken from the report by the Institute for Higher Education Development (HIS-HE, 2020). These were based on the UTN's maximum climate action targets. The assumptions reflect the highest realistically achievable savings potential under ambitious conditions. The activity data were then extrapolated to CO_2 equivalents. In both scenarios, it was assumed that the emission factor would be reduced by 1% annually. This assumption was based on the expectation that future efficiency improvements, technological developments and structural changes would lead to a continuous reduction in the emission factor. The CO_2e factors were applied uniformly in both scenarios, as they cannot be influenced by the UTN, with the exception of electricity consumption, where green electricity has a different CO_2e factor.

Presentation and evaluation of scenarios

Figure 15 shows the total emissions in kg CO_2e for the two scenarios considered. It shows that emissions in the reference scenario are around three to four times higher than in the climate action scenario, revealing considerable potential for reduction.

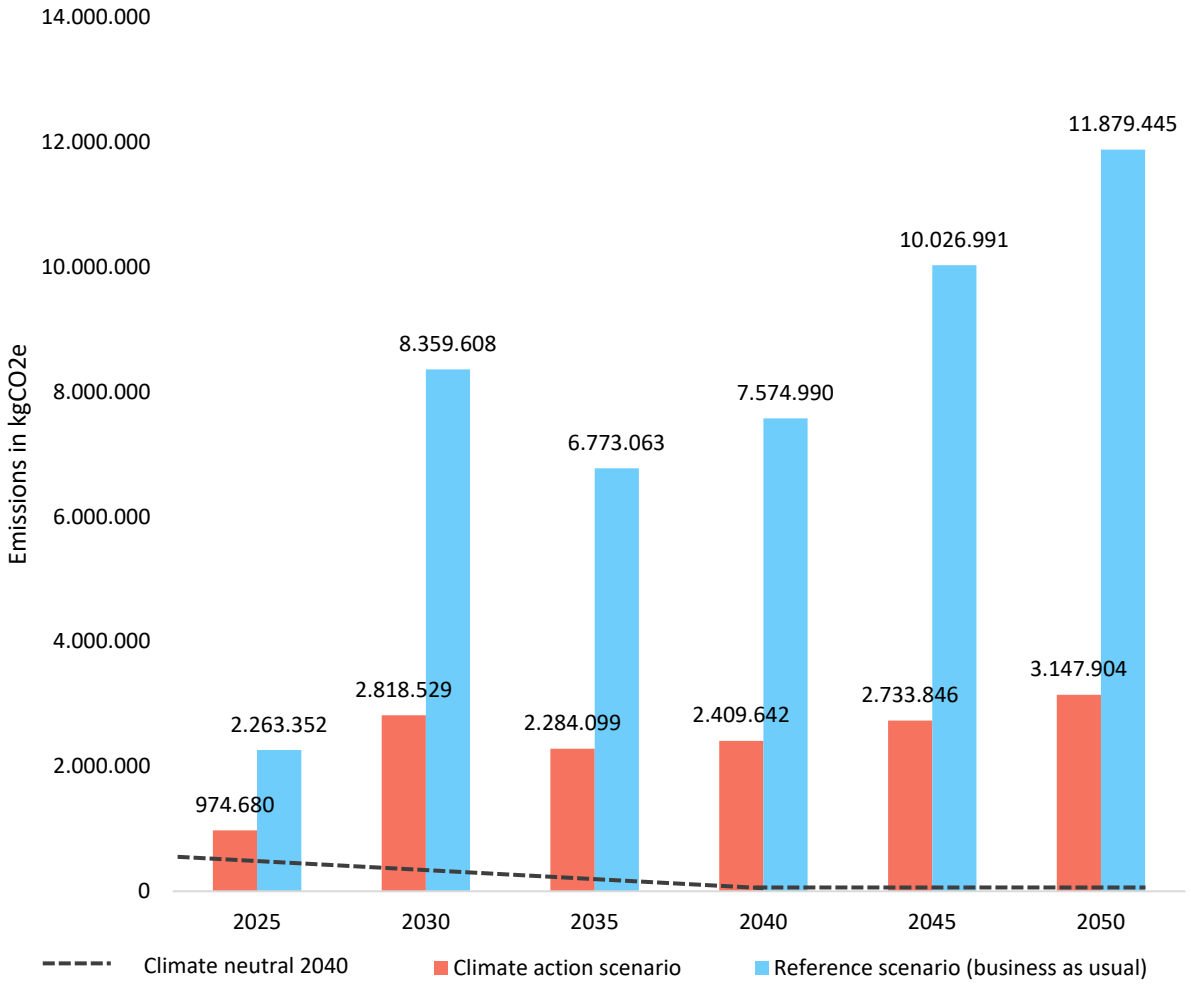

Figure 15: Overall comparison of climate action and reference scenarios (Scope 1-3)

Figure 16 shows only emissions from Scope 1 and 2, as this demonstrates that the climate neutrality target agreed with the StMWK for 2028 will not be achieved even in the climate action scenario. Although the target will not be met, the shortfall will not be significantly greater than in the reference scenario. At the same time, it is clear that Bavaria's climate action target for 2040 will also not be achieved. The national climate action target of climate neutrality by 2045 will be achieved (see Section 6). Scope 1 is included in the presentation, although no emissions are expected. A more detailed explanation can be found in Section 5.3.

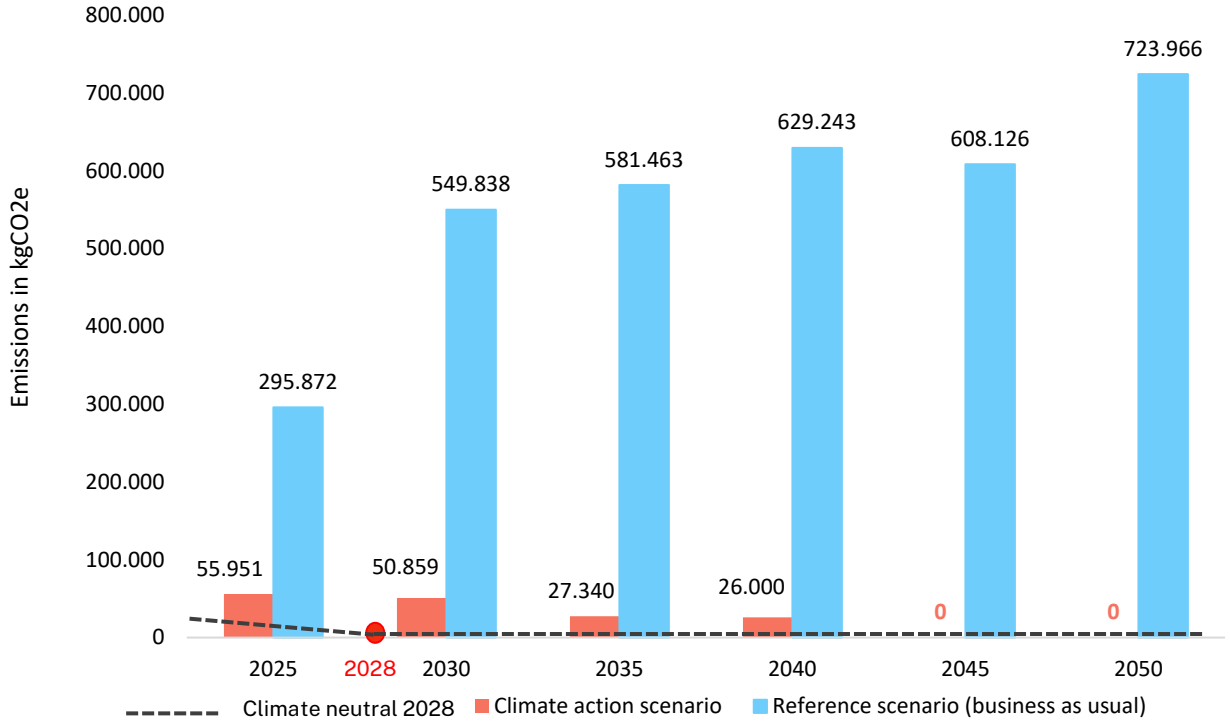

Figure 16: Comparison of climate action and reference scenario for Scopes 1&2

Figure 17 shows emissions in relation to the number of University members; this is a more meaningful relative indicator in view of the expected growth of the UTN. This clearly shows that CO_2e emissions per capita will not increase despite the planned expansion of the campus, but will continue to fall. The reason for this is that the existing infrastructure will be used by a growing number of students and employees. The year 2030 is an exception, with an increase recorded. This is due to the fact that several new buildings will be commissioned in 2029 and 2030, which will initially cause higher emissions, while the number of University members will not increase to the same extent.

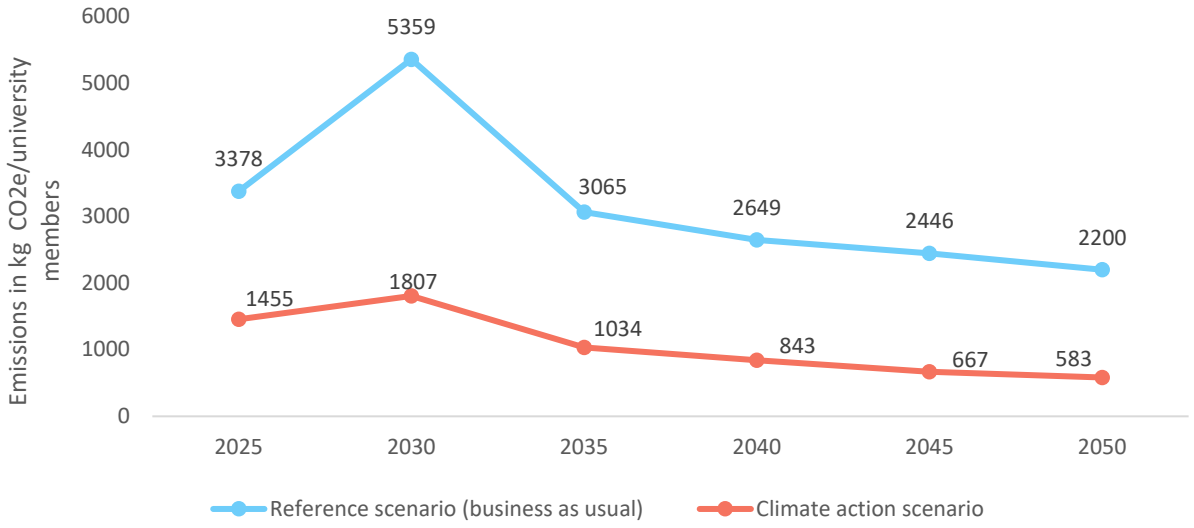

Figure 17: Scenario representation based on the number of University members

5.3 Potential analysis in Scope 1

In both scenarios, no emissions are expected for Scope 1, which covers all direct emissions from sources owned or controlled by the UTN. It is assumed that the vehicle fleet will remain fully electric and that only environmentally friendly refrigerants will be used for the cooling systems used to cool the buildings. As a result, the greenhouse gas potential in this area is virtually zero.

5.4 Potential analysis in Scope 2

The data for both scenarios is based on the UTN's energy concept. Only electricity purchased from the grid is included in the projections. Electricity consumed from photovoltaic systems was not taken into account, as it does not cause any CO_2 emissions. In the long term, the plan is to equip around 75 percent of the suitable roof space at the UTN with PV systems, which will lead to a high level of self-sufficiency in the medium term.

Electricity is currently procured through a central tender process organised by the Free State of Bavaria, which is committed to 100% renewable energy. This assumption continues to apply in the climate action scenario. Both general electricity consumption and the vehicle fleet show that the use of green electricity does not result in any emissions (see Figure 18 & Figure 19).

In 2024, the Bavarian state government implemented various measures to consolidate the budget. Therefore, a switch to electricity from the regular energy mix cannot be ruled out in the future. Against this backdrop, the nationwide electricity mix is used as the basis for calculation in the reference scenario as a precautionary measure.

Despite expansion, the reference scenario shows a downward trend in emissions for the e-fleet. This is due to the assumption of an annual reduction in the emission factor of 1% (see Section 5.1).

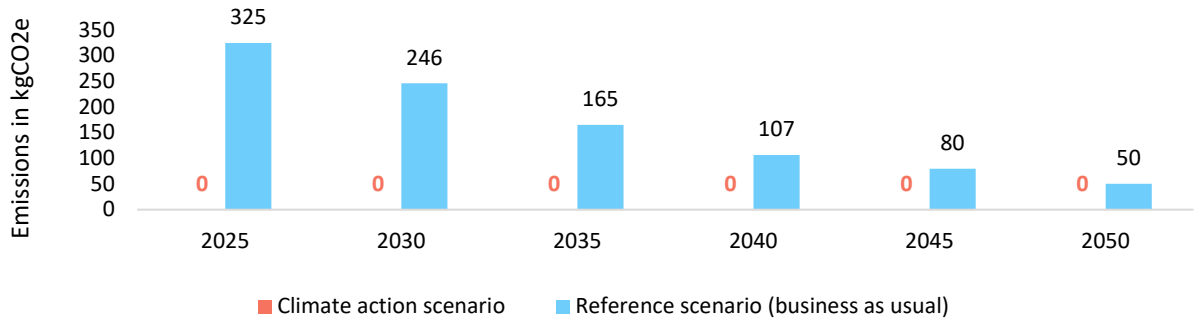

Figure 18: E-fleet: comparison of climate action and reference scenarios

In contrast, an increase in electricity consumption can be observed. This increase offsets the declining emission factors, meaning that overall emissions are not declining.

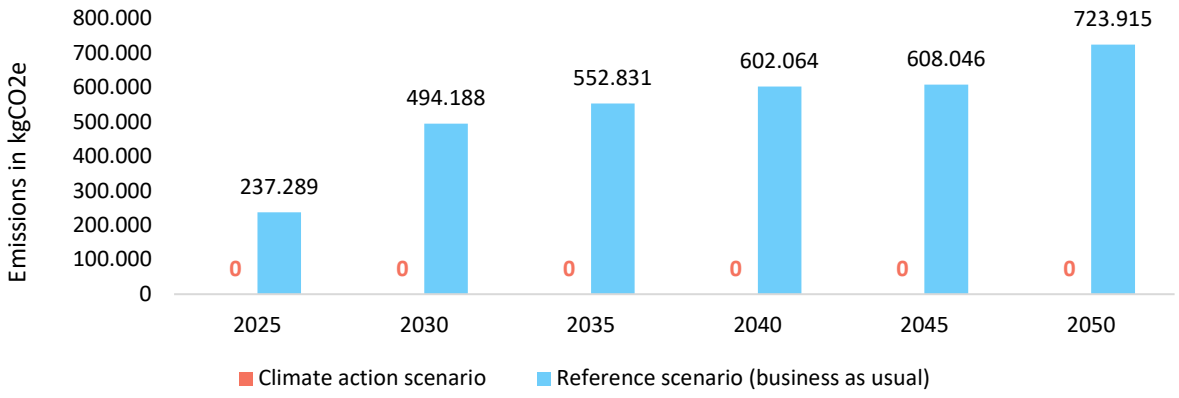

Figure 19: Electricity: comparison of climate action and reference scenarios

Figure 20 shows that there is a difference between the reference scenario and the climate action scenario with regard to district heating: in the climate action scenario, it is assumed that behavioural changes and efficiency measures will result in annual savings of 2% in heating energy.

The calculation also takes into account that the rented buildings in Ulmenstrasse and Nordostpark will be used only until 2040, as sufficient buildings will then be available on campus. From this point onwards, heat consumption there will be completely eliminated.

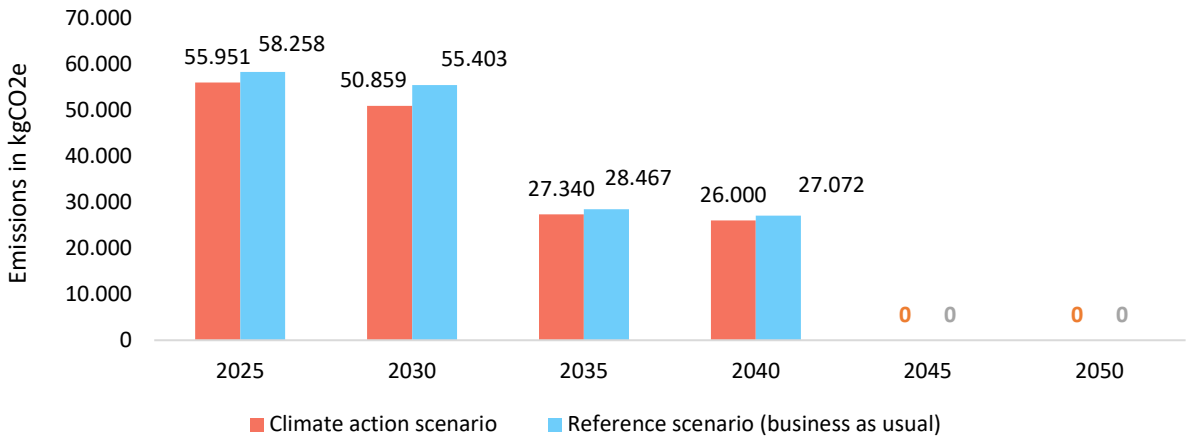

Figure 20: Heat: comparison of climate action and reference scenarios

5.5 Potential analysis in Scope 3

Cafeteria/canteen

The first cafeteria on campus will open in 2027, with a second cafeteria expected to follow in 2029. The Erlangen-Nuremberg Student Services Association will be solely responsible for operating both cafeterias and the planned canteen (after 2045).

