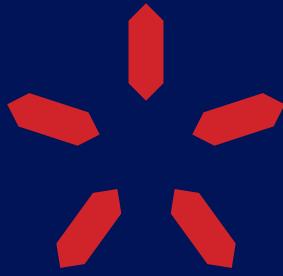Connect. Exchange. Innovate.

Sustainability and Climate Action on Campuses

Working Group on Climate and Sustainability

IDEA League

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Part A
Call to Action

01 Introduction

01.01 Background

This publication is drawn up by the Working Group on Climate and Sustainability of the IDEA League; five prime European universities that collaborate on various elements of education, research, and organisation. As universities we have to follow science in everything we do, and the science is clear; humanity has an immense challenge at hand regarding anthropogenic climate change. The latest IPCC report [IPCC 2022] is alarming; unless we take radical action, we are headed for a global temperature increase beyond 2oC. This would have a devastating impact on the earth's ecosystems. High temperatures will incite drought in some places, water excess in others, and extreme weather conditions everywhere. For humankind, these impacts would result in diminished freshwater availability, compromised food production capacity, and entire regions becoming uninhabitable, potentially causing climate refugees to move to more benign places on earth. Moreover, the long-term availability and supply of many resources is in danger, requiring a different economy, a circular one.

If the signs are this clear, there is no other conclusion than to take action. The place where this can be explored best is at universities and other institutions for higher education, which contain intelligent communities that follow science and the space and scope to develop experiments and living labs that can take place before implementation in practice. Therefore, these institutions can pave the way for organisations and cities, which struggle with the same ambitions relating to climate action and sustainability.

Therefore, the IDEA League working group wrote this report, to present examples of our approaches, concepts, and solutions and to inspire others to take action themselves.

01.02 Reading guideline

With this document, we want to discuss the different approaches, challenges, achievements, and lessons learned of the IDEA League universities to create guidelines for sustainability and climate action on campuses to assist other universities, cities, and organisations in achieving their own sustainability goals.

02 Vision and Ambition

02.01 Definitions

Before we can start, we need a common understanding of the most relevant terms affiliated with sustainability and climate. Dobbelsteen & Gameren [2022] defined several terms that are commonly used under the umbrella term of 'sustainability' (p.16). These terms are defined here:

"Sustainability

Sustainability is derived from 'sustainable development' [Brundtland et al. 1987]; development that meets the needs of the present without compromising the needs of future generations. According to Brundtland et al. 'sustainability' is about equity across the world and a balance between economy and ecology. As defined by Elkington [1997], sustainability has three main dimensions: social sustainability (people), ecological sustainability (planet), and economic sustainability (profit, later altered to prosperity). To achieve sustainable development, all three must be addressed. Kristinsson & Dobbelsteen [2012] defined 'sustainable' as: everything future generations want to inherit, use, and maintain. This definition gives sustainability a key focus relating to what each generation leaves for the next.

GHGs (greenhouse gases)

Greenhouse gases are the chemical gaseous compounds that in the outer layers of the atmosphere prevent infrared heat waves from escaping to outer space. This phenomenon is called the 'greenhouse effect', which occurs naturally on Earth but is exaggerated due to human activities, thereby enhancing global warming. The dominant greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and water vapour (H_2O). In order to unify the impact of these compounds on climate change based on their global warming potential, they are converted to CO_2 equivalent emissions (CO_2-eq), which represents the amount of CO_2 that would be needed to have the same impact.

GWP (global warming potential)

Global warming potential (GWP) is an indication of the relative contribution of a gas to the greenhouse effect when compared to an equivalent mass of carbon dioxide 100 years after its release into the atmosphere (GWP100). The GWP100 of CO_2 = 1, GWP100 of CH_4 = 34, GWP100 of N_2O = 298 [IPCC 2013]. As an example, methane is 34 times more potent than carbon dioxide with regards to the greenhouse effect.

Climate neutral

Climate neutral means that an organisation, a project, or action has net zero GHG emissions over the period of a year [Graamans & Dobbelsteen 2018]. Net zero does not mean 'no emissions'. It means that the emissions are reduced to an absolute minimum, which are then compensated for elsewhere.

Carbon neutral

Carbon neutral means that over the period of a year, an organisation, a project, or action has net zero carbon emissions, which can refer to CO_2 and CH_4. When speaking of carbon neutral or CO_2 neutral, in this report, we mean climate neutral; referring to all GHG emissions, or in other words 'CO_2-equivalent neutral'. Carbon neutral is not the same as energy neutral, because energy neutral requires renewable energy to have been produced in the vicinity of the project or action considered. With carbon neutral, renewable energy can come from afar and carbon emissions can be compensated for [Graamans & Dobbelsteen 2018].

Energy neutral

Energy neutral means that over the period of a year, an organisation, a project, or action produces as much (renewable) energy as it uses [Graamans & Dobbelsteen 2018]. An energy-neutral building, for instance, is a building that produces, via sustainable sources, the same amount of energy it requires over the period of a year. Overproduction of renewable energy can compensate for remaining fossil fuel consumption. So, in an energy-neutral system, one is still allowed to use fossil fuels as long as these are compensated for by extra renewable energy production. An example thereof is the Danish Island of Samsø, which is energy neutral although it still uses fossil fuels for cars, ferries, and some old boilers. The overproduction of wind power compensates for the use of fossil energy. Samsø is now in the process of becoming entirely fossil free.

Fossil free

A fossil-free organisation, project, or action, eliminates the use of fossil fuels. In this case, no use of fossil resources (mineral oil, natural gas, coal) is allowed anywhere in the system considered. In a fossil-free system, all elements run on renewable energy resources. A fossil-free system can be called circular for the use of energy but not yet for other flows, such as water, materials, and food (nutrients) [Broersma et al. 2018].

Circular

Circular refers to all resources: energy, water, materials, and nutrients. A circular economy ([Ellen MacArthur Foundation 2013], strongly linked to Cradle to Cradle [McDonough & Braungart 2002]) has two possible cycles it can refer to: the technical cycle, focussed on technical materials, components, and products, that can be reused or reprocessed almost infinitely, and the natural cycle, which refers to the replenishment of renewable sources and the safe return of non-toxic waste to nature. Reusing or reprocessing of renewable resources is even better, of course. The so-called R-ladder can be used for circular use of resources: refuse, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, recover.

From the moment a system is circular, all resources are reused and recycled or replaced by renewables; one could call this a self-sufficient, autarkic system. From that moment onwards, one would say that a sustainable system has been established, but a circular system does not amend for damages and lingering impacts from the past. Therefore, a system needs to be regenerative.

Regenerative

Understanding that at present the earth is already overstretched, unbalanced, and damaged by human development, a truly sustainable situation would arise when a system also repairs old damages, restores natural reserves, and rebuilds capacity that was lost in the past. This is called a regenerative system. A regenerative system therefore does more than a circular one, in that it repairs damages and rebuilds shortfalls that have evolved over time, before a system became circular. Becoming regenerative means that a system does not only take care of its own self-sufficient functioning but also makes amends for the damage created in the centuries before [Broersma et al. 2018]. Hence, it is the ultimate system for a truly sustainable world."

02.02 The current worldwide situation

The physics and chemistry of the earth's atmosphere largely determines the climate. The composition of the atmosphere changes due to human actions such as deforestation and burning coal, oil, and gas. Due to the release of these anthropogenic greenhouse gases, heat is trapped in the lower atmosphere, which makes the temperature rise, which is also called 'climate change' [Hardy 2003]. The world is facing several challenges due to climate change. A consequence of the rising temperature is melting ice and a rising sea level, which will lead to flooding and erosion of coastal areas and lower lands. Another effect of climate change is extreme weather conditions, such as droughts, floods, heat waves, and extreme winds. Different parts of the world will face different challenges. To keep the planet and all our campuses viable, climate mitigation and climate adaptation must play an important role.

02.03 Vision for sustainable universities and campuses

A significant reduction in greenhouse gas emissions is needed, together with a different way of living and handling the cycle of materials to redress the balance. As progressive universities that want to be an example for other organisations, the goal is to become regenerative. However, to reach that goal several sub-steps are needed, which we refer to as the '4 Cs': carbon neutral, circular, climate adaptive, contributing to quality of life.

Pave the way
All over the world, governments are setting goals to reduce the current trend of climate change. One of the first common vows made was the Paris Agreement. This is a legally binding treaty on climate change, which was adopted by 195 parties on 12 December 2015. The goal of this agreement is to limit global warming to 1.5 degrees Celsius. In addition, the European Commission introduced the European Green Deal with the aim to be the first climate-neutral continent by 2050. The IDEA League universities all strive to support this goal and reach climate neutrality as soon as they can. These universities acknowledge that they have the responsibility to pave the way forward, so that other universities, cities, and organisations in general, can follow and learn. The IDEA League universities will become the frontrunners and will demonstrate how to become sustainable.

In addition, the IDEA League universities realise that the transition to becoming sustainable is as important, perhaps more so, than the final goal. There is still a lot of barriers to overcome, especially while scaling up requires acceleration. It is important to overcome these bottlenecks and barriers to help society become more sustainable.

Unique opportunity
The IDEA League universities are the home of scientists, researchers, and motivated students, who form essential factors in the much-needed technological transition. Together, they can come up with innovative ideas that can be tested in field labs and can be scaled up by creating start-up companies. Universities will not only be the base for the technical transition but also for the equally important sociological transition.

02.04 Campuses as living labs

The IDEA League universities are already focussing on sustainability and a lot of research is currently being conducted into this area. However, most of this work is not visible on the campuses itself. A few universities have some facilities where they can test and showcase innovation. Beside these few spots, most of the research takes place behind closed doors. The IDEA League universities want to use their campuses as living labs so that on the one hand they can test and demonstrate new technologies on their campus and on the other hand experiment with non-physical research, such as new regulations and alternative business propositions. Special areas are allocated as zones for short and long-term living labs. These labs can attract new partners that want to strive for sustainability together with the university.

02.05 Sustainability ambitions

Informed by, and based on, scientific evidence, we propose to define sustainability and climate action on campuses according to the following practical goals.

The universities aim to:

• **Become climate-adaptive**
and adjust to the already changing
dealing with heat, drought, excessive rainfall, floods and extreme weather

• **Become carbon neutral**
to avoid runaway climate change in the long run
referring to all related activities done on and from the campus

• **Become fully circular**
closing cycles for efficient use of resources
related to all resource and waste flows going through the campus

• **Contribute to quality of life**
for people and nature on the campus
aiming at improving biodiversity, safety, health, comfort, inclusiveness, and happiness

• **Expose and test sustainability and climate action on campus**
demonstrating living labs and innovative projects
related to technical and non-technical aspects of sustainability

02.06 Common declaration

With this publication, the authors of the IDEA League working group aim to provide guidelines for sustainability and climate action on campuses across Europe. By drawing attention to the different approaches, challenges, achievements, and lessons learned at the IDEA League universities, we want to inspire and set an example for other universities, cities, and organisations in general. A common starting point is the work that is done at each of our universities with respect to the Sustainable Development Goals and sustainable campuses.

The IDEA League considers the climate to be a crucial and prioritised issue. We think that higher education institutions (HEIs) can play a central role in efforts to combat climate change. We see it as our task to contribute through teaching and research, and by reducing the negative impact of our own operations.

The IDEA League universities declare to do the following:
- Through education, research, operations and external engagement we will help society as a whole to achieve set sustainability targets.
- We will work to reduce our own climate impact, in line with society's commitment, as expressed in national and international agreements.
- We will, based on HEI-specific conditions, set up a climate action plan with far-reaching targets for climate-related work and we will also allocate resources so that we can achieve these targets and conduct follow ups.
- We will clearly communicate our climate-related work to inspire and spread knowledge to other organisations and members of society.

Part B
Learn

03 Chalmers

03.01 Approach

As with all universities, Chalmers' primary task is to produce and disseminate knowledge and innovations for the benefit of a sustainable society through education, research, and utilisation, in collaboration with the wider research community and society. In addition, it is the responsibility of the organisation to harness its skills and review and reduce its own environmental and climate impact.

Climate Framework

Chalmers' work on sustainable development is based on both the UN Sustainable Development Goals (SDGs) and the national Climate Framework that Chalmers has developed with partners such as KTH Royal Institute of Technology in Stockholm. The Climate Framework stipulates 13 key areas of climate impact from the higher education sector that institutions can use for guidance. These key areas provide information on how organisations can work on sustainability and reduce their impact on the world so that by 2030 they have implemented measures in line with the 1.5oC target. With the Climate Framework as a support, higher education institutions (HEIs) can select areas in which they set goals and implement measures based on their own circumstances. The Climate Framework has been disseminated at Swedish higher education institutions and most of Sweden's universities have joined and are actively working with the Climate Framework as their inspiration and starting-point.

Guidelines for the Climate Framework

Campus plan

Chalmers has a campus plan, adopted in 2019, looking forward to 2035 and 2050, which was developed jointly by Chalmers University of Technology, Chalmers Student Union and the two property owners Chalmersfastigheter and Akademiska Hus. The campus

Sustainability reporting

Chalmers' strategic goals are compiled in an annual document[1] in which the sustainability goals are integrated with core activities: education, research, and utilisation. These goals then form the basis for departments and other activities to act. Chalmers also prepares an annual Sustainability Report[2] and a Climate Report[3] (the report indicates the CO2 footprint of Chalmers' activities during the year) to monitor progress in the areas of Environment, Social Relations, Human Resources, Respect for Human Rights, and Anti-Corruption. Based on these, decisions are made on future measures to be planned and implemented in the area of sustainability, such as the installation of solar panels, refurbishments using smart materials or the reuse of previous materials, improvement of the external environment for biodiversity, and the creation of safe pedestrian routes.

plan aims to create a long-term sustainable campus and calls for a holistic approach to sustainability to be applied in the development of Chalmers' campus. It is important for all development projects on campus to relate to the bigger picture, and to ensure that the different dimensions of sustainability reinforce, rather than compete, with each other. The campus plan states that Chalmers' campus should be green, health-promoting, and resilient to the effects of climate change. It also states that the campus should make an active contribution to reducing environmental impact by means of responsible use of land, energy, water, and other resources and the development of new technologies. The vision of the campus plan is entitled 'Chalmers campus – people and meetings for a sustainable future' and there are six goals that relate to sustainability issues to varying degrees: 1) Leading international knowledge environment; 2) Integrated part of the city with its own distinct character; 3) Attractive

Campus housing for international students and visiting researchers

living environment contributing to people's well-being; 4) Good accessibility with sustainable transport; 5) Green campus promoting ecological values; 6) Responsible and efficient use of premises, land and other resources. The campus plan, with its goals and strategies, is the basis for the continuous work on campus development and both the short-term and long-term provision of premises for Chalmers.

Research and innovation – SDGs 9 and 17

One of Chalmers' greatest contributions to sustainable development is research and the production of new knowledge. Chalmers has a wide variety of different research areas that contribute to a more sustainable world and to the global goals. A number of Chalmers' research initiatives in the field of sustainability are described below, several of which use the campus and its buildings as test beds.

Chalmers Power Central

There are several examples in the field of energy, in particular Chalmers Power Central, which is located in the middle of the Johanneberg campus, and which is an advanced research facility focussing on carbon capture and conversion of biomass. Leading international research is conducted at Chalmers Power Central, attracting researchers and industry partners from all over the world, who together develop and implement new knowledge that contributes to a climate-neutral, sustainable future. At the same time, Chalmers Power Central accounts for a large part of the energy supply on campus.

The Chalmers Power Central

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[1] Chalmers' Prioritised Operational Development, C 2021-0091
[2] Annual Review, Sustainability Report and Annual Reports for Chalmers University of Technology 2021 C-2022
C 2022-0289-2
[3] Chalmers' Climate Report 2021 C 2022-0429

Chemical looping combustion
One possible means of limiting global warming is the use of a tool to remove carbon dioxide from the atmosphere, referred to as negative emissions. Researchers at the Division of Energy Technology at the Department of Space, Earth and Environment, and linked to Chalmers Power Central, have developed a combustion technology called chemical looping combustion, in which waste carbon dioxide is emitted separately instead of mixed with air. This technology makes it cheap and easy to separate and capture carbon dioxide instead of releasing it into the atmosphere. There are currently 34 pilot installations of chemical-looping combustion worldwide.

Fuel cells
For many years, fuel cells have been too expensive to make a breakthrough as an energy and transport solution. A research team at the Department of Chemistry and Chemical Engineering is developing new materials that can increase the efficiency and lower the cost of fuel cells. Part of the Solar Initiative research has moved onto campus, using the roofs of buildings to continue research in real-world conditions. In addition to testing active materials to increase the efficiency of solar cells, the test site has been used in the development of Most – Molecular Solar Thermal Energy Storage.