Although the canteen and cafeterias are not considered direct sources of emissions according to the control approach, they are nevertheless included in the UTN's emissions inventory. The decisive factor here is their relevant contribution to campus-related emissions. The UTN is in contact with the student services organisation and can influence emission-related factors by shaping the range of services on offer and through targeted communication.

The inclusion of the cafeteria and canteen in the balance sheet serves to promote transparency and forms the basis for considering climate action at the UTN not only in terms of figures, but also in terms of structure and strategy.

The reference scenario continues to assume that around 35% of university members (employees and students) use the canteen on almost every working day. This assumption is based on information provided by the student services organisation. The food on offer will consist mainly of mixed meals, some of which will be organic and regional.

The climate action scenario assumes that both main courses and snacks will be offered exclusively in vegan, regional and organic quality (see Figure 21).

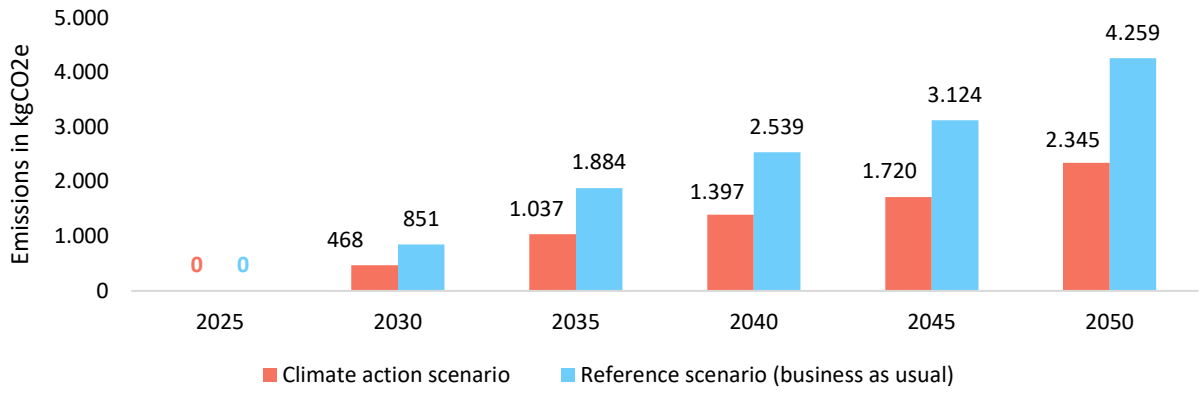

Figure 21: Cafeteria/canteen: comparison of climate action and reference scenario

IT hardware and software

In the field of IT technology, there are clear differences between the scenarios (see Figure 22), particularly with regard to the service life of the devices. Whereas in the reference scenario, annual depreciation is calculated in accordance with the rules on depreciation for wear and tear (AfA), the climate action scenario assumes a longer useful life of three years.

The climate action scenario also assumes an annual reduction of 1% in toner consumption. This assumption is based on ongoing digitalisation and the associated decline in printing volumes.

Furthermore, it is expected that server components will be able to be used for seven years instead of five in the climate action scenario.

As already explained in Section 4.4.3, a significant portion of data centre operations is handled by the RRZE. Since green electricity is used for this purpose, there are no differences between the scenarios in this regard. Nevertheless, the remaining outsourced IT services still require electricity. The climate action scenario therefore assumes that the energy consumption of these services will be reduced by 1% per year through awareness-raising measures, such as more conscious use of computing power and storage space.

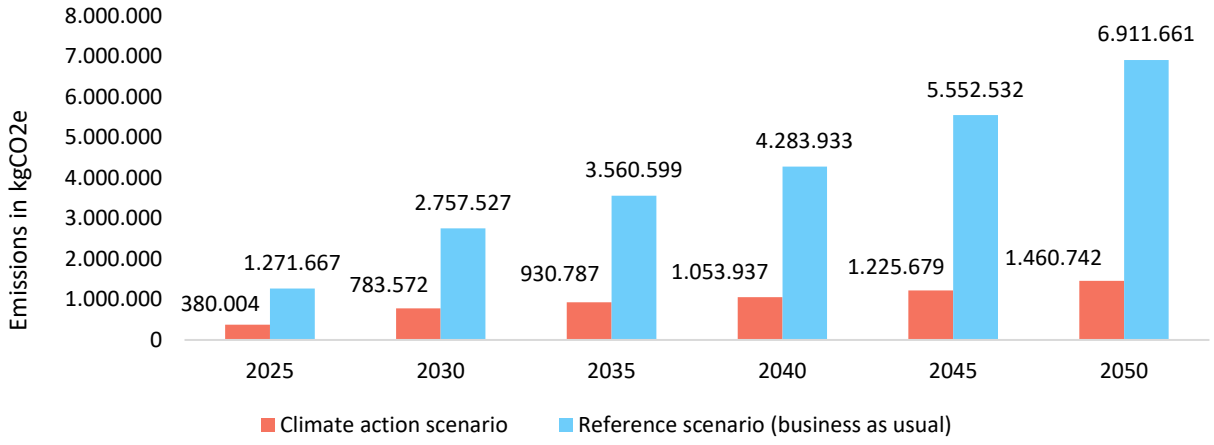

Figure 22: IT: comparison of climate action and reference scenarios

Furniture

Figure 23 shows the difference between the two scenarios for the procurement of furniture. In the reference scenario, it was assumed that one filing cabinet is required per employee, with a depreciation period of 13 years in accordance with AfA.

By contrast, the climate action scenario assumes that, due to advancing digitalization processes, demand will fall to just 0.25 shelves per person. It also assumes that the useful life will double.

Assumptions were also made regarding workplace furnishings, specifically desks and office chairs. The climate action scenario assumes that mobile working will continue to be promoted and that, on average, only 0.75 fully equipped workstations per employee will be required, whereas the reference scenario assumes one workstation per employee.

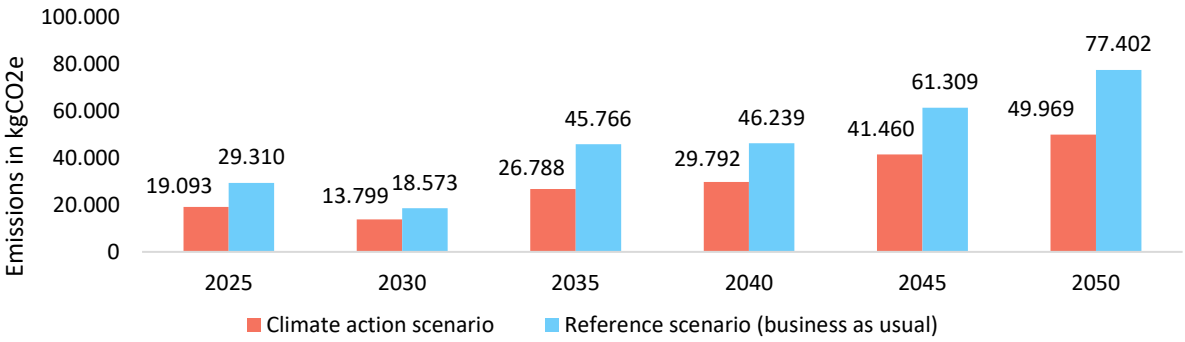

Figure 23: Furniture: comparison of climate action and reference scenarios

Cleaning and hygiene

As can be seen in Figure 24, targeted awareness-raising measures have resulted in a slight difference. The climate action scenario assumes that the consumption of hygiene products and cleaning agents will decrease by 1% annually. The reference scenario assumes that the use of cleaning agents will remain unchanged.

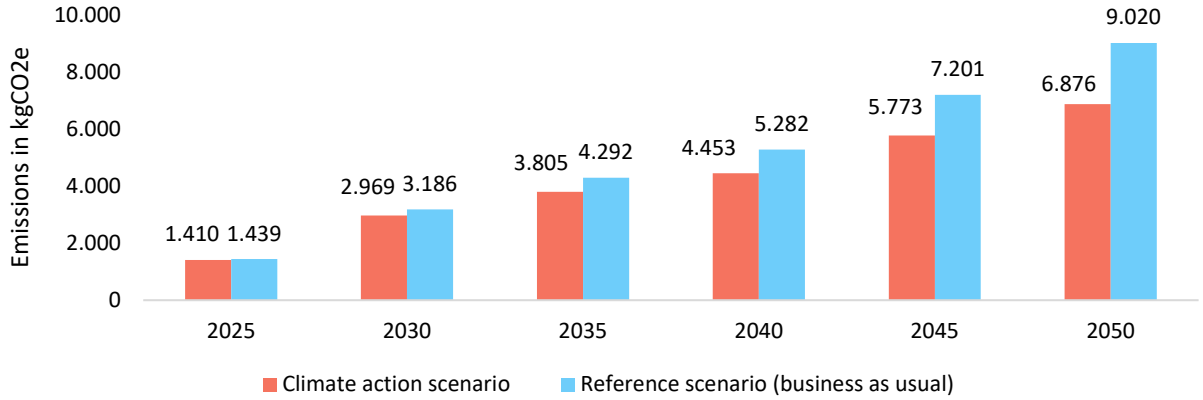

Figure 24: Cleaning & hygiene: comparison of climate action and reference scenarios

Paper and printed materials

The reference scenario assumes that the recycled printer paper quota (82%) will remain at the base year level of 2023. In contrast, the climate action scenario assumes that the share of recycled printer paper in total paper consumption will increase linearly to 95% by 2030 and remain constant thereafter. In addition, an annual reduction in total paper consumption of 1% is assumed, due to on-going digitisation processes. The large increase in emissions in 2030 is due to the completion of the library, which will be a learning centre with approximately 50,000 volumes (see Figure 25).

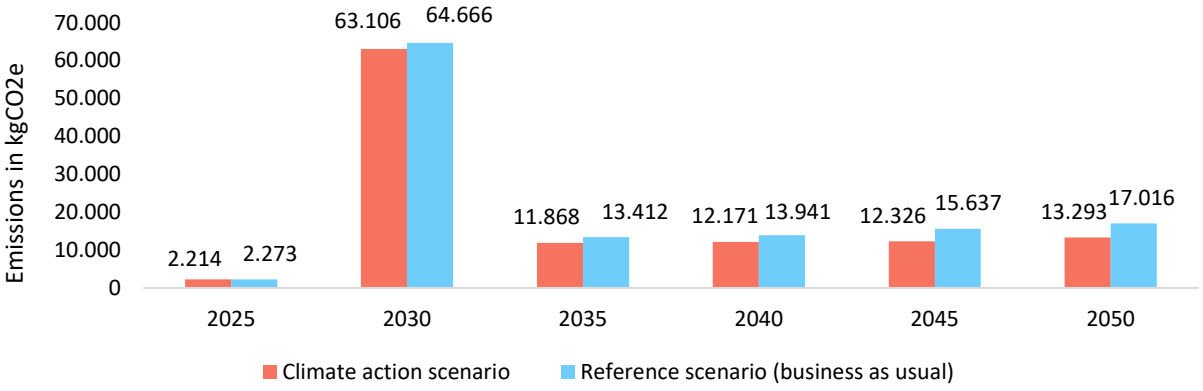

Figure 25: Paper & printed products: comparison of climate action and reference scenarios

Capital goods: buildings and surface sealing

In the area of capital goods, the construction of new buildings on campus and the sealing of land are considered in particular.

To determine the scenarios, a CO_2 inventory was calculated for the already completed 'Cube One' building. However, this inventory was not included in the GHG inventory (2023) of the Climate Action Plan, as 'Cube One' will not be completed until 2024. However, based on this accounting, it was possible to extrapolate the quantities of materials for the buildings planned for the future. There are clear differences between the reference scenario and the climate action scenario (see Figure 26).

In the climate action scenario, based on the 'Cube One', it is assumed that wood will continue to account for a high proportion of building materials (approx. 60% by volume). In contrast, the reference scenario assumes a share of only 10% for timber building materials. This is due to current cost-cutting measures by the Bavarian state government. As a result, more cost-intensive construction methods using timber or other sustainable materials could be implemented less frequently.
In addition, the calculation assumed that approximately 10% of the fire doors are made with wooden frames and that load-bearing façade elements and substructures of façade cladding are not made of aluminium but also of wood. In addition, hemp is used as insulation material in this scenario instead of conventional mineral wool.

The significant difference between the scenarios is due to the negative CO_2 equivalent value of wood, as CO_2 emissions are bound in wood.

As explained in Section 4.6.3, only construction phases A1 to A3 are taken into account in the balance sheet in accordance with the BayCalc system. If later life cycle phases were also included (as is common in more comprehensive accounting systems), the climate advantage of wood would be reduced, but timber construction would still remain significantly lower in emissions than conventional alternatives within the scope of this study.

The comparatively low greenhouse gas inventory in 2025 in both scenarios is due to the additional sealing of surfaces.

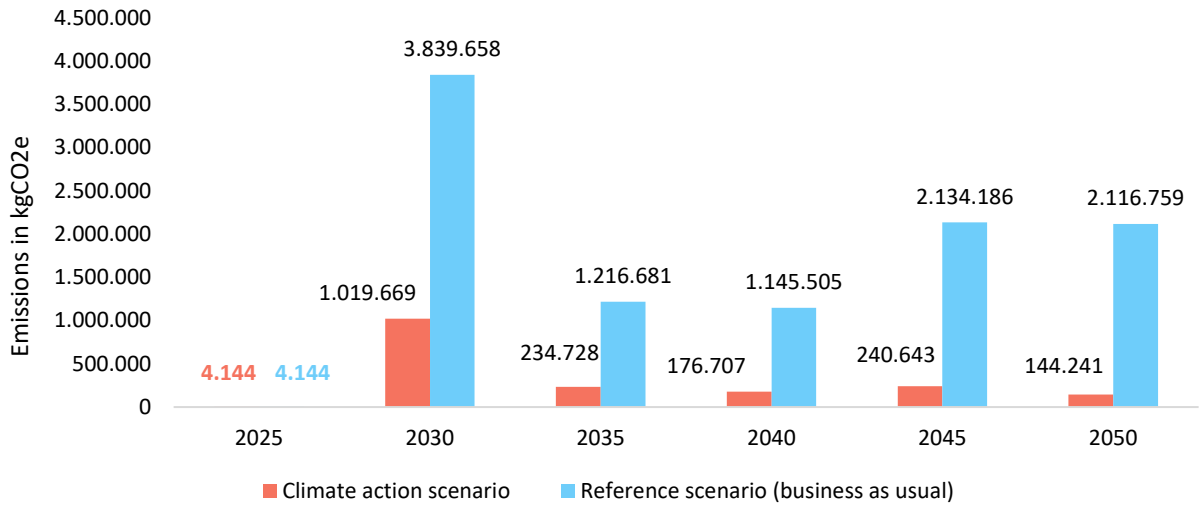

Figure 26: Capital goods: comparison of climate action and reference scenarios

Upstream processes

As shown in Figure 27, emissions are also significantly lower in the upstream sectors in the climate action scenario. The reason for this is the use of green electricity, which is associated with lower emission factors in Scope 3. As a result, emissions in the climate action scenario rise only slightly, while they increase significantly in the reference scenario.

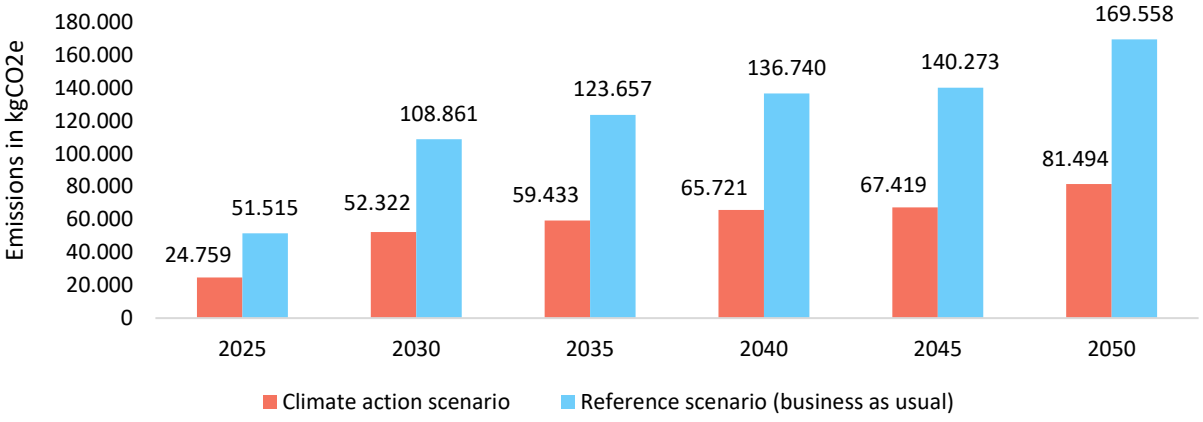

Figure 27: Upstream processes: comparison of climate action and reference scenarios

Mobility of visitors

As can be seen in Figure 28, raising visitors' awareness leads to a clearly measurable reduction in CO_2 emissions. In the area of visitor mobility, the climate action scenario assumes that the proportion of online events will increase by one percent annually. At the same time, participants' mobility behaviour is changing noticeably in favour of local public transport, whose use is increasing by 10%. In addition, medium-haul flights are being replaced by rail travel in half of all cases.

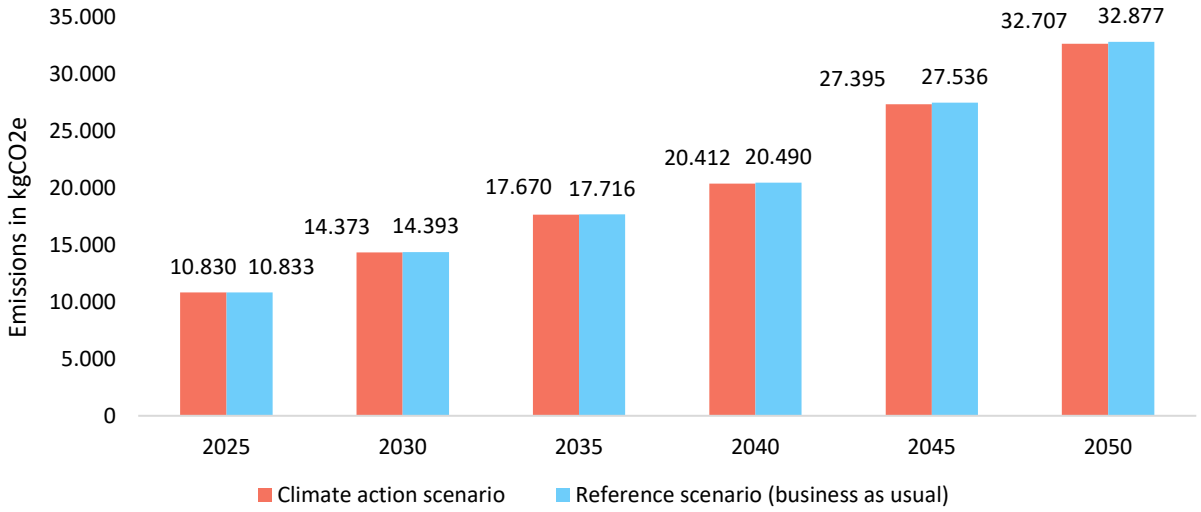

Figure 28: Visitor mobility: comparison of climate action and reference scenarios

Business travel

As shown in Figure 29, internal guidelines for employees can also contribute effectively to reducing CO_2 emissions. The climate action scenario assumes that the proportion of online events will increase by 1% annually. At the same time, the number of car journeys made by staff will decrease by 10% in favour of local public transport.

Instead of private cars, greater use will be made of public transport and the UTN vehicle fleet. From 2035 onwards, business trips by private car will no longer be permitted. In addition, it is assumed that half of all air travel, especially medium-haul flights, will be replaced by rail travel.

In the reference scenario, however, emissions rise in proportion to staff growth.

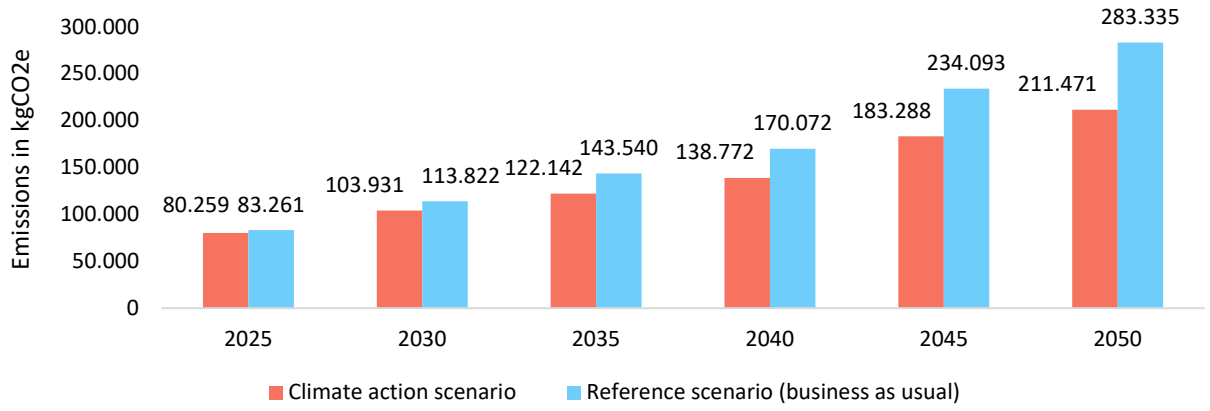

Figure 29: Business travel: comparison of climate action and reference scenarios

Mobility of employees

There is also potential for savings in commuter traffic (see Figure 30). Although emissions rise in both scenarios, they do not increase proportionally to the number of University members. This is based on the assumption that the proportion of electric vehicles will continue to increase compared to combustion engines. In addition, a 10% shift in traffic volume towards local public transport is expected.

However, there is still a relevant difference in the climate action scenario. This is based on the assumption that, instead of the current two days per week, mobile working will be possible on three days per week in the future. This measure will contribute to a further reduction in commuting distances and thus also in traffic-related CO_2e emissions.

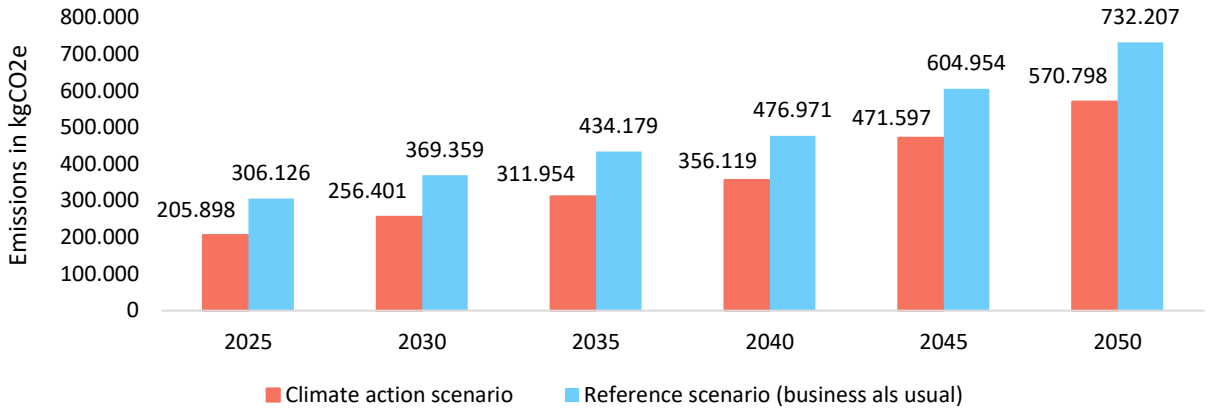

Figure 30: Commuter traffic by employees: comparison of climate action and reference scenarios

Mobility of students

Since no reliable baseline data on student commuting patterns was available for 2023 (see Section 4.6.3), a comparative approach was chosen. It was assumed that the modal split of students at the UTN would be similar to that of Kiel University (Christian-Albrechts-Universität zu Kiel, 2024), as both locations have comparable infrastructure.

Based on this, it was assumed that the modal split would shift by 10% towards local public transport. In addition, both scenarios assumed that the proportion of vehicles with combustion engines would gradually decrease in favour of electric drives (see Figure 31).

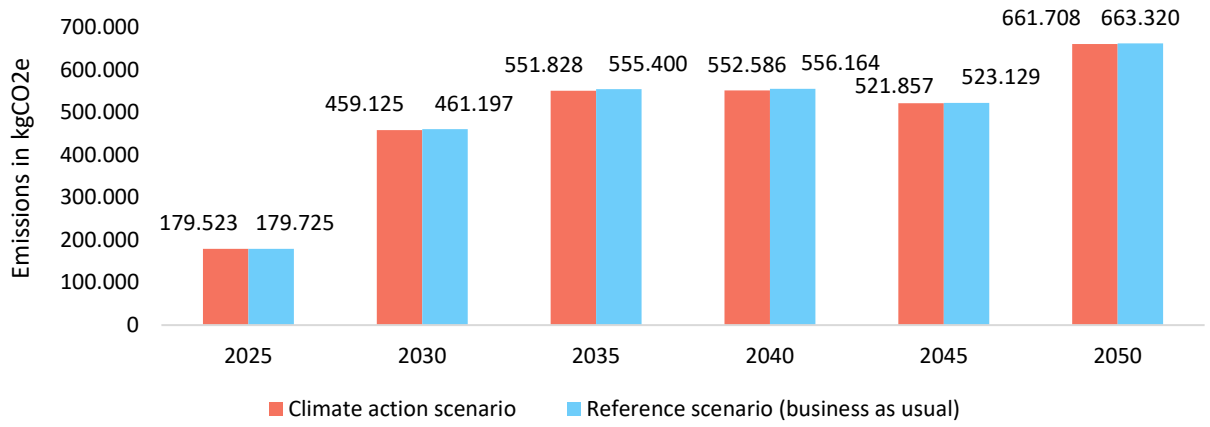

Figure 31: Commuter traffic by students: comparison of climate action and reference scenarios

Waste

As can be seen in Figure 32, there are significant differences between the scenarios in terms of waste. No separate surveys were conducted for IT waste in the base year. The figures have therefore been extrapolated based on EMAS (Eco-Management and Audit Scheme) data from comparable universities.

The climate action scenario assumes an annual reduction of 2% in electronic waste, all other types of waste and wastewater.

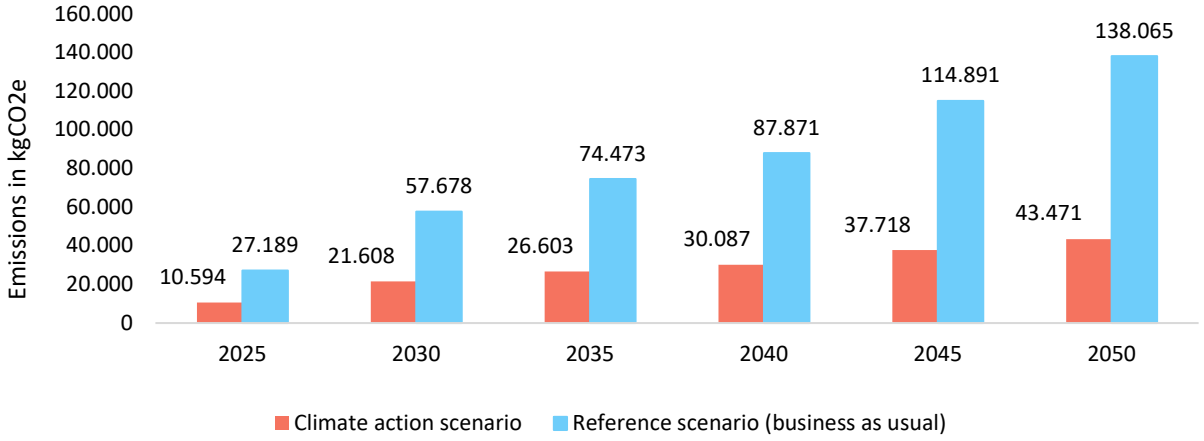

Figure 32: Waste: comparison of climate action and reference scenarios

5.6 Conclusion: scenarios and potential in the context of establishing the UTN

Figure 33 shows the biggest differences and potential savings between the climate action scenario and the reference scenario. A combined analysis of scenarios and potential shows that early and structured integration of climate action measures into the UTN development process is crucial to realistically achieving the defined targets, in particular climate neutrality in Scope 1 and 2 by 2028.

The scenarios illustrate that Scope 3 emissions in particular will account for a growing share of the overall inventory. However, reducing these emissions often requires more complex structural measures or cooperation. The potential analysis provides specific starting points: IT, construction (capital goods), business travel and employee mobility in particular prove to be major levers with a significant impact on emissions development and should therefore be included in the selection of measures at an early stage. While areas such as energy supply and business travel can be influenced relatively directly, procurement, construction and mobility require more far-reaching strategies and institutional coordination.

Overall, the analysis confirms that ambitious reduction targets remain challenging but can be achieved with targeted measures. This requires that climate action is understood as an integral part of strategic development at the University from the outset and is continuously integrated into all decisions.

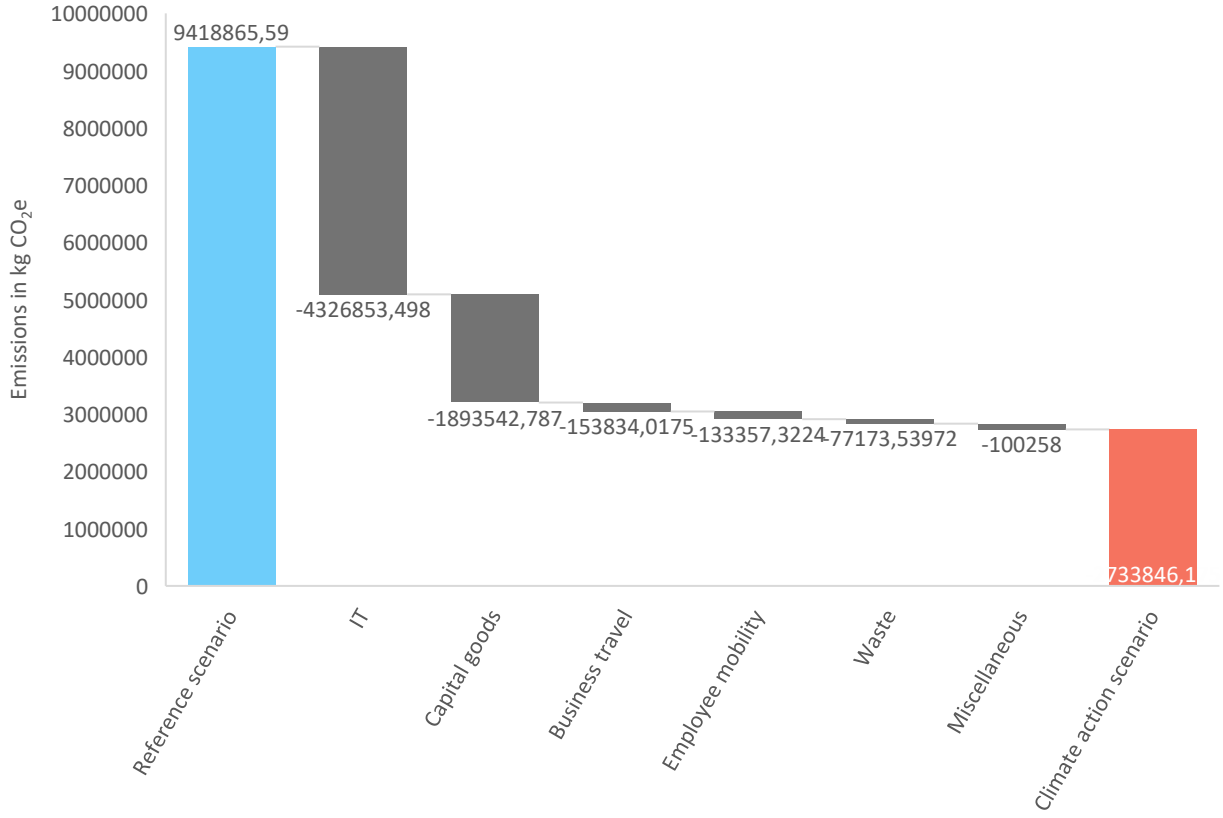

Figure 33: Savings potential in 2045

6 Climate action goals and strategies

This section describes the UTN's objectives in the area of climate action and sustainability. It sets out clear goals aimed at significantly reducing the UTN's greenhouse gas emissions, promoting the responsible use of resources and transforming the University into a greenhouse gas-neutral institution in the long term. At the same time, efforts are being made to keep the increase in emissions from new construction projects on campus as low as possible.

Since terms such as ‘greenhouse gas neutrality’ and ‘climate neutrality’ can be interpreted in different ways, it is important to define them clearly for the purposes of this Climate Action Plan: (UBA, 2024)

Greenhouse gas neutrality: Greenhouse gas neutrality means (according to the definition in the Kyoto Protocol) that no more greenhouse gases are emitted than are simultaneously removed from the atmosphere.

This can be achieved through savings, e.g. in heating and transport, or through renewable energies. Remaining emissions can be offset, for example through forests or technical processes such as the capture and storage of CO_2 underground (e.g. carbon capture and storage).

The aim is to achieve a stable climate through a balanced ratio of emissions and removals.

Climate neutrality encompasses more than just offsetting greenhouse gases; it also takes into account indirect influences on the climate, such as changes in soil, land use or surfaces that help determine the Earth's temperature behaviour.

6.1 Climate action targets at the federal and state levels

The UTN's climate action goals are primarily based on the climate action goals of the German federal government and the Bavarian state government. These form the legal framework and serve as minimum requirements for the objectives of the UTN.

Climate action targets of the German federal government: According to the Federal Climate Change Act, greenhouse gas emissions are to be gradually reduced as follows compared to 1990 levels:

By 2030: by at least 65%

By 2040: by at least 88%

By 2045: net greenhouse gas neutrality

Climate action targets of the Free State of Bavaria: The Free State of Bavaria has set itself the goal of becoming climate neutral by 2040 in the Bavarian Climate Change Act. For the immediate state administration, this goal is already being pursued by 2028. Universities and colleges are explicitly excluded from this, but contribute to achieving Bavaria's climate action goals.