Solar cells on campus rooftops

New batteries
At the Department of Physics, one of the research teams aims to develop and understand (conceptually) new electrolytes at the molecular level by combining modelling and spectroscopy with practical performance studies, especially for the next generation of batteries. At the Division of Building Technology at the Department of Architecture and Civil Engineering, a research team has developed cement-based batteries enabling future storage of energy in building structures.

Off-campus research
To give a few examples of all the sustainability-related research conducted off-campus, research in the field of health is conducted in close collaboration with a large number of stakeholders. Chalmers' research collaboration with Sahlgrenska University Hospital has resulted in several successful applications, such as mind-controlled prosthetics and bone-anchored hearing aids. Projects that can contribute to the sustainable preservation and utilisation of the oceans and marine resources are carried out at the Department of Mechanics and Maritime Sciences. They include research into the environmental impact of shipping, such as discharges into water, growth on hulls, wrecks that may emit pollutants and research into toxic antifoulants.

Pulp and paper
Researchers at the Department of Electrical Engineering conduct research on advanced process control in the pulp and paper industry, among others. The research team's results in solid controller settings for optimum control of complex systems have great energy-saving potentials and have demonstrated an annual saving of 25 GWh per mill. Tests are currently running at 2 mills. The estimated reduction in CO_2 equivalent is approximately 20 kT per annum. According to their energy declarations, universities such as Chalmers and Lund University Faculty of Engineering each account for about 9 kT CO_2 equivalent per annum. This demonstrates the savings and climate impact reduction from implementing our advanced research, which could be more clearly presented in our annual reports and sustainability reports.

First-cycle and second-cycle education – SDG 4
In first-cycle and second-cycle education, Chalmers has worked actively for many years to ensure that sustainable development is an integral part of all programmes. Chalmers' first-cycle education has as a degree requirement[4] that a certain number of credits in the environment, and sustainable development must be included in all BSc and MSc engineering programmes, architecture programmes and the marine engineer, master mariner and subject lecturer programmes. This is also in line with the national degree requirements in Sweden.

Sustainable development in all programmes
Chalmers has the ambition for all degree programmes to include integrated elements of sustainable development in other courses as well and for all students to have the opportunity to choose a master's programme with a special focus on the environment and sustainable development. Chalmers currently has five master's programmes with a specific and specialised focus on sustainable development. It is also possible to choose additional courses in the field of sustainability.
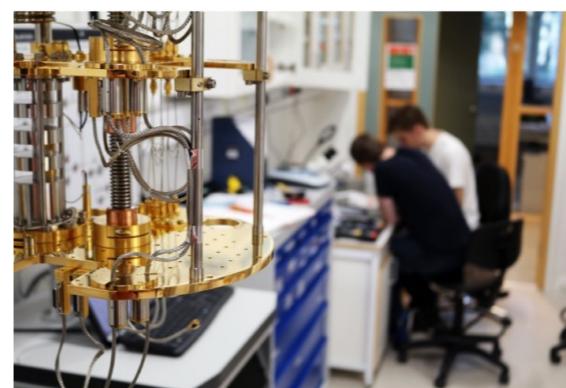
Students learning to build and programme a quantum computer within the Tracks initiative.researchers

Complex societal challenges
The TRACKS[5] education initiative at Chalmers aims to create individual and flexible study opportunities that are better able to address complex societal challenges by introducing multidisciplinary, challenge-oriented, flexibly designed courses to all Chalmers students in a structured educational format. These courses are optional and address specific challenges. They fall 'between' the programmes, allowing students to meet students from other programmes and disciplines, and prepare to solve the complex problems of the future. Chalmers is also home to Challenge Lab, where master's students take on global challenges alongside industry, government, and academic partners.

Chalmers Students for Sustainability
Chalmers Student Union has a student association, Chalmers Students for Sustainability (CSS), which works towards a sustainable society by supporting research, education, and collaboration for sustainable development. CSS organises meetings, lectures, study visits, and runs projects. Chalmers Student Union also works actively to reduce the environmental impact of its operations, for example, through environmental certification of the conference and restaurant company owned by the Student Union.

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[4] Local degree regulations for Chalmers University of Technology for degrees at first and second cycle levels 1.10 C 2022-0035
[5] Tracks | Learning and learning environment

Collaboration and innovation – SDG 17

To reach out with research and education in the field of sustainability, close collaboration with other actors in society is needed, as well as initiatives in innovation and entrepreneurship.

Chalmers Innovation Office

Since its inception, Chalmers Innovation Office has had a clear ambition to work on sustainability and include this perspective in discussions with researchers who have presented their early ideas. Sustainability is also a criterion for the projects Chalmers has chosen to support on its own validation fund or alongside research funder Vinnova. When the SDGs were presented in 2015, it was natural to include them as the basis for an active dialogue with researchers on how they see their utilisation supporting sustainability. Sustainability has also been an important element of the many seminars, workshops, and programmes that the Innovation Office has conducted over the years, for both Chalmers researchers and the regional network of innovation advisors. Of particular importance is the module on sustainability in a third-cycle course for doctoral students that the Innovation Office has been conducting regularly since 2012. By strongly linking utilisation and sustainability, Chalmers can best prepare researchers for the major transitions to come in relation to climate change and other sustainability challenges.

Fossil-free Energy Districts

The Fossil-free Energy Districts (FED) project was an innovative initiative to reduce energy use and the dependence on fossil fuels in buildings. In this project a unique local marketplace for electricity, district heating, and district cooling was developed on Chalmers' Johanneberg campus with nine partners in 2016 - 2019, with the City of Gothenburg as the driving actor. The initial project ended in 2019, but the marketplace remains open to both researchers and companies that want to test new energy solutions to transition to a sustainable society. The marketplace is used, for example, in the ongoing Flexigrid project, in which Chalmers and 15 partners are developing smart new flexible solutions for power grids, which are needed for the transition to a renewable power system. The project equips power grid operators with advanced tools, enabling them to meet growing capacity shortages with flexibility, and update old systems with smart technology.

HSB Living Lab

The HSB Living Lab is located on the Johanneberg campus as a unique infrastructure for research and collaboration projects for 12 partners in the built environment sector. The Living Lab is a residential building with 29 apartments for students and guest researchers on the campus. The partners involved, the sensor systems available and the processes established all aim to facilitate and develop sustainable solutions for future dwellings and ways of living.



Solar panels on the HSB Living Lab

HoloHouse

HoloHouse, a non-profit association located on the Chalmers campus, helps create meetings between industry and academia through student projects for sharing knowledge and skills. The aim of the initiative is to raise awareness and value of the roles played by everyone in a sustainable transition, whether you are a producer, consumer, employer, employee, teacher, or student. HoloHouse has helped bring together 6,000 students and 2,000 organisations in 2,700 different projects.

ElectriCity

ElectriCity started as a collaboration between research, industry, and society, to develop, demonstrate, and evaluate new sustainable transport solutions. Chalmers campus was used as a test bed for these solutions. An electric bus route that was part of Gothenburg's public transport system was established between Chalmers' Johanneberg and Lindholmen campuses as a pilot project and test bed in the development work. ElectriCity's goal is to develop silent, zero-emission buses, ferries, and even heavy vehicles powered by renewable electricity for future transport. Chalmers is also part of the Electric Worksite project, in which several key players are helping to take concrete steps to electrify construction sites. With a focus on construction and street maintenance projects, the project is testing how electrically powered machines can work in real-world environments in Gothenburg.