6.2 Climate action goals at the UTN

The University contract between the UTN and the Bavarian State Ministry of Science and the Arts (StMWK, 2023) sets out the following objectives:

Development of an institutional sustainability strategy

The UTN aims to develop a comprehensive sustainability strategy that takes into account all of the University's key areas of activity. These include governance, teaching, research, property planning and construction, operations, transfer, employees, students and student initiatives.

The sustainability strategy is being developed in parallel with the Climate Action Plan. The content of the sustainability strategy will be addressed within the framework of the Climate Action Plan. The sustainability strategy will then refer to the Climate Action Plan in the relevant sections.

Establishment of greenhouse gas monitoring in accordance with the GHG Protocol

The UTN prepares a greenhouse gas inventory sheet based on the GHG Protocol. The aim is to transparently and continuously record and evaluate greenhouse gas emissions specific to the university. The balance sheet is updated annually to provide a clear overview of developments and document progress in the area of climate action. In accordance with the agreement with the Bavarian State Ministry of Economic Affairs and Digitalisation, an initial assessment must be submitted by the end of June 2026. The UTN has already prepared an initial assessment for 2023 as a basis for the Climate Action Plan.

Development and definition of a strategy for avoiding GHG emissions

As part of the university development process, the UTN is obliged under its agreement with the Bavarian State Ministry of Economic Affairs and Digitalisation to develop a strategy for avoiding and limiting greenhouse gas emissions. The aim is to define and implement climate-friendly and resource-efficient measures during the development phase.

This avoidance strategy is being developed by the UTN and coordinated closely with the Bavarian State Ministry of the Interior and of the Interior, Building and Community (StMWK). The final version of the strategy requires the approval of the Bavarian StMWK. The strategy paper is expected to be available by the end of June 2026.

Climate-neutral development of the University

The UTN is being constructed in accordance with binding requirements to make it as climate-neutral as possible. Structural, operational and organisational decisions are systematically analysed and evaluated from the perspective of climate neutrality.

This includes planning and implementing a climate-friendly and low-emission university structure, as well as consistently considering climate-friendly aspects and integrating them into construction and operational concepts.

Offsetting remaining emissions from 2028 onwards to achieve climate neutrality

In accordance with the agreement with the Bavarian State Ministry of Economic Affairs and Digitalisation, the UTN will offset remaining emissions, at least from Scope 1 and 2, through appropriate compensation measures. Compensation enables unavoidable emissions to be neutralised in order to achieve the overall goal of climate neutrality.

Reporting

The UTN ensures that all measures and results achieved in the context of climate action are systematically integrated into the designated reporting systems in accordance with Objective 9.1 (Sustainability, Climate Action) of the Framework Agreement (StMWK, 2023) to the Bavarian State Ministry of Science and the Arts.

The UTN sets its own climate action targets that go beyond its legal obligations. These are based on the results of the potential analysis and include in particular:

- Achieving GHG neutrality in Scope 1-3 by 2040
- Expanding renewable energies, installing smart storage systems and optimising energy efficiency on campus
- Climate-neutral, flexible infrastructure with digital monitoring
- Reducing energy consumption by at least 2% per year
- Integrating climate action and sustainability into all planning and decision-making processes
- Sustainable mobility through increased use of cycling and public transport, reduction of motorised private transport and business air travel, and use of digital meeting alternatives
- Greening, unsealing and rainwater utilisation for biodiversity and climate resilience

Although Bavarian and national climate action targets do not currently specify any explicit requirements for achieving climate neutrality in Scope 3, this is precisely the area where the UTN's highest emissions are currently located. The UTN has therefore made a conscious decision to actively include Scope 3 emissions in its own climate action targets and to become climate neutral in all areas in the long term.

6.3 Strategies for achieving goals

The potential analysis for the UTN identified commuting, business travel, procurement and capital goods as key levers for reducing GHG emissions.

In order to achieve its goals, the UTN follows the principle of avoiding emissions wherever possible, limiting unavoidable emissions and offsetting unavoidable emissions that cannot be limited in the long term.

The UTN is guided by three overarching strategies:

Investment: Even in the start-up phase, the UTN is focusing on technical solutions that will help to avoid an unnecessary increase in greenhouse gas emissions. These include forward-looking investments in energy-efficient facilities, renewable energy sources and sustainable mobility options.

Regulation: Guidelines, standards and internal regulations are used to promote climate-friendly conditions at an early stage. The aim is to prevent climate-damaging developments from becoming established in the first place, for example through restrictions on air travel for business purposes or clear guidelines for sustainable procurement.

Communication and awareness: Since not all GHG emissions can be avoided for technical or organisational reasons, the UTN has focused from the outset on raising awareness among all members of the University community. Transparent communication about climate action and sustainability is intended to actively involve students and staff in the development of a responsible campus.

In addition to the immediate benefits for climate action, a forward-looking focus on climate action also brings strategic advantages for the UTN. By integrating climate action requirements into planning and decision-making processes at an early stage, potential future requirements and guidelines can be proactively taken into account. This creates long-term planning security and minimises the risk of costly adjustments at a later date.

In addition, early investment in climate-friendly technologies and infrastructure enables a sustainable reduction in ongoing operating costs, especially when compared to potential compensation payments. This also makes climate action an economically viable field of action.

7 Stakeholder involvement

The successful development of a comprehensive Climate Action Plan for the UTN requires the active involvement of various stakeholders both within and outside the University. This participation not only strengthens acceptance and support for the planned measures, but also enriches the planning process with diverse perspectives and expertise. As the Climate Action Plan will be part of the sustainability strategy, a number of stakeholders were involved in parallel.

This Section explains how the integration was structured and which stakeholders were involved in developing the Plan.

7.1 Stakeholders

The following internal stakeholders were identified as part of the process:

- Executive Board
- Departments (scientists)
- University administration
  - Team of the Founding Executive Board
    - Strategic Controlling Team
    - Boards and networks
  - Communication Unit
  - Finance and Human Resources Unit
    - Finance and Controlling Team
    - Procurement Team
    - Human Resources
  - Real Estate Unit
    - Buildings and Infrastructure Team
    - Estate Service Team
  - IT unit
  - Diversity, Equity and Inclusion
- Students

In addition to internal stakeholders, external stakeholders were also identified:

- State Building Authority
- City of Nuremberg
- Student Services Erlangen/Nuremberg
- Centre for Higher Education and Sustainability Bavaria (BayZeN)

7.2 Forms of involvement

As part of the process of developing the Climate Action Plan, numerous formats were offered to enable employees and students of the UTN to play an active role in shaping it. There were many opportunities for participation, and the entire process was designed to be as transparent and participatory as possible.

In addition to public events, members of the university community were also able to contribute their ideas and suggestions by email or on a Miroboard. A press release was published to inform the public. The contents of the Climate Action Plan can also be viewed on the UTN website. Active participation in the creation of the Climate Action Plan was promoted through direct contact, email invitations and as an exhibitor at the WOW exhibition (an internal trade fair for new students).

Interviews on the sustainability strategy

In summer 2024, various individuals were surveyed at the UTN about the current situation in the area of sustainability. These included students, employees from the departments and from the following departments: Governance, Diversity, IT, Finance and Controlling, Procurement, Human Resources, and Real Estate.

The feedback from these discussions has been incorporated into the Climate Action Plan and has helped to provide a realistic picture of the status quo.

Workshop on green space irrigation

In June 2024, the State Building Authority invited employees from the Building & Infrastructure, Technical Services, and Estate Service departments to a workshop. The aim was to optimize the irrigation of green spaces during the upcoming construction phases. In addition, sustainability aspects were taken into account and integrated into the planning — an important contribution to ecologically responsible campus development. The UTN's climate action manager was invited to this exchange and contributed the perspective of climate action.

Workshop on the sustainability strategy

In July 2024, a workshop on sustainability was held for all organisational units, during which the relevant stakeholders within the UTN were first identified. Together, initial key topics and areas for action in the field of sustainability were identified. In addition, the interfaces with the Climate Action Plan and the designation of the fields of action were coordinated. The results of this workshop formed an important basis for the Climate Action Plan and contributed significantly to its further development.

Online information event on GHG inventory

In November, the UTN's greenhouse gas report was presented to all employees and students during an online information event. In addition to presenting key findings, initial proposals for measures in the respective areas of action were discussed. Attention was also drawn to the upcoming measures workshop in January 2025.

Action workshop

At the end of January 2025, a comprehensive workshop was held, attended by representatives from all organisational units of the UTN. During this workshop, potential emission reductions and various scenarios were presented (see Figure 34). The previously defined objectives were reviewed, revised and supplemented. Finally, concrete measures for implementation were developed and prioritised (see Section 8).

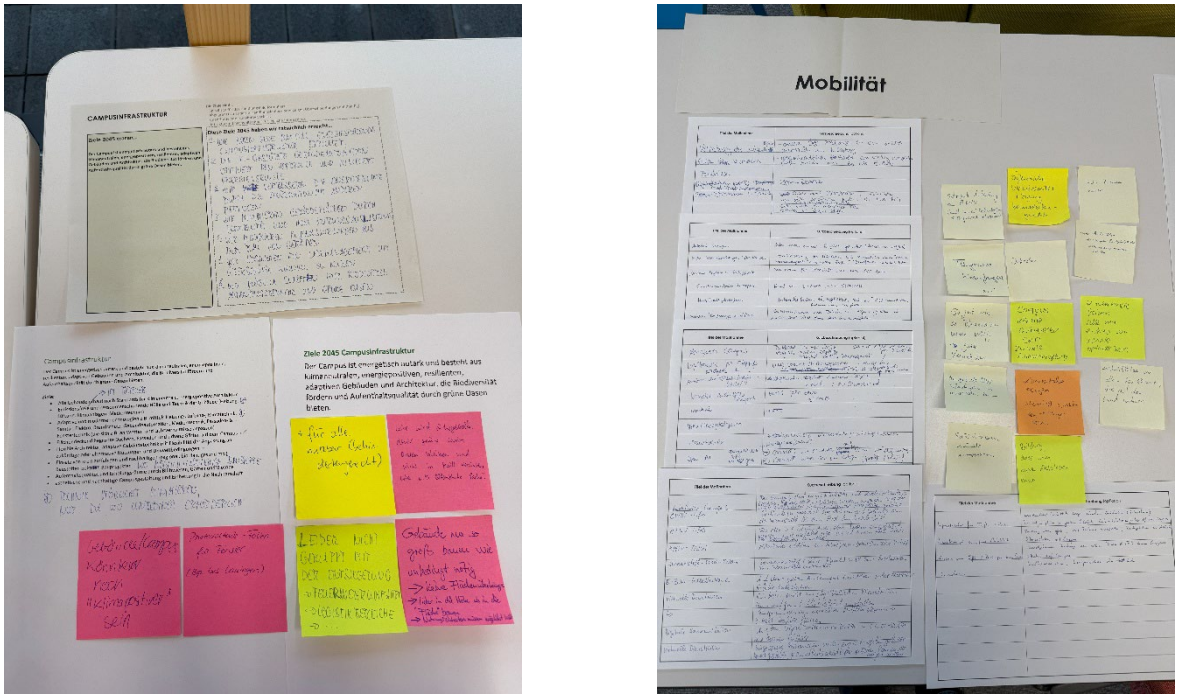

Figure 34: Sample photo from the action workshop

Internal discussions and interviews

During the design phase, numerous discussions were held with representatives of the various organisational units of the UTN, both in one-on-one meetings and in smaller groups. The focus was on collecting relevant data for the GHG inventory, discussing possible climate protection measures and identifying potential for reducing emissions. The information obtained provided a sound and practical basis for developing the Climate Action Plan. Particular emphasis was placed on dialogue with students, who are considered key drivers of climate action measures on campus. Due to the

small number of students currently enrolled (around 30), opportunities for participation were limited. Nevertheless, several discussions were held with students in order to incorporate their perspectives.

Participation in committee meetings

During the design phase, the climate action manager presented the individual components of the Climate Action Plan at the Executive Committee meetings on 11 July 2024 and 15 January, 13 March, 8 May and 5 June 2025, and also presented key content to the founding committee on 15 May 2025. This ensured that all relevant decision-makers were involved at an early stage and were fully informed.

Exchange within the core climate action team

Since last autumn, there has been a permanent core climate action team comprising employees from various organisational units (Real Estate, IT, Department Management, Procurement, StaRs). The team meets regularly and provides strategic support for the implementation of the Climate Action Plan and contributes ideas for climate action.

8 Objectives and measures

The measures were identified during a workshop held at the end of January 2025, which was attended by representatives from all organisational units, including departments. The workshop was based on a forward-looking strategy: participants imagined themselves in the year 2045 and considered what goals the UTN might have achieved by then. For each area of action, objectives were first presented, which were then supplemented and adapted by those present.

The fields of action themselves were not developed in line with Scope 1-3 or the GHG Protocol classification, but rather in a practical manner based on the funding body's specifications. In each field of action, an analysis was carried out to determine which measures would have contributed to achieving the defined goals.

The measures were divided into two categories: quick wins, i.e. measures that can be implemented quickly and in the short term, and strategic measures that require more comprehensive planning. For the latter, a detailed action sheet was created containing all relevant information – from the steps to be taken, effort and benefits to monitoring indicators, costs and the potential for reducing GHG emissions. In addition, the persons responsible for implementation, the start date and the planned implementation period are also specified there. The action sheets are listed in Appendix A .

The measures were then supplemented and specified by the climate action manager with support from the consulting agency plant values. In the next step, they were discussed and further developed together with participants from the various organisational units and with input from students.

The approach described in this section forms the basis for the following sections, which first explain the objectives of the UTN and then present the measures developed in tabular form.

8.1 Sustainable procurement (BS)

The Procurement department at the UTN aims to consistently align procurement processes with sustainability principles in order to assume ecological and social responsibility and reduce GHG emissions.

The focus is on five strategic goals:

- Ensuring 100% traceable and transparent supply chains
- Promoting fair working conditions along all stages of the value chain
- Consistently implementing sustainable procurement practices, for example through regional purchasing, short delivery routes and reusable systems
    - Introducing mandatory sustainability criteria for all products and services
    - Targeted development of programmes to provide sustainable support for suppliers and partners through training and cooperation
    - Promoting cooperation with suppliers who can demonstrate fair working conditions and circular production methods

The measures for achieving these goals in procurement are shown in Table 12.

Number	Name of the measure	Quick Win [Q]/ Strategy [S]
BS-01	Development or expansion of a tool for assessing the necessity of procurements	Q
BS-02	Establishment of an internal ZOOM channel for exchanging and sharing resources	Q
BS-03	Information and advertising for eGon (Entbehrliche Gegenstände online, or 'disposable items online') as a central digital platform for the sustainable exchange of items in Bavarian public authorities	Q
BS-04	Training courses for requisitioners and procurement staff on sustainable procurement of products and services	S
BS-05	Measure for recording supplier information for transparency and traceability	S
BS-06	Criteria catalogue for procurement, development of guidelines, handouts, forms and specifications for sustainable procurement	S

Table 12: Overview of measures for sustainable procurement

8.2 Resource-efficient operation (BT)

The UTN aims to make all its operational processes completely greenhouse gas neutral and resource efficient by 2045 through circular strategies.

The focus is on several key objectives:

- Introduction of comprehensive recycling programmes with complete waste separation and a target recycling rate of 95%
- Establishment of a real-time digital monitoring system to monitor resource consumption such as water, energy and waste
- Regular training for employees on sustainable behaviour in their everyday work
- Accelerated conversion of all operating processes to climate-neutral alternatives – for example, through the use of environmentally friendly cleaning agents
- Increasing efficiency through modern technologies and maintenance programmes
- Intensifying cooperation with the student services organisation to jointly promote sustainable measures and achieve set goals

The following measures are planned to achieve these objectives (see Table 13):

Number	Name of the measure	Quick Win [Q]/ Strategy [S]
BT-01	Purchase of a worm box for organic waste	Q
BT-02	Check whether all standby devices are equipped with power strips	Q
BT-03	Check whether decommissioned IT equipment (laptops, monitors) can be donated to employees, charity shops or schools	Q
BT-04	Regularly informing employees about ways to save resources through targeted campaigns	Q
BT-05	Optimising building automation in existing buildings with a view to saving energy	Q
BT-06	Introducing a digital monitoring system for resource consumption and subsequent consumption optimisation	S
BT-07	Recycling programme to promote resource cycles and zero waste (including paper reduction)	S
BT-08	Introduction of EMAS for the systematic recording, evaluation and improvement of environment-related processes and to increase transparency	S

Table 13: Overview of measures for resource-efficient operation

8.3 Sustainable campus infrastructure (CI)

By 2045, the University campus is set to become a place where students and staff feel at home; the design optimally tailored to their needs. The aim is to create an energy-self-sufficient infrastructure consisting of climate-neutral, energy-positive and resilient buildings. This architecture not only promotes biodiversity, but also offers a high quality of life due to green, CO_2-binding oases.

The campus infrastructure will be built according to standards for climate-neutral and energy-positive architecture, with a focus on resource-saving building envelopes and emission-free building services. Adaptive technologies that adjust to weather and light conditions will be used in a targeted manner, for example in heating, ventilation, air conditioning, sanitation and electrical systems. Technology will be integrated only where it is actually necessary.