03.02 Challenges

The work on sustainable development in different parts of Chalmers has developed at different speeds and in different initiatives that have become difficult to keep track of. One challenge is to restructure, simplify, and focus to make progress on what is most important and produces the most impact. Sustainability has been seen by some as a separate area from climate, environment, health and safety, gender equality, etc., and the challenge here is to simplify the structure of the work, while managing the holistic complexity of sustainability.
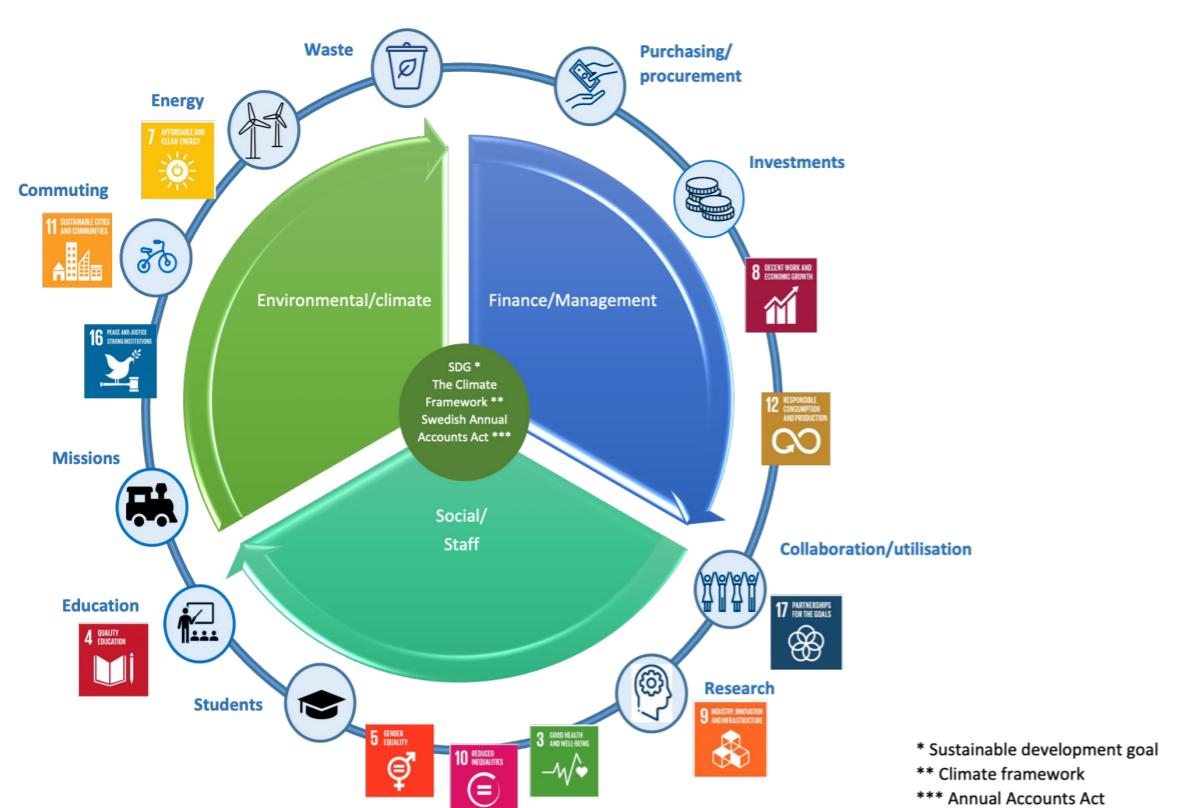
Sustainability affects all activities from recruitment of staff to financial allocation to which innovations and strategic collaborations Chalmers should invest in. This requires a partially new way of managing activities and the directions Chalmers decides to pursue in the future. The structure to be developed should be simple, easy to follow upon, and communicable to all staff, students, and external parties.

Overview of initiatives
One challenge is to identify all the individual and constantly new initiatives that our ambitious teachers, researchers, and doctoral students take on as part of Chalmers' broad activities, often with our committed partners. It is difficult to have an up-to-date overview of the research results produced and the applications that have been developed and implemented, and thus have an overview of what Chalmers is contributing to in the field of sustainable development.

Air travel
Another challenge is to maintain a low level of international air travel. Even before the Covid-19 pandemic, we had a trend of decreasing air travel, but the pandemic contributed to a significant reduction in flight hours for obvious reasons. However, at the same time, it built up an expectation and need for researchers to meet again physically to pursue research projects and for scientific and personal exchanges. As universities' main contribution to the transition to a sustainable society is to produce and disseminate knowledge that enables a rapid transition, managing our own travel is a difficult balancing act.

The building stock
There are great opportunities to use our campuses and buildings to develop, test, and demonstrate new sustainability solutions, not least because buildings and construction account for a large part of climate impact, but also because there are challenges in using existing building stock. Here we can set a good example and demonstrate concrete solutions, but this must be done using processes and under conditions that simultaneously create financial sustainability, where we set the right priorities for where we focus our financial and spatial resources.

Insect hotel on the Chalmers campus

Collaboration
Collaboration with the property owners, in Chalmers' case both our own property company Chalmersfastigheter and the state-owned Akademiska Hus, must be close, open and with a common agenda. Chalmers has a campus plan, adopted in 2019, looking forward to 2035 and 2050, which was developed jointly by Chalmers University of Technology, Chalmers Student Union, Chalmersfastigheter and Akademiska Hus. The campus plan aims to create a long-term sustainable campus and calls for a holistic approach to sustainability to be applied in the development of Chalmers' campus.

Planning
There are challenges in realising an overall common agenda relating to ambitious, actual, realisable construction projects, and creating incentives that address aspects of property economics, circular processes, building conservation, reuse, differing time frames, and funding types for construction and research, and not least the risk-taking inherent to advanced experimental research on the front line. A key challenge for the university is to be a clear, expert client to ensure that the major, long-term assets and resources that the university's built environment represents are designed with a high level of quality and in a flexible, robust, sustainable way.

03.03 Progress in achievements

Chalmers highlighted sustainability issues as an important part of its operations at an early stage. As a university, Chalmers was an early adopter of sustainability and identified sustainability issues as a profile area in 1998.

Internal governance

The ongoing restructuring of internal governance documents and increased collaboration between different areas such as purchasing and procurement, the environmental unit and HR are important factors in strengthening internal joint work on our own sustainability and climate impact and seeing sustainability as a whole and everyone's joint responsibility. The task of including sustainability, which has previously been a separate area, in all decision-making documents, in strategic documents and in the action plans of every research team requires major change work.

Energy and climate strategy

Work is also underway to further strengthen and integrate energy and climate initiatives in collaboration with Chalmers' property company Chalmersfastigheter by recruiting resources in the energy strategy area and formulating a more clearly joint energy and climate strategy with action plans linked to both the operation and use of buildings and campuses.

Gothenburg Centre for Sustainable Development

Chalmers and the University of Gothenburg have been collaborating in a joint centre called GMV (Gothenburg Centre for Sustainable Development) since 2000. Around 650 researchers and doctoral students in sustainable development at Chalmers and the University of Gothenburg are part of a research network, and active student associations in sustainable development collaborate through the Gothenburg Students for Sustainability Alliance (GSSA). Both these networks are held together by GMV. A change project for GMV's future mission and organisation has been underway since autumn 2021. The President of Chalmers and the Vice Chancellor of the University of Gothenburg made a policy decision in June 2022 to develop GMV into a West Swedish arena for sustainable development with the association Lärosäten Väst. In addition to Chalmers and the University

International student ambassadors

of Gothenburg, Lärosäten Väst also includes the University of Borås, the University of Skövde, University West, and Jönköping University. With such a West Swedish arena, the work that Chalmers and the University of Gothenburg have developed at GMV will be expanded with a stronger basis for collaboration and to a national level.

Vice President for Campus and Sustainable Development

From January 2022, Chalmers clarified the management responsibility for sustainability issues by appointing a Vice President for Campus and Sustainable Development. The ambition is to take a holistic approach to restructuring sustainability work so that sustainability becomes an even more naturally integrated part of operations and all strategies, plans, and decisions. Previous sustainability work focussed on internal operational impact. By engaging its own research and prominent researchers in the field of sustainability, Chalmers wants to take a big step forward in disseminating and using research results and innovations for the benefit of society at large more clearly.