In addition, the aim is to create a flexible architecture that can be adapted to future uses and environmental conditions. The use of durable, recyclable and sustainable building materials – preferably regional, organic and fair trade – is another key objective. The quality of life will be enhanced by flowering meadows, gardens and biotopes, while the aesthetic and sustainable campus design will harmoniously support its integration into the neighbourhood.

Table 14 lists the measures developed for these objectives:

Number	Name of the measure	Quick Win [Q]/ Strategy [S]
CI-01	Flower meadows on undeveloped land	Q
CI-02	'Circular Campus Building Guideline' as a guide to the use of sustainable, circular building materials in all future buildings	Q
CI-03	Design and development of an adaptive smart campus operation through intelligent building automation and AI-supported systems, e.g. presence-controlled outdoor lighting, adaptive lighting control for blinds	S
CI-04	Brainstorming and coordination with the Federal Ministry of Science and the building authorities for the construction of an energy-positive lighthouse building as a model for the visionary Campus 2050	S
CI-05	Development and introduction of a uniform, climate-friendly and climate-adapted building standard in accordance with the Sustainable Building Assessment System (BNB certification system) or in accordance with our own specifications for future construction measures	S
CI-06	Development of a concept for the consistent implementation of a 'sponge' campus with rainwater retention and utilisation and campus-wide rainwater management	S

Table 14: Overview of measures for campus infrastructure

8.4 Renewable energy (EE)

By 2045, the University aims to become energy self-sufficient and cover all its energy needs exclusively with locally generated renewable energies. Surplus energy will be fed into the public grid, allowing the University to make an active contribution to the regional energy supply.

To achieve this goal, solar power systems will be installed on campus and adjacent areas. In addition, the use of energy storage systems will be promoted to optimise energy supply and compensate for fluctuations in supply. Another focus is on recovering and utilising waste heat from University processes in order to use resources more efficiently.

Partnerships with regional energy providers should enable surplus energy to be fed into the grid or withdrawn as needed. At the same time, regular investments are being made in research and development of new renewable energy technologies in order to continuously increase the level of innovation and sustainability of energy supply.

The following measures have been developed to achieve these objectives (see Table 15):

Number	Name of the measure	Quick Win [Q]/ Strategy [S]
EE-01	Examination of additional areas for photovoltaics on campus in conjunction with climate adaptation measures – climate-friendly sun protection and covered walkways	S
EE-02	Concept for an intelligent energy storage (battery, hydrogen, heat) and load management system	S
EE-03	Cooperation with external partners for the joint use of waste heat, waste, wastewater and energy, e.g. data centre with vegetable cultivation in Knoblauchsland (waste heat will be used)	S

Table 15: Overview of renewable energy measures

8.5 Space management (FM)

By 2045, the entire campus infrastructure of the University is to be designed according to the principle of optimal and fully utilised space utilisation. Buildings and usable space will be managed efficiently, with a focus on multifunctional utilisation concepts.

The architecture is designed to be flexible and adaptable so that building services and uses can be adapted to future requirements and environmental conditions. Underground space utilisation, for example through service corridors and basements, will also be optimised. Permeable materials or alternative construction concepts such as stilt construction will be used to reduce soil sealing.

Another focus is on greening roofs, walls and brownfield sites, complemented by the integration of photovoltaic panels on the façades. The quality of life will be enhanced by flowering meadows, gardens and biotopes, while the aesthetic and sustainable design of the campus will ensure that it blends harmoniously into the neighbourhood.

These objectives promote maximum space utilisation, CO_2 emissions reduction, biodiversity and the creation of social spaces.

Table 16 lists the corresponding measures for achieving the objectives.

Number	Name of the measure	Quick Win [Q]/ Strategy [S]
FM-01	Consideration of mobile working in area management	Q
FM-02	Creation of binding 'Circular Campus Building Guidelines' for flexible room concepts and adaptable architecture for optimal use of space	Q
FM-03	Ensuring efficient use of space	Q
FM-04	Modifying the Experience Cubes to raise awareness of climate action among employees of the UTN and students	Q
FM-05	Introducing a structured process for assessing actual needs before new buildings are constructed, with alternatives such as renting or renovating	S
FM-06	Introduction of a process to ensure optimal land use and minimise soil sealing	S
FM-07	'Green Campus' The UTN – Holistic greening concept with roof and façade greening, orchard meadows, insect hotels and campus beekeeping	S

Table 16: Overview of space management measures

8.6 Sustainable IT operations (IT)

By 2045, the University's IT infrastructure is to be completely climate-neutral, resource-efficient and future-oriented. The focus is on durable, modular devices that are transferred to an IT reuse system after use, e.g. in schools or social institutions. The entire IT infrastructure, including servers, clouds and networks, will be converted to energy-efficient and emission-free technologies in order to minimise energy consumption. Artificial intelligence (AI) will also be used in an ethical and resource-efficient manner in order to reduce the ecological footprint of data processing.

Efficient data management is key to minimising data consumption and optimising digital processes, particularly in administration, teaching, research and transfer. In addition, digital teaching will be expanded on site and environmentally friendly digital channels will be used for marketing and communication in order to reduce the ecological footprint of the digital presence.

The following measures were identified to achieve these goals in this area of action (see Table 17):

Number	Name of the measure	Quick Win [Q]/ Strategy [S]
IT-01	Reduction of data volume through regular server clean-ups ('cleaning days') and automated deletion routines	Q
IT-02	Preliminary assessment of the necessity of data collection and processing	Q
IT-03	Lean and clean programming practices (clean/green coding) – efficient code saves CPU power	Q
IT-04	Preferential use of energy-efficient devices in everyday life – commitment to purchasing energy-saving hardware	Q
IT-05	Switch hardware to energy-saving mode when not in use and switch it off when not in use, where energy-efficient	Q
IT-06	Review digital meetings – strengthen effective meeting culture	Q
IT-07	Extend device life through centralised maintenance and updates using Mobile Device Management (MDM)	Q
IT-08	Introduction of sustainable life cycle management for IT devices, including optimisation of use, maintenance, repair and IT reuse system for high-end hardware	S
IT-09	Development of a concept for the introduction of efficient, structured and resource-saving data management (data minimisation)	S
IT-10	Prioritisation of virtualised and containerised solutions over dedicated server structures, provided this is technically and economically feasible	S

Table 17: Overview of measures for sustainable IT operations

8.7 Environmentally friendly mobility concepts (MB)

By 2045, mobility on campus is to be completely emission-free. The concept focuses on reducing motorised private transport and combines bicycle-friendliness, the expansion of public transport, incentive systems, electric mobility and digital communication solutions.

The infrastructure will be designed to optimally integrate pedestrians and cyclists, including covered bicycle parking spaces and charging points for e-bikes and company bicycles. At the same time, the city of Nuremberg is specifically expanding the cycle path network and public transport to ensure that the UTN is easily accessible in the long term.

The University's entire vehicle fleet is to be completely emission-free by 2045. Incentive systems are to be implemented to promote low-emission mobility, for example by subsidising public transport tickets for students, employees and visitors. A digital mobility platform will also support the formation of carpools. To further reduce the ecological footprint, business trips will be conducted virtually whenever possible or offset by CO_2 emissions compensation.

The measures appropriate to these objectives are listed in Table 18:

Number	Name of the measure	Quick Win [Q]/ Strategy [S]
MB-01	Establish virtual alternatives for business trips and meetings	Q
MB-02	Recommendations for mobile working	Q
MB-03	Bicycles and e-bikes (car-free campus/bridging locations)	Q
MB-04	UTN umbrellas and rain jackets (infrastructure for pedestrians to support walking routes)	Q
MB-05	Mobility platform for carpooling on BayernCollab	Q
MB-06	The UTN is actively working to improve the cycle connection between the Ulmenstrasse and Cube One locations.	Q
MB-07	Integrated mobility concept to avoid motorised private transport (MPT)	S
MB-08	Develop solutions to financial and legal hurdles in order to promote the job ticket	S
MB-09	Zero-emission University vehicle fleet	S
MB-10	Introduction of binding mobility guidelines to reduce emissions from business travel – with the aim of long-term climate neutrality	S

Table 18: Overview of measures for environmentally friendly mobility concepts

9 Communication and involvement

A clear communication strategy is crucial to inform University members and the public about the Climate Action Plan of the University of Technology Nuremberg, raise awareness and motivate people to get involved. It creates transparency, promotes commitment and supports the implementation of the concept, in particular by providing impetus or framework conditions for individual behavioural changes. The climate action manager is responsible for this in close coordination with the Communication Unit.

9.1 Communication objectives and concepts

The accompanying public relations work has three core objectives:

1. **Transparency:** Provision of information on the content, progress, and successes of the Climate Action Plan
2. **Awareness raising:** Creating understanding for climate action and necessary behavioural changes
3. **Mobilisation:** Motivation of University members to actively participate

The content focuses on the following concepts:
The urgency of active climate action, the individual responsibility and potential impact of each person, the social significance of joint efforts, and specific opportunities for participation. In addition, current progress and data on energy consumption and emissions are communicated openly.

9.2 Target groups and partners in communication

Communication is tailored to the specific needs of:

Internal target groups:

- Students
- Employees in teaching, research and transfer
- Employees in administration

External target groups:

- Prospective students and potential new employees
- Local public and media
- Bavarian State Ministry of Science and the Arts (StmWK)
- Partner institutions and companies
- Third-party funding providers
- Erlangen/Nuremberg Student Services Organisation
- Project sponsors

9.3 Implementation and participation

Integration into the Climate Action Plan

Communication is considered a cross-cutting issue in various measures of the Climate Action Plan and will be further specified during implementation. Structured communication work is currently being developed. The core team, which meets regularly every two weeks online, acts as the initial coordinating body (see Section 7.2).

Internal formats:

- Presentation of the concept in committees and at events
- Lectures, workshops, training courses
- Climate newsletter
- Participation formats with students and employees
- Information stands

External formats:

- The UTN climate action website
- Press releases
- Social media posts

10 Implementation and sustainability concept

In order to firmly establish climate action and sustainability, they must be integrated into the organisational structures and processes of the UTN. This includes continuing climate action management and sustainability work.

At the same time, a sustainability strategy is currently being developed that regularly refers to the Climate Action Plan and considers it an integral part.

Achieving climate targets and implementing measures requires the provision of sufficient human and financial resources.

The stabilisation strategy described in this section aims to secure climate action in the long term at an institutional level. Centralised, coordinated and verifiable anchoring is just as crucial here as close links to the emerging sustainability strategy. This will enable synergies to be exploited and a lasting impact to be achieved.

Climate action management is established as a permanent full-time position within the organisation and plays a central role in implementing the Climate Action Plan and achieving climate targets.

Through continuous coordination, monitoring and further development of measures, climate action management provides a supporting structure for the long-term effectiveness of climate action activities. Another key ongoing task in climate action is the regular preparation of reports and comparative analyses of developments over various periods of time. These are used to review the achievement of the targets set and to adapt existing measures or develop new ones. The reports are then reviewed and compared again (see Section 11).

Establishment of a sustainability steering committee

In order to successfully implement the Climate Action Plan, it makes sense to set up a steering committee with representatives from various areas of the UTN. This committee will monitor the implementation and further development of the Plan and continuously review the goals and measures to ensure that they are up to date and need to be adapted. This will ensure that different perspectives within the University are taken into account.

In order to better exploit synergies and increase efficiency, the steering committee should cover all sustainability-related areas. It will therefore be established as part of the development of the sustainability strategy and will not be listed as a separate measure in the Climate Action Plan.

The climate action manager is permanently represented on the committee and reports annually on the last amended status of climate action measures and GHG reduction.

For effective implementation, the steering committee should include at least the following representatives:

- Chancellor
- Sustainability Officer
- Climate Action Manager
- Student representative with a focus on sustainability
- Head of the Real Estate Unit
- Head of Buildings and Infrastructure Team
- Head of Estate Service Team
- Head of Technical Service Team
- Head of Procurement Team
- Head of IT Service Team

Provision of relevant resources

The provision of appropriate human and financial resources is essential for the successful implementation of the Climate Action Plan and other sustainability activities. In addition to central management, this applies in particular to the operational organisational units responsible for implementing the measures.

A particular focus of resources lies in the area of real estate, as this is where key measures in the fields of campus infrastructure, energy and mobility are located.

The financing of investment measures is also of central importance for achieving climate targets. It is unlikely that this can be covered entirely from the current budget. The acquisition of additional funds, for example through subsidy programmes or special grants, is therefore advantageous.

The catalogue of measures contains initial approaches for estimating resource requirements and can be used as a basis for future financing decisions.

If the necessary resources are not available to the extent required, the following effects are to be expected:

1. The time frame for achieving the goal is shifting.
2. Measures are delayed in their initiation and/or implementation.
3. Individual measures may not be realised.

The planned steering committee will decide on any necessary adjustments to the Plan as part of its responsibilities.

11 Monitoring and controlling concepts

Effective controlling is crucial for the long-term implementation and further development of the Climate Action Plan. Climate action management is responsible for regularly reviewing the defined targets and measures. The monitoring is based on the Plan-Do-Check-Act cycle (see Figure 35), which enables ongoing evaluation and adjustment of the measures. This ensures that the Plan remains effective in the long term.

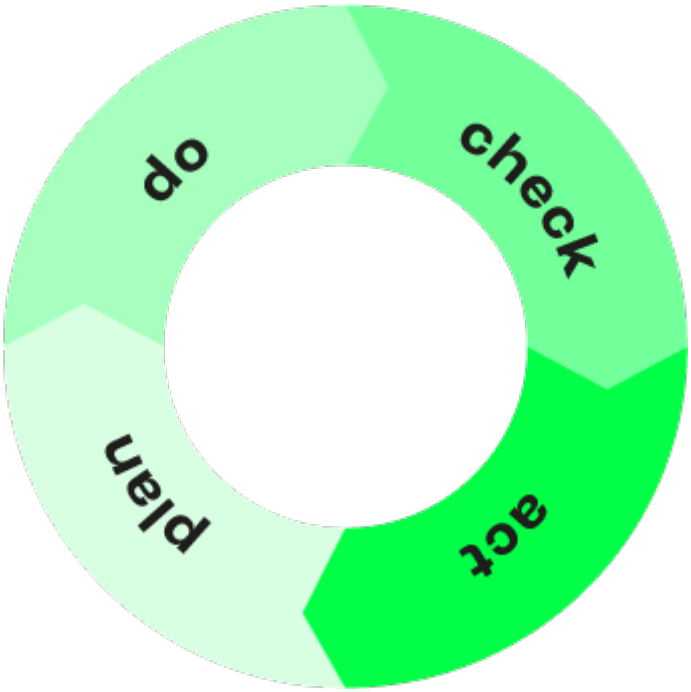

Figure 35: Plan-Do-Check-Act cycle (the UTN representation)

11.1 Plan: Planning and defining measures

The Climate Action Plan provides an overview of all measures planned to achieve the climate action targets set in the defined areas of action. In a next step, the executive board will make a binding decision on which measures will be implemented by which actors and within what time frame.

11.2 Do: Implementing the measures

The measures decided upon by the executive board are implemented. Responsibility lies with the organisational units specified in the catalogue of measures. They are responsible for coordinating, implementing and documenting the measures.

11.3 Check: Review of objectives and measures

To ensure that the objectives are achieved and that the climate action measures are effective, a regular review is carried out, usually on an annual basis. The results are documented in a climate action report and published, thereby ensuring transparency and traceability. The review includes:

- the implementation status of the measures,
- a comparison of actual and target values based on defined indicators (annually) and supplemented by results from the area of sustainability
- a classification of emissions development,
- the assessment of target achievement

The results are presented and discussed in the relevant steering committee. The data is based on the annually updated energy balance and GHG inventory, the indicators collected and the results from the sustainability area.

Updating the energy balance and GHG inventory sheet

The annual update of the energy balance and GHG inventory sheet forms the basis for controlling and enables a reliable assessment of the development of energy consumption and emissions. It provides key information on the effectiveness of the measures implemented.

The GHG inventory is updated annually based on the methodology defined in the Climate Action Plan.

The data collected is classified not only in terms of its quantitative development, but also in the context of methodological changes and structural developments (e.g. construction measures, new data sources). The results are visually presented in a manner appropriate to the target audience.

Indicators for monitoring progress

Specific indicators are used to assess the qualitative and quantitative impact of the measures. These key figures are collected and published annually. The current energy balance and GHG inventory sheet forms the basis for this.

Some of the indicators are defined in the catalogue of measures, while others were established as benchmarks in coordination between the universities as part of the Bavaria-wide BayZeN Climate Action Management Working Group.

The UTN will continuously report the following indicators; see Table 19. The GHG inventory sheet previously reported emissions in kg CO_2. As emissions are expected to rise, the values will be reported in tons (t) CO_2 in future.