03.04 Lessons learned

Digital ways of working

During the pandemic, digitisation advanced in leaps and bounds, and the use of digital tools such as Teams and Zoom has become commonplace for many people. The ongoing digitisation initiative provides an opportunity to further refine teaching and examination methods in particular. Projects to develop educational methods and environments based on the new, more digital ways of working are underway, such as recording more elements in labs and teaching and designing learning environments and various types of premises in adapted, flexible ways.
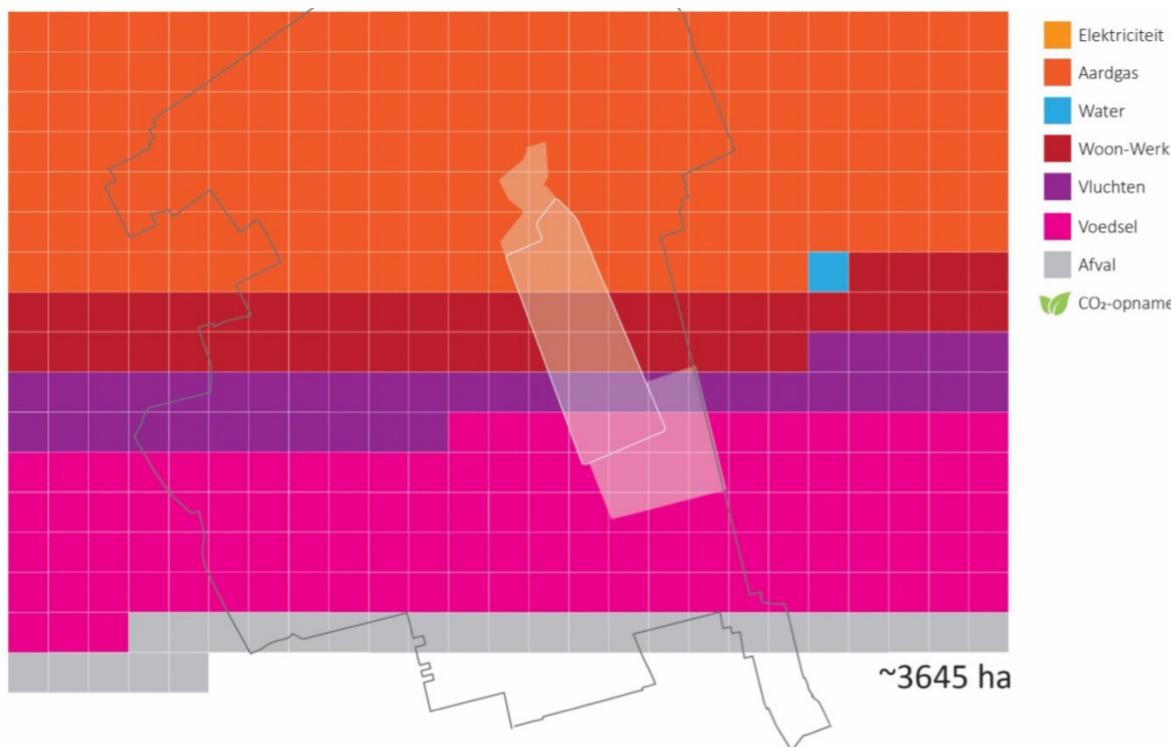
Monitoring progress

One of the most important lessons learned is to set clear, measurable targets to be able to monitor the progress and development of the sustainability work. To gain acceptance and raise awareness among all employees, the follow-up needs to be simple and easily communicated to the level within Chalmers at which it is possible to influence the outcome.

04 TU Delft

04.01 Approach

The way to the Sustainability Action Plan

Climate Action Position Paper
In the year 2019, TU Delft published their view on climate change and the actions required due to this by means of the Climate Action Position Paper[6]. This paper states that anthropogenic climate change is real and that greenhouse gases are changing our living environment through their impact on the global climate system. TU Delft vows that it will harness its innovative powers to support the world-wide transition to non-fossil energy, and adapt living environments to the consequences of global warming.

Carbon footprint of TU Delft in the year 2019, expressed as forest area that is needed to sequester all CO2-equivalent emissions, with the borders of the city of Delft (grey lines) and domain of TU Delft (white patch) visible underneath [based on Tax 2021]

CO2 Roadmap
In the year 2019, TU Delft's Campus & Real Estate department (CRE) asked professor Andy van den Dobbelsteen to conduct a carbon analysis of the buildings and energy systems on the campus. In the research, Andy, along with his colleague Tess Blom, took more into consideration than originally instructed, including travel, food, waste, water, and greenery for a more complete picture of the university's GHG emissions. This resulted in the CO2 Roadmap for TU Delft [Blom & Dobbelsteen 2019], which illustrated the first clear picture of the enormous challenge ahead to get the university to net-zero carbon by 2030.

[6] https://www.tudelft.nl/en/tu-delft-climate-institute/tu-delft-position-on-climate-action

Sustainability coordinator
From the 1st of January 2021, the Executive Board of TU Delft appointed Andy van den Dobbelsteen as the university's Sustainability Coordinator[7]. In this role, he looks at sustainability campus wide, including research, education, and operation. At the same time, Deirdre van Gameren was appointed as a researcher to support the sustainability coordinator. By appointing a sustainability coordinator, the university showed that it is serious about integrating sustainability into the organisation. In the first year of their appointment, Andy and Deirdre, supported by various teams of staff and students, wrote Sustainable TU Delft – Vision, Ambition, and Action Plan. This report presents recommendations for specific organisational measures, as well as projects and actions on the TU Delft Campus. The Executive Board officially established the report in January 2022 and approved projects resolving from it, including financial means, in July 2022.

Climate Action Programme
In April 2021, TU Delft launched the Climate Action Programme (CAP)[8], a university-wide programme that builds on the position paper, featuring a formal structure and plans for research, education, and action on the TU Delft campus, as well as cooperation with politics and industries. The university allocated a considerable budget for this programme, to appoint tenure-track researchers and PhD candidates. The CAP focusses on Climate Science, Climate Change Mitigation, Climate Change Adaptation, and Climate Change Governance, with AI as an overlapping theme. The goal is to contribute to a climate-resilient world. The programme supports the transition to non-fossil resources and helps the built environment to adapt to the effects of global warming.

Approach

The Sustainability Action Plan begins by discussing the current state of TU Delft and defining its ambitions. In the document, recommendations are made for structural organisational measures, projects, and actions to reach the sustainability goals set.
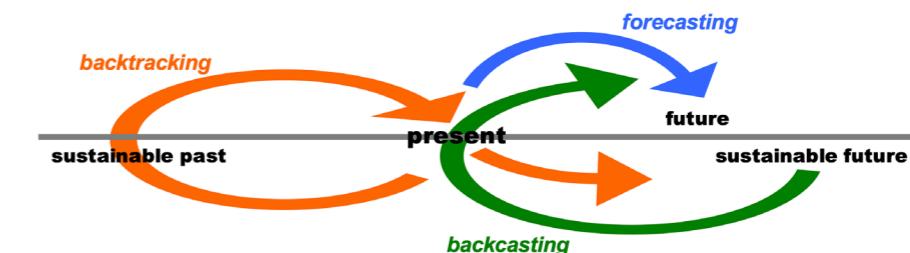
Graphical representation of the principles of backtracking (learning from a sustainable past), forecasting (forward pro-jecting of expectations) and backcasting (basing interventions on a desired sustainable future [Dobbelsteen et al. 2006]

[7] https://www.tudelft.nl/en/2021/tu-delft/andy-van-den-dobbelsteen-appointed-sustainability-coordinator
[8] https://www.tudelft.nl/en/2021/tu-delft/tu-delft-launches-large-scale-climate-action-programme

Backcasting
The sustainable Action Plan uses the technique of backcasting. This means that the desired future situation is envisioned first and then it is determined which (technical) steps are needed to achieve this [Vergragt & Jansen 1993]. Backcasting is a more effective means to arrive at the desired state in the future than forecasting or backtracking, although both of these can be helpful.