Indicator	Measured variable [per year]
GHG-G	Total GHG emissions [t CO_2e]
GHG-U	GHG emissions per University member [t CO_2e]
GHG-S	GHG emissions per student [t CO_2e]
GHG-M	GHG emissions per employee [t CO_2e]
GHG-1&2	Total GHG emissions in Scope 1 and 2 [t CO_2e]
GHG-U1&2	GHG emissions in Scope 1 and 2 per university member [t CO_2e]
GHG-QM	GHG emissions in Scope 1 and 2 per square meter [t CO_2e]
E-G	Total final energy consumption [kWh]
E-U	Final energy consumption per university member [kWh]
S-G	Total electricity consumption [kWh]
W-G	Total heat consumption [kWh]
EE-S	Share of renewable energies in electricity consumption [%]
PV-G	Total installed capacity of PV systems [kWp]
PV-GS	Proportion of self-generated PV electricity in total electricity consumption [%]
GHG-B	GHG emissions from purchased items [t CO_2e]
GHG-MM	GHG emissions from employee mobility [t CO_2e]
GHG-DR	GHG emissions from business trips/guest lectures/excursions [t CO_2e]

Table 19: List of indicators for comparison

For certain climate action measures, it is not possible to directly quantify the savings in energy or greenhouse gases. In such cases, alternative targets are set in the catalogue of measures. These are based on comprehensible milestones or other measurable indicators. For example, these include the number of revised regulations and decision-making processes, the number of events held and their participants, or the scope of the communication and information formats offered. This allows progress to be reliably recorded and evaluated even for measures without direct emission figures.

11.4 Act: Adaptation and further development of measures

If regular reviews of climate action measures reveal a need for adjustment, appropriate proposals for change are developed in consultation with the relevant organisational units. These may include modifications to the content or timing of existing measures, the addition of new measures, or the discontinuation of measures that are not effective.

Documentation and reporting

The results of regular reviews of targets and measures, as well as any adjustments decided upon, are documented and published in an annual climate action report. In addition, the Climate Action Plan is updated every five years to adapt it to changing conditions and the current status of implementation.

12 Outlook

With this Climate Action Plan, the UTN has laid an important strategic foundation for its climate-neutral development. The analysis of the initial situation, the differentiated development of scenarios, and the systematic potential analysis clearly show that establishing a climate-neutral university is feasible but requires structural decisions, forward-looking planning, and a high degree of institutional responsibility.

The scenarios show that without additional measures, neither the Bavarian state government's targets nor the federal government's climate targets can be achieved. This is particularly evident in the area of Scope 3 emissions, the reduction of which requires complex coordination and cross-sector cooperation. At the same time, key levers for reducing emissions lie in areas that the UTN can directly influence, such as energy consumption, procurement processes, and mobility.

This collection of measures provides a comprehensive catalogue of options for action, including both steps that can be implemented in the short term and long-term strategic measures. The measures are not prioritized or scheduled in a definitive manner. Rather, this overview forms the basis for the next step: structured prioritization and operational scheduling of implementation.

The success of the Climate Action Plan will depend largely on whether the measures are consistently pursued, backed up with the necessary resources, and institutionally anchored in the long term. The planned monitoring and consolidation concept provides a central structure for this and facilitates regular review and adaptation to changing conditions.

The structure of the UTN also offers a unique opportunity: many structures and processes are still under development and can be designed to be sustainable from the outset. This opens up possibilities that are often difficult to achieve in established institutions. Climate action is not integrated retrospectively, but is understood as a guiding principle from the outset.

At the same time, this consistent focus on climate action and sustainability also opens up new competitive opportunities. Universities are increasingly in the public eye, whether it be through students, third-party funding providers, funding institutions, or social actors. A credible Climate Action Plan becomes a mark of quality and can significantly increase the attractiveness of the UTN as a place of research and learning. Climate action thus becomes not only a cross-cutting task, but also a strategic flagship for a future-oriented university.

In the coming years, it will be crucial to continue along the chosen path, to bring the targets to life, and to make concrete progress visible. The UTN has the potential to help shape a new form of university: one that is pragmatic, emission-conscious, future-oriented, sustainable, and climate-neutral.

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Annex

A Strategic measures

Title and brief description of the measure			
BS-04	Training courses for requisitioners and procurement staff on sustainable procurement of products and services		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
Low-moderate	2-3 information events, possibly versions for speakers and staff time	short-term	Starting immediately and at regular intervals, update
Steps What are the milestones?			
1. Review of the user group (requesters and purchasers) 2. Define training requirements for the user group 3. Prepare training materials or research and commission training 4. Preparation and organisation of the event and follow-up appointments 5. Invitation of participants 6. Conducting the training 7. Making the content available to a wider group of users, e.g. recording information events, implementing an internal sustainability platform where the latest information, developments and innovations are presented 8. Follow-up to the training and, if necessary, introduction of improvement measures for the training			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Sustainability & Executive Committee	Sustainability	Sustainability together with Procurement (focus on Procurement)	everyone
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
Training courses are offered and conducted	Approximately €5,000 for external speakers plus approximately one working week of one FTE with existing staff per training course	n/a	n/a

Title and brief description of the measure			
BS-05	Measure to record supplier information for transparency and traceability		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
high	very high	long-term	Long-term and then continuous learning and innovation processes
Steps What are the milestones?			
1. Enquiry to suppliers regarding manufacturing processes and raw materials, consumables and supplies used 2. Identification of cooperation partners, conclusion of contracts including defined objectives (recycling, upcycling, long-term use of products and opportunities to reuse them elsewhere) 3. Establishment of criteria for climate-neutral manufacturing/production, regulations that must be met/provision of quality seals etc. 4. Develop programmes for compliance with the circular economy			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Sustainability	Sustainability in connection with all units	Sustainability, Procure-ment,	Suppliers, Policy, Executive Committee
Monitoring indicators How can the success of the measure be evalu-ated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
All suppliers were surveyed; proportion of sustainable cooperation partners among all co-operation partners [%].	None, human re-sources Approx. 2 working weeks 1 FTE with existing staff	n/a	n/a

Title and brief description of the measure			
BS-06	List of criteria for procurement, development of guidelines, handouts, forms and specifications for sustainable procurement		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
high	moderate	short-term	permanently
Steps What are the milestones?			
1. Development of binding guidelines and a set of criteria for more sustainable procurement 2. Review of the introduction of a binding guideline and a set of criteria for sustainable procurement 3. Development of appropriate processes and related forms 4. Integration of sustainability criteria into procurement and procurement consulting			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Procurement & Sustainability	Procurement & Sustainability	all persons involved in procurement	Executive Committee
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
Criteria catalogue, guidelines and forms for sustainable procurement have been introduced; sustainability criteria are an integral part of procurement consulting; proportion of expenditure on sustainably procured products and services relative to total expenditure on all procured products and services	None, human resources Approximately 8 working weeks 1 FTE with existing staff	n/a	n/a

Title and brief description of the measure			
BT-06	Introduction of a digital monitoring system for media consumption and subsequent consumption optimisation		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
High due to transparency and better control of consumption data and reduction of energy and water consumption through data-based optimisation	• Financial: medium (costs for software and sensors) • Time: medium (development and implementation approx. 1-2 years) • Personnel: introduction: medium to high • Operational: low (system can be mostly automated)	Short-term (within 1 year)	Ongoing with campus growth
Steps What are the milestones?			
1. Needs analysis and selection of suitable monitoring software 2. Construction planning and installation of sensors for energy, water and waste consumption 3. Evaluation via digital dashboard for real-time data analysis 4. Meaningful monitoring and use of the system by those responsible 5. Continuous optimisation and adaptation based on the data obtained			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Climate action management, Technical Service	Building Projects Management, Technical Services, IT, Estate Service	IT, Estate Services, external technology providers	Executive Committee, staff, students, general public
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• Energy consumption (kWh/m^2). • Water consumption (m^3/year). • Waste volume by category (kg/year). • Reduction in operating costs (in %).	• Acquisition costs for software and sensors: approx. £130,000 – £220,000 • Annual maintenance costs: approx. £8,500 – £17,000	• x	• Involvement of the IT department required for data security • Training of users for effective application

Title and brief description of the measure			
BT-07	Circular economy programme to promote resource cycles and zero waste		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
High due to reduction in material, procurement, energy, water and waste consumption	Medium Financial: low (waste separation systems, training). Time: low. Personnel: medium (training and awareness-raising necessary)	Short-term	Ongoing
Steps What are the milestones?			
1. Obtain advice on zero waste and recycling programmes 2. Needs analysis and impact analysis of resource inflows and outflows, e.g. in research, procurement, planning and construction of buildings, etc. 3. Evaluation, potential for improvement and scenarios for the future 4. Development of a programme 5. Implementation of the programme 6. Continuous review and optimisation of the programme			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Climate action management, sustainability officers	Procurement, Human Resources, Estate Services	Procurement, Human Resources, Estate Services	Executive Committee, staff, students
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• Recycling rate (target: 95%) • Reduction in waste generation by type (in kg/person per year))	• One-off costs: approx. €50,000–100,000 (for infrastructure, training and waste monitoring systems) • Ongoing costs: approx. €10,000–20,000 per year for maintenance and further development	• x	• Regular awareness-raising (e.g. notes, training courses) for staff and students

Title and brief description of the measure			
BT-08	Introduction of EMAS for the systematic recording, evaluation and improvement of environmental processes and to increase transparency		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
High benefits through transparent environmental management processes, better control of environmental aspects and reduction of resource consumption, including waste, through continuous improvement and data-driven optimisation	Medium: Costs for EMAS certification and internal resources). • Time: Medium (introduction and implementation approx. 1-2 years). Personnel: High, half a full-time equivalent position	in the medium term (within 2 years).	Ongoing with campus growth
Steps What are the milestones?			
1. Commissioning of an EMAS consultant & software for documenting and analysing environmental performance 2. Software for documenting and analysing environmental performance 3. Definition and implementation of measures for recording relevant environmental aspects (e.g. energy, water, waste) in accordance with EMAS requirements 4. Creation of an environmental management plan and integration of the data into a monitoring system for continuous recording and evaluation 5. Monitoring and utilisation of the system by responsible persons to ensure continuous improvement and compliance with environmental objectives 6. Regular internal audits and adjustment of the system based on the results obtained to optimise environmental performance			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Climate action management, Technical Service	Technical Services, IT, Estate Services	IT, Estate Services, Technical Service external certifiers	Executive Committee, staff, students, general public
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• Energy consumption (kWh/m^2) • Water consumption (m^3/year). • Waste volume by category (kg/year). • Reduction in operating costs (in %).	• Consulting and certification costs approx. €10,000–15,000 • Annual review: approx. €1,500	• x	• Involvement of the IT department required for data security • Training of users for effective application

Title and brief description of the measure			
CI-03	Design and development of adaptive smart campus operations through intelligent building automation, e.g. presence-controlled outdoor lighting and AI-based light control for blinds		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
High, due to automated, data-driven resource savings in energy, water, and operating costs	• Financial: medium to high (IoT infrastructure, building management systems, sensor technology, system integration, training, cloud platform) • Time: medium (gradual introduction) • Personnel: medium (IT, Technical Services, Estate Services)	In the mid-term	Long term
Steps What are the milestones?			
1. Development of a smart campus strategy, including a roadmap for building automation, in collaboration with the state building authority and the Ministry of Science 2. Technical analysis of existing buildings and planned new buildings (potential assessment, retrofitability) 3. Selection of suitable systems (building management system, IoT platform, sensors, actuators) 4. Implementation of a pilot project in the existing building 5. Gradual introduction in other buildings / integration in new buildings 6. Development of a central facility monitoring dashboard 7. Training for operating personnel and accompanying evaluation 8. Ongoing data monitoring and AI-supported optimization			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Climate Action Management, Building Project Management, Technical Services and State Building Authority, Ministry of Science	Building Project Management, Technical Services and State Building Authority, Ministry of Science, IT	Building Project Management, Technical Services, Management and State Building Authority	Employees, students (e.g., via dashboard), research (e.g., data access)

Monitoring indicators How can the success of the measure be evaluated?	**Costs** **What costs are associated with the measure?**	**GHG savings potential** **What is the GHG savings potential?**	**Notes**
• Energy consumption per square meter per year (kWh/m^{2}a) • Degree of automation (% of buildings with smart controls) • Number of activated sensors and optimized operating procedures • User satisfaction (room comfort, lighting, temperature)	Concept development: no financial resources, personnel resources 0.5 FTE for 1 year	moderate	• x

Title and brief description of the measure			
CI-04	Brainstorming and coordination with the Ministry of Science and the building authorities for the construction of an energy-positive flagship building as a model for the visionary Campus 2050		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
high (negative primary energy demand, high radiance)	• Financial: high (premium standards, sustainable building materials, technology) • Time: high (planning, approval, construction) • Personnel: high (building project management, sustainability, technical service, research)	In the mid-term	mid-, long term
Steps What are the milestones?			
1. Definition of building standards (positive energy, circular building materials, AI-supported control) **2.** Ideas competition for planning **3.** Selection of sustainable/regional materials **4.** Implementation with partners from research and industry **5.** Monitoring phase with optimization of operating data			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Climate Action Management, Building Project Management, Technical Services and State Building Authority, Ministry of Science	Climate Action Management, Building Project Management, Technical Services and State Building Authority, Ministry of Science	State Building Authority, Building Project Management, Technical Services, external specialists	Public, regional partners, neighbourhood
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• CO_2 footprint of operation and construction (kg CO_2e/m^2) • Energy surplus (kWh/year) • Proportion of circular materials (%) • User satisfaction (indoor climate, quality of stay)	• €15–25 million (depending on size)	• x	• x

Title and brief description of the measure			
CI-05	Development and introduction of a uniform, climate-friendly, and climate-adapted building standard in accordance with the BNB certification system or in accordance with our own specifications for future construction projects		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
high	• Financial: medium (costs for external auditors, training, additional costs for planning and documentation) • Time: medium (development and introduction 1–2 years; continuous application in projects) • Personnel: medium (internal project team, external consulting, certification)	In the mid-term	Long term
Steps What are the milestones?			
1. Decision in consultation with ministries and building authorities 2. Selection of the appropriate BNB usage profile (e.g., BNB "educational buildings") or similar 3. Establishment of an interdisciplinary project team (building project management, technical services, sustainability, external building authorities) 4. Development of "The UTN sustainability building guidelines" based on BNB 5. Implementation of a pilot project including corresponding tender, implementation, and construction (e.g., first building with BNB certification) 6. Commissioning of certifiers (only for BNB) 7. Training for construction planners, architects, and project managers 8. Integration into tender and award documents 9. Regular review and further development of the standard			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Climate Action Management, Building Project Management, Technical Services, State Building Authority, Ministry of Science	Climate Action Management, Building Project Management, Technical Services, State Building Authority, Ministry of Science	Building Project Management, Technical Services, Building Authority, certifier	Building authority, University management, employees, students, general public

Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• Number of buildings constructed with BNB certification • BNB rating (e.g., "Silver," "Gold," "Platinum") • Degree of compliance with BNB criteria (e.g., primary energy demand, demolition potential, comfort indicators) • Proportion of sustainable building materials (%) • Level of training of employees in the construction sector	• Certification costs per project: approx. $23,000–$57,000 • Initial training & development of the UTN standard: approx. $115,000 • Increase in construction costs approx. 20% • Long-term savings through life cycle cost optimization	n/a	• Involvement of the IT department required for data security • Training of users for effective application

Title and brief description of the measure			
CI-06	Development of a concept for the consistent implementation of a “sponge” campus with rainwater retention and utilization and campus-wide rainwater management		
Benefits What is the impact on climate action and GHG emissions?)	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
Measures through substitution of drinking water, passive cooling, energy saving and promotion of green infrastructure	• Financial: medium (rainwater storage tanks, infiltration systems, pipes, sensors) • Time: medium (planning & implementation, continuous integration into new buildings) • Personnel: medium (planning, construction, maintenance, monitoring)	Short-term	In the mid-term, long-term
Steps What are the milestones?			
1. Development of a ‘sponge’ campus master plan – including water flow analysis, weak points, potential areas and assessment of potential 2. Selection of suitable technologies, e.g. retention roofs and areas, trough-trench systems, permeable surfaces (paving, gravel, green), underground cisterns, open water areas and rainwater gardens 3. Integration into the campus landscape concept and biodiversity strategy 4. Implementation of pilot systems on existing buildings 5. Integration into urban land-use planning for all new buildings and paths 6. Development of a digital monitoring and early warning system for heavy rainfall 7. Involvement of students (e.g. in research, design, maintenance)			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Climate Action Management, Building Project Management, Technical Services, State Building Authority	Climate Action Management, Building Project Management, Technical Services, State Building Authority	Building Project Management, Technical Services, State Building Authority, external specialists	Employees, students (e.g. via dashboard), research (e.g. data access)

Monitoring indicators How can the success of the measure be evaluated?	**Costs** **What costs are associated with the measure?**	**GHG savings potential** **What is the GHG savings potential?**	**Notes**
• Rainwater infiltration area (%) • Rainwater retention volume (m^3/year) • Water consumption substitution (m^3/year) • Cooling capacity/temperature difference due to microclimate (°C) • Number of green/ unsealed areas • Biodiversity indicators (e.g. number of species)	• Human resources for concept development 0.25 FTE for 1 year	• x	• x