The City-zen methodology
Since the TU Delft Campus can be seen as a small city in itself, the EU City-zen methodology can be applied to the TU Delft campus. This methodology results in an energy roadmap, which is based on pre-defined targets and on an energy analysis (demand and potentials). It results in different energy interventions and measures at different technical and strategic scale levels and timeframes.
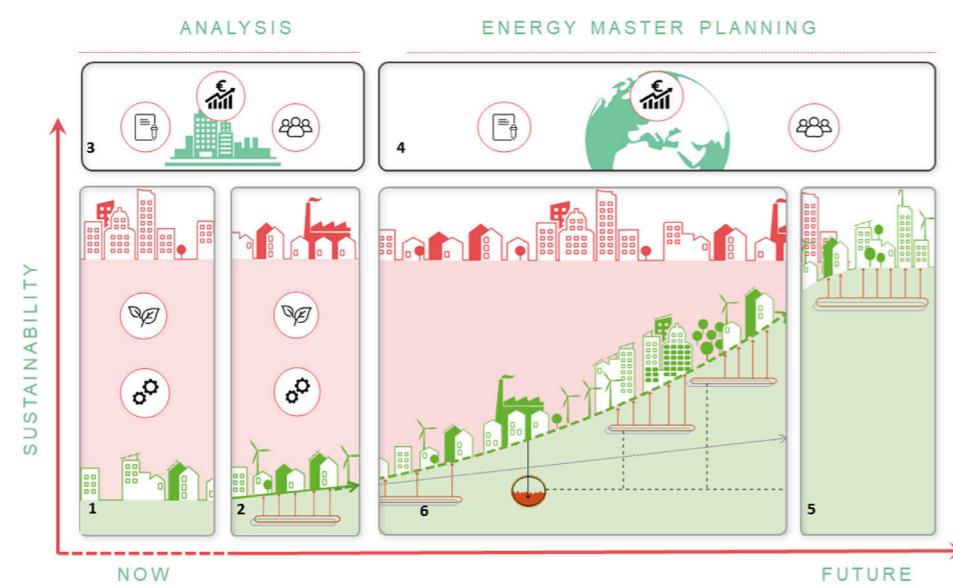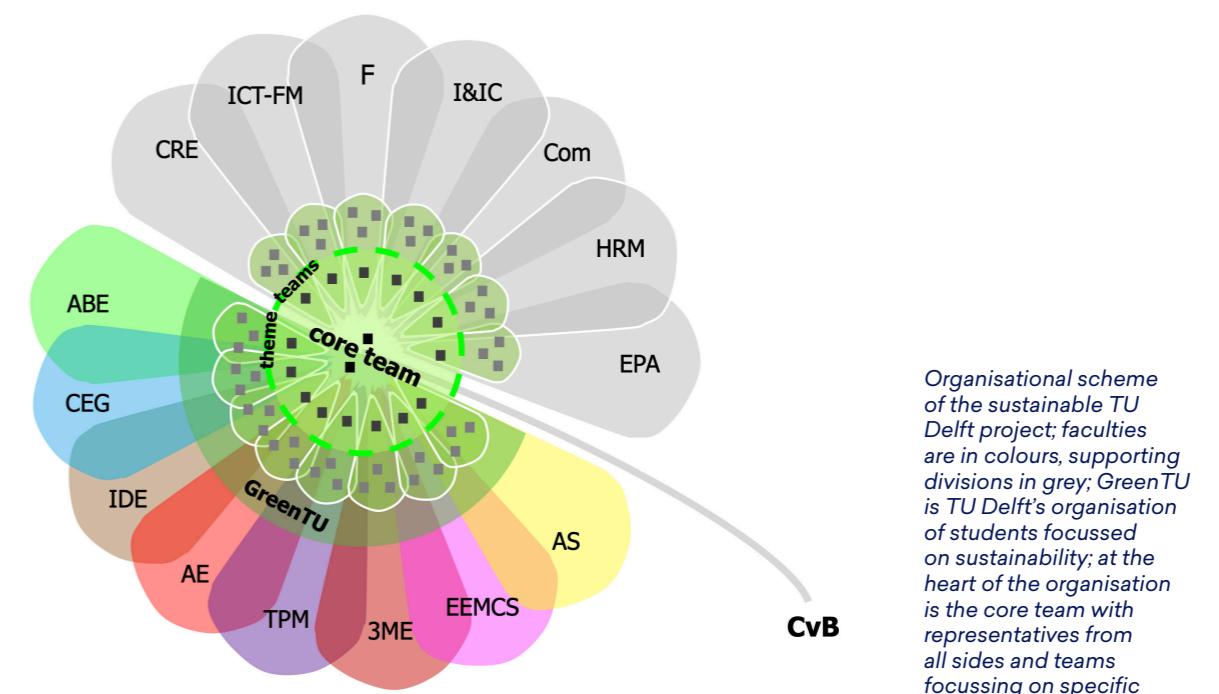

The City-zen methodology: how a city goes from an starting situation (1) and already planned developments (2) to a sustainable future situation (5), via stakeholder analysis (3) and scenario studies (4). The roadmap in between (6) is the defining element [Broersma et al. 2018]

Organisational structure
An organisational structure was set up with a core team and twelve[9] sustainability theme teams that cover everything that is done on and from the campus. In these teams, Andy and Deirdre worked together with more than one hundred students, academic staff, supporting staff, management staff, and external parties. The report forthcoming from this work (Sustainable TU Delft – Vision, Ambition and Action Plan) was divided into 5 domains: 1. Governance, 2. Education, 3. Research, 4. Operations, 5. Community.

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[9] Education; Research, Valorisation & Technology Transfer; EcoCampus; Construction & Renovation; Energy Systems; Mobility; Food & Beverage; Procurement & Waste Management; ICT, AI & Data Management; Social Engagement; Communication; and Reporting

Organisational scheme of the sustainable TU Delft project; faculties are in colours, supporting divisions in grey; GreenTU is TU Delft's organisation of students focussed on sustainability; at the heart of the organisation is the core team with representatives from all sides and teams focussing on specific sustainability themes.

04.02 Challenges

Most important interventions

Effectiveness
TU Delft needs to take serious steps before 2030, less than eight years from now. Therefore, effectiveness is key: how are we going to get there in fastest way? Effective measures have a great potential for improvement and can be applied to a large share of the system considered. It is important to achieve both.

Sustainable procurement: as soon as possible
Half of the emissions of TU Delft relate to the products (stationary, equipment, furniture, building materials, etc.) and services (hired external parties) it procures. All items bought should stand the test of sustainability, circularity in particular. Furthermore, getting the full supply chain of products to be sustainable is paramount. TU Delft can motivate or enforce suppliers and partners to get it accomplished together. Agreements and contracts with partners and suppliers need to comply with TU Delft's climate and sustainability goals.

Geothermal heat
For the campus' district heating system, TU Delft plans to develop a geothermal well as a new source of high-temperature (HT, 70+oC) heat, replacing hot water coming from the cogeneration plant, currently powered by natural gas. In due time, the geothermal heat can be supplied to other parts of the city of Delft using the mid-temperature (MT, 40-70oC) heat from the return flow to supply most buildings on the campus. Several newly built and renovated buildings can be served by low-temperature (LT, 25-40oC) heat, combined with heat and cold storage in aquifer thermal energy storage (ATES) systems. The need for cooling will become an ever more significant part of the energy system in due course.

Or all-electric?
Without the geothermal well installed, TU Delft must shift to a system entirely based on electricity. This is also the case for a hydrogen network, because hydrogen would have to be produced with redundant renewable power. A logical alternative to geothermal heat would be a LT heat network fed by various sources and boosted by heat pumps. Therefore, it would be necessary to renovate most buildings on campus, to make them suitable for the lower temperatures. Apart from the renovation of older buildings, the roll-out of photovoltaics (PV) on campus needs to start as soon as possible.

Energy renovation
Regardless of the choice of heat and cold systems, an absolute no-regret measure is the renovation or transformation of existing buildings on the campus. In TU Delft's campus strategy, buildings with the greatest energy use (per square metre) are planned to be tackled first.

New buildings: exemplar of TU Delft's sustainable ambitions
All new developments must encompass everything that TU Delft aims to be; that is energy positive, circular, climate adaptive, and nature inclusive. This applies to new buildings and all areas on campus. After the first energy-neutral building at TU Delft (the Pulse educational building), ECHO is the our latest project.

Flagship: ECHO
TU Delft recently opened the ECHO building, which is energy-producing and constructed to a great extent according to circular principles and plants will grow along its glass facades. The ambitions for other planned buildings must even go further, including nature and climate adaptation more explicitly.
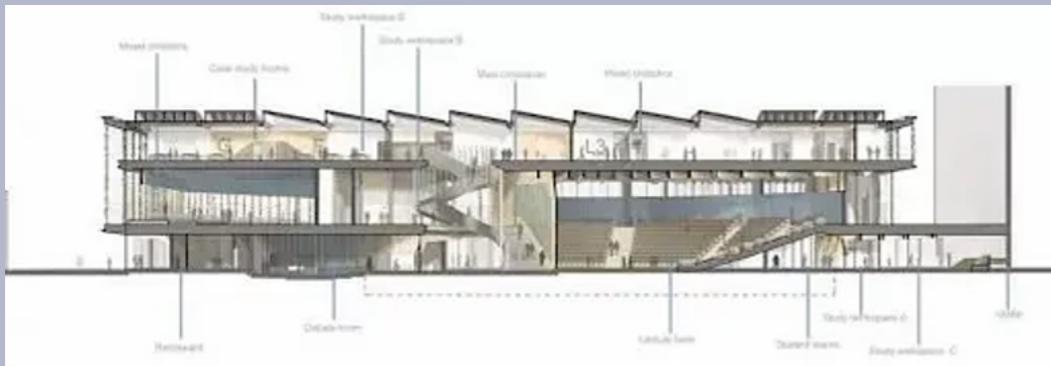
Section of the ECHO building, by UNStudio

Food & beverage: continue to improve the sustainability of food
TU Delft aims to offer only healthy, sustainable food: local, seasonal, organic, animal-friendly, more plant- and less animal-based. This complies with the EAT Lancet diet. This policy of sustainable food will be extended to all restaurants, food trucks, and distribution points. In addition, we have investigated how behaviour can be influenced by adjusting the prices of food, based on environmental impact.