Title and brief description of the measure			
EE-01	Examination of additional areas for photovoltaics on campus in conjunction with climate adaptation measures – climate-friendly sun protection and covered walkways		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
High, due to in-house generation of renewable energy	• Financial: high (investment costs for equipment and infrastructure) • Time: high (moderate planning costs, long implementation period) • Personnel: moderate (need for experts in planning, construction and maintenance)	Mid- to long-term	ongoing
Steps What are the milestones?			
1. Analysis of possibilities and locations on campus, e.g. solar windows and facades 2. Planning and approval processes by external and internal experts 3. Tendering 4. Installation and commissioning of the systems 5. Integration into the university's energy management system 6. Monitoring and optimisation of the systems			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Climate Action Management, Real Estate Building Project Management, Executive Committee; State Building Authority	Climate Action Management, Building Project Management, Estate Services, external service provider, Executive Committee	State Building Authority/ Technical Services, external service provider;	Energy suppliers, city administration, Executive Committee, staff, students, general public
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• Amount of energy generated (kWh) • Internal consumption rate	High investment costs, long-term savings	• x	• x

Title and brief description of the measure			
EE-02	Concept for an intelligent energy storage (battery, hydrogen, heat) and load management system		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
High due to efficient use of renewable energies	• Financial: medium to high (investment in storage technologies and control systems) • Time: high (complex planning and implementation) • Personnel: medium (need for IT and energy management specialists for development and operation)	Mid- to long-term	ongoing
Steps What are the milestones?			
1. Inclusion in campus planning, needs assessment and location analysis. 2. Development of a digital control system to optimise storage and load flows. 3. Purchase and installation of suitable battery storage systems. 4. Integration into campus energy management. **5.** Test phase and continuous improvement.			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Technical Services/Executive Committee	Building Project Management, Technical Services, external service provider	external service provider	Energy suppliers, city administration, Executive Committee, staff, students, general public
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• Storage capacity (MWh) • Degree of optimisation of the self-consumption ratio (%)	High investment costs, long-term savings	• x	• x

Title and brief description of the measure			
EE-03	Cooperation with external partners for the joint use of waste heat, waste, waste water and energy, e.g. data centre with vegetable cultivation in Knoblauchsland (waste heat is used)		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
High, thanks for example to increasing energy efficiency and reducing GHG emissions through the shared use of existing resources such as waste heat	• Financial: medium to high (investments in infrastructure, partner coordination) • Time: medium to high (planning and implementation approx. 3-5 years) • Personnel: medium (coordination between partners, technical implementation)	Long-term	Ongoing with campus growth
Steps What are the milestones?			
1. Identification of potential partners (industry, research institutions, local authorities) 2. Development of cooperation agreements and framework conditions 3. Planning and development of the technical infrastructure for the use of waste heat, waste, and energy 4. Integration of the systems into the university's existing energy management system 5. Ongoing optimization of cooperation and synergies			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Climate Action Management	Technical Services, external partners (N-Ergie, industry, research institutions)	Technical Services, externe Partner (N-Ergie, industry, research institutions)	Executive Committee, staff, students, general public
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• Amount of waste heat used (MWh/year) • CO_2 reduction through shared resources (t/year) • Number and efficiency of collaborations	• Infrastructure investments: approx. $500,000–$1,500,000 • Maintenance and operating costs: approx. $50,000–$100,000 per year • Human resources: approx. 0.5 FTE	• x	Close coordination with the city and regional energy suppliers is necessary

Title and brief description of the measure			
FM-05	Introduction of a structured procedure for assessing actual demand before new construction – with alternatives such as renting or renovation		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
High: avoidance of unnecessary new buildings or land sealing and thus significant GHG emissions in the life cycle (grey energy, resources, land consumption); contribution to land efficiency and sustainable resource use	• Financial: low (procedural implementation, external consulting for standards if necessary) • Time: medium (development of a binding testing procedure application in planning processes) • Personnel: low (coordination with construction department, controlling, consumers)	Short-term, before/during the start of planning	Ongoing from 2026 onwards
Steps What are the milestones?			
1. Creation of a review form with requirements clarification, room book, review of alternatives 2. Description of requirements by future users 3. Review of requirements by the UTN using review form; comparison with any existing resources 4. If new construction is necessary from the UTN's perspective: submission of requirements to ministry 5. Recognition of requirements by ministry			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Estate Services in exchange with Executive Committee and Departments	Executive Committee	Estate Services	

Monitoring indicators How can the success of the measure be evaluated?	**Costs** **What costs are associated with the measure?**	**GHG savings potential** **What is the GHG savings potential?**	**Notes**
• Evaluation of land use efficiency • Proportion of new construction projects with documented needs assessment (%) • Number of new buildings avoided as a result of the assessment • Savings in potential new construction area (m^2) • Reduced CO_2 emissions by avoiding new construction (modelled)	• No costs, personnel costs for initiation 0.5 FTE for ½ year	• x	• x

Title and brief description of the measure			
FM-06	Introduction of a process to ensure optimal land use and minimise land sealing		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
High: reduction in land consumption for new buildings or land sealing, thereby enabling efficient use of buildable land, also for the benefit of preserving or creating unsealed areas	• Financial: low (procedural implementation, external consulting for standards if necessary) • Time: medium (development of a binding testing procedure + application in planning processes) • Personnel: low (coordination with construction department, controlling, consumers)	Short-term, before/during the start of planning	Ongoing from 2026 onwards
Steps What are the milestones?			
1. Development of a standardised testing process for sealing in new construction projects, including a list of criteria 2. Integration of the process into all construction and development projects as a mandatory first step 3. Creation of a test form 4. Description of requirements by future users 5. Requirements assessment by the UTN using the test form			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Building Project Management	Building Project Management	Building Project Management	
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• Land consumption in relation to usable floor space in new construction projects	• Creation and establishment of process 1.0 FTE for 8 weeks	• x	• x

Title and brief description of the measure			
FM-07	The UTN 'Green Campus' – Holistic greening concept with roof and façade greening, orchard meadows, insect hotels and campus beekeeping		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
High: CO_2 storage, temperature reduction in the microclimate, rainwater retention, promotion of biodiversity, in-house UTN honey, improvement of the quality of life and identity formation of the campus as a sustainable learning and living space	• Financial: medium to high (feasibility studies, planning services, implementation depending on area and building structure) • Time: medium to high (design and implementation period of approx. 3–7 years) • Personnel: medium (coordination between climate action management, landscape architecture, building management, research)	Short-term (starting in 2025 with concept development)	Ongoing from 2026 onwards
Steps What are the milestones?			
1. Creation of a campus greening concept for planting that is as well adapted as possible to climate change, CO_2-binding, native, biodiverse and easy to maintain, with external expert planning and participatory involvement 2. Mapping of all potential areas (grounds, roofs, facades, spaces between buildings) 3. Ecological assessment of the areas and prioritisation 4. Creation of an action and maintenance plan (e.g. extensive/intensive greening, suitable plant species) 5. Implementation of initial pilot greening projects (e.g. main building roof, south-facing façades) in accordance with sustainable planting and maintenance practices (e.g. peat-free soils and organic fertilisers) 6. Expansion of the concept with growing areas of the University			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Climate Action Management, Building Projects Management, Estate Services	Climate Action Management, Building Projects Management, Estate Services, external specialist planners	external specialist planners, specialist companies	University management, staff, students, general public

Monitoring indicators How can the success of the measure be evaluated?	**Costs** **What costs are associated with the measure?**	**GHG savings potential** **What is the GHG savings potential?**	**Notes**
• Green space (m^2 roof/façade/ground) • CO_2 binding potential in tonnes per year (modelled based on vegetation types) • Change in air and surface temperature over the course of the year (°C) • Biodiversity indicators (e.g. number of plant and insect species) • Length of stay/use by campus members (via surveys/sensors)	• Initial concept d evelopment: approx. £85,000–£130,000 • Greening costs Roofs: £150–400/m^2 (depending on the system), facades: £300–800/m^2, floor areas (close to nature): £50–150/m^2 • Operating costs (maintenance, monitoring): approx. 5–10% of investment costs/year	• x	• x

Title and brief description of the measure			
IT-08	Introduction of sustainable life cycle management for IT equipment, including optimization of use, maintenance, repair, and IT reuse system for high-end hardware		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure**
Funds due to extended life cycle, cost savings	Low personnel, time, and costs for outsourcing or external maintenance; higher for in-house use	short-term	ongoing
Steps What are the milestones?			
1. Inventory of all devices 2. Condition assessment + introduce repair processes 3. Determine requirements and compare them with available free resources 4. Implementation/redistribution of the appropriate devices 5. Establish reuse management, i.e., reuse by students, clubs, etc., or define take-back and recycling processes			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
IT Service with PCM	IT Service	IT **S**ervice with PCM	Executive Committee, employees, students
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• Device lifespan • Number of devices repaired • Proportion of devices reused, recycled, or repurposed	• Ongoing personnel costs for compiling and maintaining the necessary lists • Purchase of suitable software, if necessary	• x	• x

Title and brief description of the measure			
IT-09	Development of a concept for the introduction of efficient, structured, and resource-saving data management (data economy)		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
Funds from savings on data carriers and storage capacities, resource and energy savings	• Financial: low (tools, consulting, training) • Time: medium • Personnel: medium (involvement of all necessary)	Short-term	Short-term, ongoing
Steps What are the milestones?			
1. Analysis of current data stock and storage consumption 2. Definition of deletion and archiving guidelines 3. Establishment of a central data management system 4. Use of file systems with deduplication functions 5. Training of employees in the efficient handling of data 6. Introduction of automated routines for data reduction 7. Integration into existing digital workflows			
Initiation, coordination **Who initiates and coordinates the measure?**	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Climate Action Management, IT Service	Climate Action Management, IT Service	Executive Committee, Employees, students	
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• Total storage volume (TB) per year • Reduction in redundant data (%) • Energy consumption due to data storage (kWh/year) • Number of deleted or archived legacy data • CO_2 reduction through storage optimization (t CO_2e/year)	• Personnel costs for initial implementation and ongoing personnel costs for routine compliance sampling	• x	• x

Title and brief description of the measure			
IT-10	Prioritisation of virtualised and containerised solutions over dedicated server structures, provided this is technically and economically feasible		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
Funds from savings through better use of free computing and storage resources	• Low • Possibly resources for procuring and operating virtualisation solutions (Docker, VMware, Proxmox, etc.) • Human resources for maintaining the systems	Short-term	Short-term, ongoing
Steps What are the milestones?			
1. Analysis of planned resource consumption 2. Comparison with existing resources and examination of virtualisation options 3. Creation of the required virtual machines or containers 4. Monitoring of ongoing operations and, if necessary, modification of the computer resources provided			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
IT Service	IT Service	IT Service, if necessary, in consultation with users for special applications	
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• Number of services per physical server • Number of virtualised CPUs and shared RAM + memory • Energy consumption during operation (kWh/year)	• Personnel costs for initial implementation and ongoing personnel costs for monitoring the services	• x	• x

Title and brief description of the measure			
MB-07	Integrated mobility concept to avoid motorised private transport (MPT)		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
High due to the avoidance of motorised individual transport; increased quality of stay and safety	• Financial: high (infrastructure measures, support programmes) • Time: high (planning and implementation) • Personnel: medium (coordination with authorities, infrastructure planning)	mid-term	long-term
Steps What are the milestones?			
1. Needs analysis for mobility, routes and parking spaces 2. Development and introduction of a mobility, route and parking space concept with a variety of mobility components 3. Construction of primarily bicycle and pedestrian infrastructure (paths, lighting, signage) 4. Concept for promoting alternative mobility options such as bike sharing and e-scooters 5. Communication campaign to raise awareness of car-free campus use 6. Evaluation and improvement management			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Climate Action Management, Building Projects Management, Estate Services	Climate Action Management, Building Projects Management, Estate Services, Technical Services	State Building Authority, construction company	Employees, students, general public
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• Number of parking spaces on campus • Number of secure bicycle parking spaces • Mobility survey	• x	x	• x

Title and brief description of the measure			
MB-08	Develop solutions for financial and legal hurdles in order to achieve funding for the job ticket		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
Incentive to switch to public transport medium – high	Approximately €400,000 per year Assumption: approximately 3/4 of employees receive job ticket benefits	Short-term	Ongoing
Steps What are the milestones?			
1. Clarification of the legal framework 2. Clarification with the Ministry 3. Executive Committee decision 4. Announcement within the UTN			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Chancellor	FHR	FHR	All employees
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• x	• x	x	• x

Title and brief description of the measure			
MB-09	Zero-emission university fleet		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
High due to GHG reduction through conversion to zero-emission vehicles and equipment	• Financial: medium to high (acquisition costs, charging infrastructure) • Time: medium • Personnel: medium (fleet management, user training)	Already started	Ongoing with campus growth
Steps What are the milestones?			
1. Needs analysis for the University's own vehicle fleet and equipment 2. Setting up the charging infrastructure on campus 3. Procurement of vehicles, such as rental and cargo bikes, e-bikes, e-cars, e-commercial vehicles, e.g. for maintaining outdoor facilities 4. Introduction of a booking system for vehicles for business trips, etc. 5. Raising awareness among users 6. Evaluation and improvement management			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Estate Services	Estate Services, Technical Services	Estate Services, Procurement	Executive Committee, staff, students, general public
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• Proportion of zero-emission vehicles in the fleet • Number of charging points	• Investments for vehicle procurement proportional to campus growth • Operating costs proportional to campus growth	x	• Usage analyses for optimising the vehicle fleet

Title and brief description of the measure			
MB-10	Introduction of binding mobility guidelines to reduce emissions from business travel – with the aim of achieving long-term climate neutrality		
Benefits What is the impact on climate action and GHG emissions?	**Cost** What resources are needed in terms of finances, time and/or personnel?	**Introducing the measure** When will the measure start?	**Implementing the measure** When will the measure be implemented?
High due to reduction of individual car use, promote on of emission-free modes of transport (cycling, public transport, e-mobility), reduction of business travel emissions through digital alternatives	• Financial: low (e.g. for concept development, communication, external consulting if necessary) • Time: low (development and coordination, years, ongoing evaluation) • Personnel: low	Short-term	Ongoing
Steps What are the milestones?			
1. Development of guidelines for business travel (e.g. priority and incentives for rail travel, virtual alternatives, compensation obligation 2. Coordination with committees and approval by university management 3. Information campaign 4. Monitoring and annual evaluation with adjustments			
Initiation, coordination Who initiates and coordinates the measure?	**Responsibility** Who is responsible for the measure? Which departments need to work together?	**Implementation** Who is implementing the measure?	**Information** Who else must be informed or involved?
Climate Action Management, Travel Service, Estate Services	Executive Committee, Travel Services, Estate Services	Travel Services	All employees, students, guests, external partners (e.g. for business trips, shuttle services, etc.)
Monitoring indicators How can the success of the measure be evaluated?	**Costs** What costs are associated with the measure?	**GHG savings potential** What is the GHG savings potential?	**Notes**
• GHG emissions from business travel (Scope 3 reporting) • Number of kilometres flown on business per year • Use of public transport, bicycles, e-mobility • Proportion of meetings and business trips conducted digitally	• One-off concept development: approx. £25,000–£50,000 • Communication, training, ongoing evaluation: approx. £8,000–£16,000 per year	• x	• recommended

B Emission factors table

Item	Unit	Emission factor (kg CO_2e/ unit)	Time of research	Description	Reference	Link
German electricity mix	kWh	0.43	14/02/2024	German electricity mix according to the Federal Environment Agency; final consumption without taking into account the electricity trading balance, published in July 2021 for 2020	UBA	https://www.umweltbundesamt.de/themen/co2-emissionen-pro-kilowattstunde-strom-stiegen-in
Snack break	Piece	1.02	13/07/2023	Provision of food for a snack + (hot) drink, including food waste disposal, transport, refrigeration and preparation	KlimAktiv calculation for 2022 based on average tonnage per person in Germany (KlimAktiv CO_2 calculator for private individuals) IFEU 2022	https://www.umweltbundesamt.de/themen/co2-rechner-fuer-veranstaltungen-online

Main course	Piece	2.4	13/07/2023		KlimAktiv calculation for 2022 based on average tonnage per person in Germany (KlimAktiv CO_2 calculator for private individuals) IFEU 2022	https://www.umweltbundesamt.de/themen/co2-rechner-fuer-veranstaltungen-online
Main course (organic, vegetarian, regional)	Piece	1.3	13/07/2023		KlimAktiv calculation for 2022 based on average tonnage per person in Germany (KlimAktiv CO_2 calculator for private individuals) IFEU 2022	https://www.umweltbundesamt.de/themen/co2-rechner-fuer-veranstaltungen-online
Desktop PC	Piece	226	18/03/2024		ClimCalc Austria (originally Federal Environment Agency via ecoinvent), ÖkoInstitut 'Digital CO_2 Footprint', 2020, page 9, Table 3-1	https://www.oeko.de/fileadmin/oekodoc/Digitaler-CO2-Fussabdruck.pdf
Monitor	Piece	350	18/03/2024		ClimCalc Austria (originally Federal Environment Agency via ecoinvent)	https://nachhaltigeuniversitaeten.at/wp-content/uploads/2024/01/ClimCalc_v3.2_EF2021_20240130.xlsx

Notebook or laptop	Piece	172	18/03/2024		ClimCalc Austria (originally Federal Environment Agency via ecoinvent)	https://nachhaltigeuniversitaeten.at/wp-content/uploads/2024/01/ClimCalc_v3.2_EF2021_20240130.xlsx
Multifunction printer	Piece	300	18/03/2024		ClimCalc Austria (originally Federal Environment Agency using its own modelling)	https://nachhaltigeuniversitaeten.at/wp-content/uploads/2024/01/ClimCalc_v3.2_EF2021_20240130.xlsx
Printer (laser or inkjet)	Piece	63.6	18/03/2024		ClimCalc Austria (originally Federal Environment Agency via ecoinvent)	https://nachhaltigeuniversitaeten.at/wp-content/uploads/2024/01/ClimCalc_v3.2_EF2021_20240130.xlsx
Toner	Piece	14.1	18/03/2024		ClimCalc Austria (originally Federal Environment Agency via ecoinvent)	https://nachhaltigeuniversitaeten.at/wp-content/uploads/2024/01/ClimCalc_v3.2_EF2021_20240130.xlsx
Docking station	Piece	35	18/03/2024	average value; excluding usage phase and EoL	manufacturer's specifications	https://www.dell-technologies.com/asset/de-de/products/electronics-and-accessories/technical-support/lca-docking-station-family.pdf
Projector	Piece	172	18/03/2024		ClimCalc Austria (originally Federal Environment Agency, via ecoinvent)	https://nachhaltigeuniversitaeten.at/wp-content/uploads/2024/01/ClimCalc_v3.2_EF2021_20240130.xlsx
Outsourced services of the computer centre	Gb/ Jahr	0.12	01/09/2024		Öko Institut 2020 Digital CO_2 Footprint p. 37	Digitaler CO2-Fußabdruck

File shelf (3 compartments)	Piece	48.00	05/01/2024		FIRA, 2011, "Wooden filing cabinet, average"	https://www.fira.co.uk/technical-information/sustainability/study-into-the-feasability-of-benchmarking-carbon-footprints-of-furniture-products
Desk	Piece	45.00	05/01/2024		FIRA, 2011, "1600mm x1200mm work-station, average"	https://www.fira.co.uk/technical-information/sustainability/study-into-the-feasability-of-benchmarking-carbon-footprints-of-furniture-products
Office chair / swivel chair	Piece	72.00	05/01/2024		FIRA, 2011, "Task chair, average"	https://www.fira.co.uk/technical-information/sustainability/study-into-the-feasability-of-benchmarking-carbon-footprints-of-furniture-products
Paper towels (recycled)	kg	1.19	09/09/2024		UBA 2022: Life cycle assessment of graphic and hygiene paper p. 53	https://www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/texte_123-2022_aktualisierte_oekobilanz_von_grafik-_und_hygienepapier.pdf
Toilet paper (recycled)	kg	1.19	09/09/2024		UBA 2022: Life cycle assessment of graphic and hygiene paper p. 53	https://www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/texte_123-2022_aktualisierte_oekobilanz_von_grafik-_und_hygienepapier.pdf

PU cleaner	kg	0.35	14/04/2024	Cleaning 100 m² of floor with PU cleaner produces 0.035 kg of CO_2 emissions for a quantity of approx. 0.1 L (100 g).	German Institute for Sustainability & Economics 2020: Brief report on CO_2 emissions from PU cleaners	https://www.dr-schutz.com/wp-content/uploads/CE_DE_Bericht-CO2-Emission_Dr.-Schutz-GmbH-PU-Reiniger-23.11.2020.pdf
Paper	kg	0.97		EU calculations for wood-free, uncoated paper	UBA TEXTS 123/2022 'Updated life cycle assessment of graphic and hygiene paper', ID 172	https://www.umweltbundesamt.de/themen/co2-rechner-fuer-veranstaltungen-online
Recycled paper	kg	0.84			UBA TEXTS 123/2022 'Updated life cycle assessment of graphic and hygiene paper', ID 5803	https://www.umweltbundesamt.de/themen/co2-rechner-fuer-veranstaltungen-online
Wood	m3	-726.98			OEKOBAU.DAT: 3.1.02 Wood / Solid wood / Solid structural timber	https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=7aba3603-0689-4da5-8d24-fd92ae398d07&version=00.00.032&stock=OBD_2024_I&lang=de
Aluminium (primary)	t	9,890.00			BayCalc Tool Version 2	Bundesamt für Wirtschaft und Ausfuhrkontrolle (15/02/2024). Informationsblatt CO2-Faktoren.

Aluminium (secondary)	t	530.00			BayCalc Tool Version 2	Bundesamt für Wirtschaft und Ausfuhrkontrolle (15/02/2024). Informationsblatt CO2-Faktoren.
Gravel (construction gravel)	t	10.00			BayCalc Tool Version 2	Bundesamt für Wirtschaft und Ausfuhrkontrolle (15/02/2024). Informationsblatt CO2-Faktoren.
Reinforced concrete, recycled	t	136.62		The value is based on the assumption that reinforced concrete consists of 3% steel and 97% concrete (by weight). This results in the following calculation per 1000 kg: (970/2306)*279+30*0.6422 =136.62 kg/t		Prozess-Datensatz: Bewehrungsstahl (de) - OEKOBAU.DAT; https://oekobau-dat.de/OEKO-BAU.DAT/datasetdetail/process.xhtml?uuid=3e15eb88-e824-4a81-972a-45e06930aa19&version=20.24.070&stock=OBD_2024_I&lang=de
Glass, single	m²	6.76				https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=11fdd0b3-1a9a-43f5-a701-40cec9935d09&version=00.00.022&stock=OBD_2024_I&lang=de
GKF plastic	t	8,500.00				Bundesamt für Wirtschaft und Ausfuhrkontrolle (15/02/2024). Informationsblatt CO2-Faktoren.

Mineral wool (interior)	m^3	38.54				https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=a5b22bbe-175d-4aef-bb19-4954e699eb8c&version=20.24.070&stock=OBD_2024_I&lang=de
Mineral wool (blown-in insulation)	m^3	64.88				https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=7395adfa-2a3f-43f1-be88-5d4a392968a5&version=20.24.070&stock=OBD_2024_I&lang=de;
Mineral wool (flat roof)	m^3	193.40				https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=60311c13-53d4-4cee-8777-1f9c9889b770&version=20.24.070&stock=OBD_2024_I&lang=de
Plasterboard	m^2	1.82				https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=deeb0bda-20fa-412a-b945-1a589638db21&version=20.24.070&stock=OBD_2024_I&lang=de
Plasterboard fibre	m^2	3.26				https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=1b0a3488-9b02-4c98-b421-8c746d350f97&version=20.24.070&stock=OBD_2024_I&lang=de;

Linoleum	m²	3.71				https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=ed391263-0e6d-43dd-ad3e-43607545f281&version=20.24.070&stock=OBD_2024_I&lang=de;
Tiles	m²	9.47				https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=3f07b058-0e84-48ca-bffe-9672b0affc71&version=00.01.000&stock=OBD_2024_I&lang=de;
Carpet	m²	9.99				https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=fc6d4562-3ce7-4492-8c62-24cb0b6a87d7&version=00.01.000&stock=OBD_2024_I&lang=de;
Galvanised sheet steel	t	2,494.00				Verzinktes, kalt gewalztes Stahlblech (de) - Probas2
Ventilation	m²	18.00				https://nachhaltigwirtschaften.at/resources/nw_pdf/schriftenreihe-2023-66-bibi-tga.pdf
Heating	m²	11.00				https://nachhaltigwirtschaften.at/resources/nw_pdf/schriftenreihe-2023-66-bibi-tga.pdf
Plumbing	m²	6.50				https://nachhaltigwirtschaften.at/resources/nw_pdf/schriftenreihe-2023-66-bibi-tga.pdf

Electrical installation	m²	3.00				https://nachhaltigwirtschaften.at/resources/nw_pdf/schriftenreihe-2023-66-bibi-tga.pdf
PV system	kWp	810.00				https://www.ise.fraunhofer.de/content/dam/ise/de/documents/presseinformationen/2021/2221_ISE_d_PI_CO2-Fussabdruck-von-PV-Modulen.pdf
Heat and impact sound insulation panels	m³	86.93				https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=121c71e8-0f4c-4529-b72e-331198d15f0f&version=20.24.070&stock=OBD_2024_I&lang=de;
Heat and levelling insulation	m²	14.80				https://www.oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?lang=en&uuid=880e05ea-55c6-4346-a3ea-5af0e5f299e2&version=00.09.000&utm_source=chatgpt.com;
Vapour barrier	m²	0.45				https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=6869f7c1-1b2b-4f30-afc9-823a0104f1d9&version=20.24.070&stock=OBD_2024_I&lang=de;

Separating film	t	3,100.00				https://www.handelsblatt.com/unternehmen/handel-konsum-gueter/verpackungsindustrie-oekobilanz-sechs-mythen-ueber-plastik-und-papier/27404644.html;
Perimeter insulation	m²	74.00				https://www.oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?lang=de&uuid=6e916cbf-6b9f-4515-8af9-0de9e546acc2&version=00.02.000&utm_source=chatgpt.com;
Triple glazing	m²	60.71				https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=ba58d8b9-945b-4428-b4e0-aecda8b3df18&version=20.24.070&stock=OBD_2024_I&lang=de
Hemp fibre	t	373.40			BayCalc Tool Version 2	Own calculation; refers to hemp fleece in production (A1-A3), 14.17 kgCO2e/m³; density = 38 kg/m³
Concrete	t	100.00			BayCalc Tool Version 2	Bundesamt für Wirtschaft und Ausfuhrkontrolle (15/02/2024). Informationsblatt CO2-Faktoren.

Upstream German electricity mix	kWh	0.06	14/02/2024	Emission factors for electricity mix in Germany in 2022, difference between emission factor for electricity without upstream chains and electricity with upstream chains, in order to evaluate upstream chains only	UBA	https://www.umweltbundesamt.de/publikationen/entwicklung-der-spezifischen-treibhausgas-9
Electricity from renewable energies	kWh	0.04	03/03/2025		Internal calculations based on: GEMIS 5.1, El-mix-DE	
Heat (district heating)	kWh	0.15	03/03/2025		UBA, Probas, Gemis 5.1 Insight (2024)	https://tool.ecocockpit.de/
Passenger vehicle(diesel)	km	0.21	01/11/2023	Greenhouse gas emissions per vehicle kilometre over the entire life cycle of manufacture, electricity/fuel supply, maintenance, disposal/recycling for a newly registered vehicle in 2020 (compact class, 150,000 km)	ifeu 2020, published by the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection	https://www.bmuv.de/fileadmin/Daten_BMU/Download_PDF/Verkehr/emob_klimabilanz_bf.pdf

Passenger vehicle (petrol)	km	0.23	01/11/2023	Greenhouse gas emissions per vehicle kilometre over the entire life cycle of manufacture, electricity/fuel supply, maintenance, disposal/recycling for a newly registered vehicle in 2020 (compact class, 150,000 km)	ifeu 2020, published by the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection	https://www.bmuv.de/fileadmin/Daten_BMU/Download_PDF/Verkehr/emob_klimabilanz_bf.pdf
Passenger vehicle (petrol)	km	0.20	01/11/2023	Greenhouse gas emissions per vehicle kilometre over the entire life cycle of manufacture, electricity/fuel supply, maintenance, disposal/recycling for a newly registered vehicle in 2020 (compact class, 150,000 km)	ifeu 2020, published by the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection	https://www.bmuv.de/fileadmin/Daten_BMU/Download_PDF/Verkehr/emob_klimabilanz_bf.pdf
Battery electric vehicles (BEV)	km	0.16	01/11/2023	Greenhouse gas emissions per vehicle kilometre over the entire life cycle of manufacturing, electricity/fuel supply, maintenance, disposal/recycling for a newly registered vehicle in 2020 (compact class, 150,000 km)	ifeu 2020, published by the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection	https://www.bmuv.de/fileadmin/Daten_BMU/Download_PDF/Verkehr/emob_klimabilanz_bf.pdf

Hybrid electric vehicles (HEV)	km	0.20	01/11/2023	Greenhouse gas emissions per vehicle kilometre over the entire life cycle of manufacturing, electricity/fuel supply, maintenance, disposal/recycling for a newly registered vehicle in 2020 (compact class, 150,000 km)	ifeu 2020, published by the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection	https://www.bmuv.de/fileadmin/Daten_BMU/Download_PDF/Verkehr/emob_klimabilanz_bf.pdf
Public transportation	Pkm	0.08	01/11/2023	Tram, light rail, underground railway calculation UBA incl. usage (TTW), energy, vehicle, infrastructure	UBA 'Environmentally friendly mobility', March 2021, source: UBA's own calculations	https://www.umweltbundesamt.de/sites/default/files/medien/5750/publikationen/2021_fb_umweltfreundlich_mobil_bf.pdf
On foot	km	0.00				
Bicycle	Pkm	0.01		Calculation of UBA including vehicle use (TTW), energy provision, vehicle provision, infrastructure provision	UBA 'Environmentally friendly mobility', March 2021, source: UBA's own calculations	https://www.umweltbundesamt.de/sites/default/files/medien/5750/publikationen/2021_fb_umweltfreundlich_mobil_bf.pdf
E-bike	Pkm	0.01		Swiss electricity mix, 1 person, including energy supply, vehicle maintenance, vehicle manufacturing, roads	mobitool 2.1	

Long-distance coach	Pkm	0.03		Calculation of UBA including vehicle use (TTW), energy provision, vehicle provision, infrastructure provision	UBA 'Environmentally friendly mobility', March 2021, source: UBA's own calculations	https://www.umweltbundesamt.de/sites/default/files/medien/5750/publikationen/2021_fb_umweltfreundlich_mobil_bf.pdf
Rail (long-distance, ICE)	Pkm	0.05		Calculation of UBA including vehicle use (TTW), energy provision, vehicle provision, infrastructure provision	UBA 'Environmentally friendly mobility', March 2021, source: UBA's own calculations. The values for railways are based on data on the average electricity mix in Germany.	https://www.umweltbundesamt.de/sites/default/files/medien/5750/publikationen/2021_fb_umweltfreundlich_mobil_bf.pdf
Rail (regional transport, RE)	Pkm	0.07		Calculation of UBA including vehicle use (TTW), energy provision, vehicle provision, infrastructure provision	UBA 'Environmentally friendly mobility', March 2021, source: UBA's own calculations. The values for railways are based on data on the average electricity mix in Germany	https://www.umweltbundesamt.de/sites/default/files/medien/5750/publikationen/2021_fb_umweltfreundlich_mobil_bf.pdf

Short-haul flights (<500 km)	Pkm	0.26	14/02/2024		2023 Ecoact Humanitarian Carbon Calculator HCC, Waste	https://www.climate-charter.org/wp-content/uploads/2023/01/The_Humanitarian_Carbon_Calculator_HCC.xlsx
Medium-haul flights (500–3,500 km)	Pkm	0.19	14/02/2024		2023 Ecoact Humanitarian Carbon Calculator HCC, Waste	https://www.climate-charter.org/wp-content/uploads/2023/01/The_Humanitarian_Carbon_Calculator_HCC.xlsx
Long-haul flights (> 3,500 km)	Pkm	0.15	14/02/2024		2023 Ecoact Humanitarian Carbon Calculator HCC, Waste	https://www.climate-charter.org/wp-content/uploads/2023/01/The_Humanitarian_Carbon_Calculator_HCC.xlsx
IT equipment waste	kg	2.00	14/02/2024		2023 Ecoact Humanitarian Carbon Calculator HCC, Waste	https://www.climate-charter.org/wp-content/uploads/2023/01/The_Humanitarian_Carbon_Calculator_HCC.xlsx
Paper and cardboard waste (recycling)	kg	0.99	14/02/2024		2023 Ecoact Humanitarian Carbon Calculator HCC, Waste	https://www.climate-charter.org/wp-content/uploads/2023/01/The_Humanitarian_Carbon_Calculator_HCC.xlsx
Waste water	kg	0.00	14/02/2024		Probas	https://tool.ecocockpit.de/
Household waste (landfill)	kg	2.63	14/02/2024		Gemis 5.1	https://tool.ecocockpit.de/
Household waste (incineration)	kg	0.37	14/02/2024		Gemis 5.1	https://tool.ecocockpit.de/

Biowaste (composting)	kg	0.02	14/02/2024		2023 Ecoact Humanitarian Carbon Calculator HCC, Waste	https://www.climate-charter.org/wp-content/uploads/2023/01/The_Humanitarian_Carbon_Calculator_HCC.xlsx
Glass waste (recycling)	kg	0.64	14/02/2024		2023 Ecoact Humanitarian Carbon Calculator HCC, Waste	https://www.climate-charter.org/wp-content/uploads/2023/01/The_Humanitarian_Carbon_Calculator_HCC.xlsx
Plastic	kg	1.61	14/02/2024	Plastic recycling rate in Germany: 35% used as raw material or in manufacturing, 64.4% used for energy recovery	2023 Ecoact Humanitarian Carbon Calculator HCC, Waste,	https://www.umweltbundesamt.de/daten/ressourcen-abfall/verwertung-entsorgung-ausgewaehlter-abfallarten/kunststoffabfaelle#hohe-verwertungsquoten-
3- and 5-layer solid wood panel	m^3	-659.00	15/03/2025			Prozess-Datensatz: 3- und 5-Schicht Massivholzplatte (Durchschnitt DE) (de) - OEKOBAU.DAT