Flagship: vegetarian restaurant of the Faculty of Architecture
The first action taken was the introduction of the vegetarian (and partly vegan) restaurant at the faculty of Architecture and the Built Environment. Thanks to the quality of food offered, the community at the faculty was very positive about this change. Soon after, TU Delft opened its vegetarian (and partly vegan) quality restaurant at the Faculty Club.
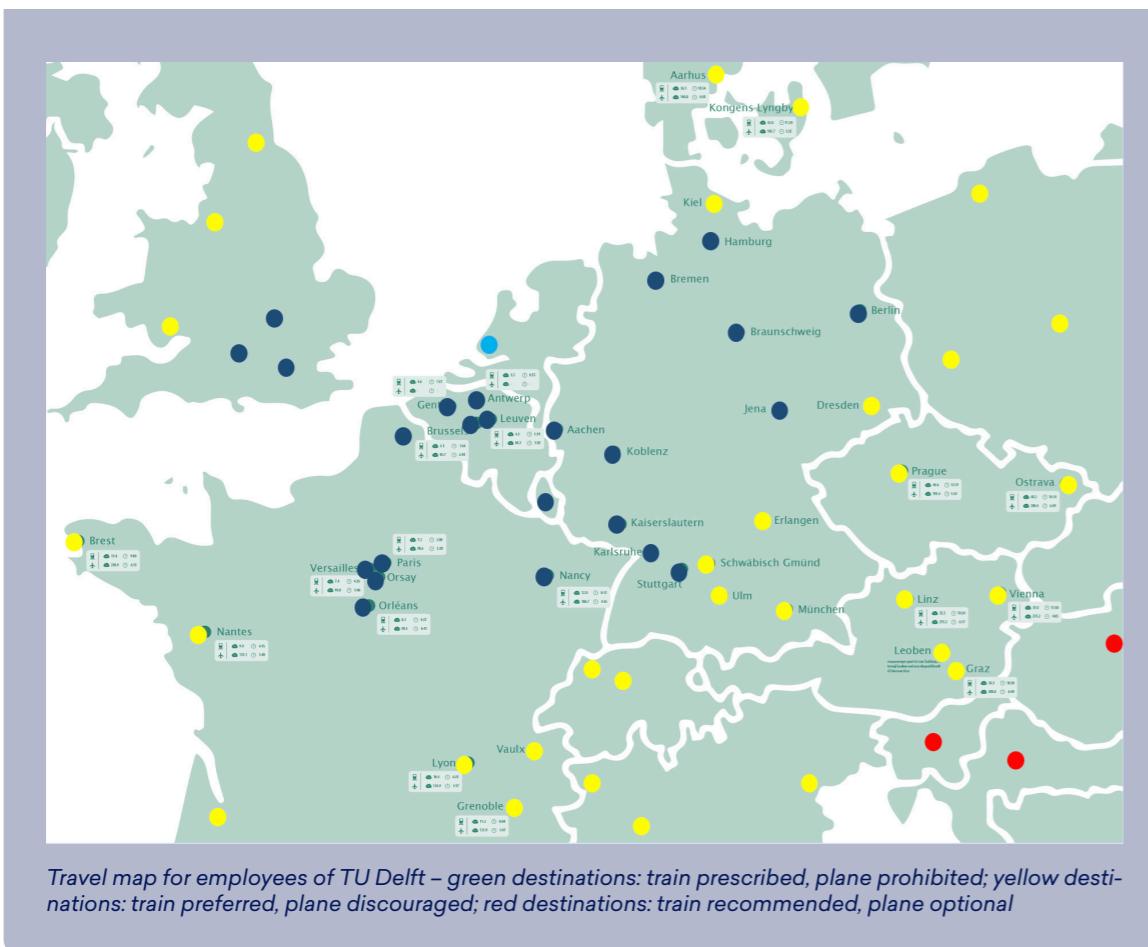

Vegetarian and vegan food offered at the restaurant of Architecture and the Built Environment

Mobility: a fossil-free campus and sustainable travel
TU Delft's strategy on mobility is as follows: avoid travel, reduce travel, plan travel smartly, and use the most sustainable mode of transport. Teleworking and teleconferencing are an important step to avoid travel and reduce emissions due to mobility. The TU Delft Campus should be fully fossil free by 2030. Non-fossil transport towards the campus, by bike, electric bike, public transport ,or electric cars are promoted and stimulated. Facilities for bikes and electric vehicles are improved.

Flagship: international travel pilot
For international travel, the rule will be 'trains, not planes', unless there are no other reasonable options. Three faculties have adopted a pilot project to make staff and students take the train (or electric cars) when travelling less than 750 km or when a train ride takes less than 8 hours. Taking the train for longer distances is also promoted. A travel map helps to clarify this.

Travel map for employees of TU Delft – green destinations: train prescribed, plane prohibited; yellow destinations: train preferred, plane discouraged; red destinations: train recommended, plane optional

Internal carbon tax
A measure proposed is the introduction of an internal carbon tax to compensate for emissions from flying (and other forms of climate-influencing travel). This internal carbon tax would be based on a carbon price of €150 per ton of CO2-equivalent. Its revenues would be transferred to a fund that will be used for sustainable projects, pilots and actions, and to support sustainable student travel across Europe (compensating for rail travel prices).

Compensation: greening the campus and compensating CO2 annually
Not all carbon emissions can be avoided by 2030, simply due to the fact that even sustainable solutions still emit carbon and that (fossil-fuelled) flying will still take place around that time. Therefore, a small fraction of today's emissions will need to be compensated for in the future. As such, carbon sequestration can be established and maximised on the campus by extending green spaces. In addition, year on year until 2030, 1,000 tons of CO2-eq will be sequestered by investing in the planting of trees. By the end of 2030, this will have produced a forest sequestering approximately 10% of the emissions of the 2020 reference.

04.03 Progress in achievements

Sustainability and carbon reporting
Reports are needed to see whether the university is making progress and to determine which areas need further action. In addition, reports also exemplify the universities actions, goals, and achievements regarding sustainability to its stakeholders. TU Delft works on 4 different forms of reporting: GRI report, the sustainability report of GreenTU (student association), carbon accounting reports, and dashboards. The first analysis of the carbon footprint was made by Tess Blom and Andy van den Dobbelsteen for the years 2017-2018. In 2019 the Finance department of TU Delft took over this task and calculates the university's footprint annually. The method used follows the international Greenhouse Gas protocol.

Progress
The carbon footprint, excluding procurement, went slightly down over the years 2017-2019, from 50,366 tons of CO2-eq in 2018 to 49,165 tonnes of CO2-eq in 2019 (two years that were assessed by the same method). In 2020, the carbon footprint reduced even further to 29.346 tons of CO2-eq but this was mainly a result to COVID-19. Since students and employees did not work on campus, the carbon footprint of mobility, food, and procurement & waste management decreased. However, the energy use of the buildings went down only by 3%, demonstrating the necessity to implement smarter building management systems and usage.

Ongoing projects
TU Delft has already started several sustainability projects. The table below shows the ongoing projects per theme.

EcoCampus
Heat square @ TGV (Rainroad, Bluebloqs, Nature-Inclusive Shed) Water street @TGV 50-litre house Polder roof @ CEG Climate arboretum @ ABE Planting flower mixtures to attract insects ECOCampus 2.0 course @ ABE

Construction & Renovation
Metabolic study of EEMCS high rise Kluyver Area ambition document by Copper8 Energy-producing educational building ECHO Circularity Roadmap

Rotterdamseweg parking garage construction
Brains for Building

Energy Systems

Roll-out of PV on roofs and facades of existing buildings
Geothermal well: final investment decision and preparation for realisation
Preparations for facilitating a heat pump centre in the vicinity of the geothermal well
Project development of a high-temperature aquifer energy storage
Adjustments to heat distribution in buildings, preparing for sustainable heat sources
E-refinery

Mobility

Electric bike pilot
NS business card pilot
Business travel pilot @ AE & CEG
Outdoor mobility dashboard

Food & Beverage

Vegetarian restaurant @ ABE
Discount when bringing own cups

Procurement & Waste Management

Waste separation pilot at ABE and Aula

ICT, AI & Digitisation

Brains for Buildings
Ecosia as standard search engine
Facilities to work from home

04.04 Lessons learned

TU Delft is fully engaged in the process to work towards 2030, when the university and its campus need to be carbon neutral, circular, and climate adaptive, but a few lessons were already learned:

• The most important commitment to, or initiative for, sustainability goals needs to come from the executive board of a university or higher education institution. This support from above helps to get it on everyone's agenda, meaning all faculties, departments, and supporting divisions are working towards the same goals.
• The appointment of someone centrally responsible for the sustainable transition process helps to write an overarching vision and ambition document. This person can be an academic with a broad understanding of sustainability and with ample experience within the university, but it can also be someone from a supporting division with a broad understanding of the university and experience of working with academics and students.
• The sustainability coordinator needs to be supported in a practical sense, to get things organised, and to properly implement said vision in all places of the university and campus. They need to organise teams or taskforces dealing with certain aspects of the sustainable transition, consisting of academics, supporting or managing staff, and students.
• Good communication to the campus community and engagement of all groups at the university is necessary for wide support of the proposed plans. Our experience was that ambitions increased, rather than reduced, after holding discussion meetings with students and staff.
• The formal decision process about ambitions, objectives, projects and investments should be well prepared with the strategic department and executive board, preferably in the order mentioned, from crude to detailed.
• Transitioning to a sustainable university requires investments. Considered in a traditional, short-term way, these seldom present a business case. Sustainability however requires a long-term perspective with consideration of the total cost of ownership (TCO) and with the inclusion of environmental costs or a carbon price (TCO2). This demands that all important decisions within the organisation are taken according to that new financial approach.
• Show, don't tell. And practise what you preach. The ambitions of an organisation have no value if, in its daily operations, it does not live up to these principles. This especially applies to the management and sustainability people themselves. Giving the right example will make other people follow.

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05 RWTH Aachen

05.01 Approach

RWTH Aachen considers it its duty to ensure that the university, in all its diversity and its wide range of different organisational units – from teaching and research institutions to administration – is structured to accommodate and facilitate sustainable development. It aims to guarantee and encourage this by embedding tools, processes, and measures in all of the university's everyday activities – research, teaching, operations, and governance.

In RWTH's Sustainability Mission Statement[10], university members developed a joint understanding of sustainability as a basis for their conduct, and have familiarised themselves with these values as a university community:

"We, the members of RWTH, are committed to acting in a sustainable manner, both in terms of our responsibility toward society and the associated educational mandate, and in economic terms. (...)

Sustainability is a clear priority for us. It is firmly established as an important cross-cutting task in all areas of the University, in the same manner as gender and diversity, transfer, and internationalization (...)

We are committed to making our university more sustainable and to creating the necessary framework conditions for this – both within RWTH and with regional, national, and international partners. (...)

We, the members of RWTH, resolve to take responsibility and contribute to a more sustainable RWTH through our individual and collective actions. Only together can we make the best possible contribution to shaping science and society for the future in a lasting and reliable way. We are fully committed to reaching this goal."

05.02 Governance – Supporting Continual, Sustainable Development

"Our goal is to develop a vision for a sustainable RWTH through a participatory process, to create and implement a road map with concrete goals for RWTH, and to continuously review and develop these goals. In order to establish RWTH as a driving force for sustainable development in society, we have aligned our development goals with national as well as international frameworks that are based on the United Nations' 2030 Agenda for Sustainable Development."
[RWTH Sustainability Mission Statement]

05.02.01 Challenges

One of the challenges in the sustainability process was and still is the tension between the ambitions and requirements of the very heterogeneous internal stakeholder groups and the framework conditions, especially legal, political and financial, in which RWTH operates as a university and public institution.
The goal is to meet this challenge with transparency and participation as core elements guiding the sustainability work at RWTH. In addition, necessary support requirements are clearly communicated to the institutions providing the framework.

05.02.02 Progress in achievements

Structures and Participation
Since mid 2020, the Sustainability and University Governance staff unit has had the special task of driving forward the continued development process towards a more sustainable RWTH. Its task is to pool existing sustainability structures, projects, and initiatives and to coordinate and promote their implementation. This also includes providing support to university management when they are preparing to make decisions. As a central contact partner, the staff unit works in close collaboration with all university groups, in particular with students, to coordinate initiatives and strategic targets regarding sustainability.

The Rectorate appoints RWTH professors to take on individual tasks of strategic importance for the university and to carry out representative functions in specific areas. In 2021, the Rectorate appointed **Rector's delegates for sustainability** for the first time to help guide the operational sustainability process with strategic planning support. In addition to advising the Rectorate and leading the so-called 'GreenTeams', these individuals also promote collaboration between RWTH and other universities and networks.

AStA, the department for **Sustainability and Student Engagement** promotes awareness of, and commitment to, sustainability among students and all other members of the university. The Department was established in 2019 and is involved in the strategy process, in close collaboration with the Sustainability and University Governance staff unit.

Through various exchange formats, the staff unit, in close cooperation with the rectorate delegates for sustainability, as well as AStA, offers opportunities for dialogue and networking among the various stakeholder groups. In addition to the weekly sustainability consultation hour, three GreenTeams sessions (each for the topics teaching, research, and operations) take place every six months under the leadership of the rectorate delegates, as does the Sustainability Round Table for exchange between student initiatives, the staff office, and AStA.

Strategy process
The challenge of synchronising a common understanding of sustainability and commitment of all members of RWTH to sustainable action as a basis for joint work for sustainable development was addressed at the beginning of the sustainability process by developing the **sustainability mission statement**. Based on the open consultations in which all university members could participate, a draft mission statement was developed. The mission statement was finally approved by the Senate and all the university groups on July 22, 2021.

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[10] RWTH Sustainability Mission Statement

The first **sustainability report**, exclusively available in a digital format, shows where the university is already fulfilling its responsibilities and where there is some room for improvement. The report features six different sections, each one explaining how sustainability is embedded in the university's underlying strategies, its responsibilities, developments to date, and selected current projects. In addition, the report summarises key figures in RWTH's various spheres of action and outlines the current situation concerning sustainability activities. It transparently presents how, for example, energy consumption and the number of business trips have developed in recent years. It was the first time that the data was collected altogether, rather than in the individual organisational units.

At the same time, the report is intended to shine a light on RWTH's activities in sustainable development and to serve as a starting-point for monitoring the university's sustainability performance.

The **Sustainability Roadmap** shall outline the process of RWTH to become a sustainable university and implement the vision from the sustainability mission statement. The roadmap will cover the period up until 2030. To decide on and implement the necessary activities, concrete and measurable goals including indicators and corresponding measures need to be defined. On behalf of the Rectorate, the Sustainability and University Governance staff unit organises the corresponding exchange in coordination with the Rector's Delegates for Sustainability and the AStA department for Sustainability and Student Engagement. Progress reports and updates on current developments will be presented and discussed in the GreenTeams. The finalised roadmap will be presented and approved in the Senate. A continuous review of the performance related to sustainability efforts will be the basis to make adjustments required in case of deviations.

Sustainability network – Good Practice Example

The aim of the internal sustainability network is to establish good communcation channels and transparent responsibilities forsustainability at RWTH Aachen University.

Students at RWTH [photo: Martin Braun]

To this end, sustainability officers have been appointed for all faculties, central institutions, and administrative units.

On the student level, the AStA department for Sustainability and Student Engagement is involved as well as partly appointed sustainability officers of individual departments.

In addition to internal networking and the forwarding of information, instruments are also implemented to facilitate work, such as a virtual "sustainability bulletin board".

05.03 Research – Science and Technology for the Benefit of Society
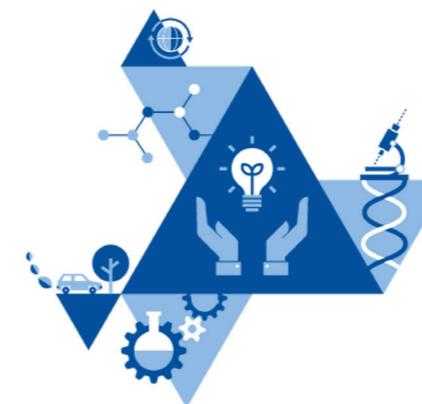
"Our Goal is to make our research more sustainable, establishing sustainability as a core topic in all faculties, profile areas, and research projects, and providing solutions for a sustainable transformation of our society."
[RWTH Sustainability Mission Statement]

05.03.01 Challenges

For hundreds of years, universities have stood for the interaction between education and research. Lately, they have also come to face a range of challenges as well as expectations regarding their roles: educating an ever-growing number of students, generating knowledge and research findings that are also applied in industry, developing the university as an ideal site for integrated and interdisciplinary work, while simultaneously promoting international networking and mobility.

RWTH's commitment to excellence also holds the university responsible for pursuing a self-reflective and pluralistic value debate regarding excellent research – both among the stakeholders of our teaching and research projects at RWTH and with additional scientific and non-scientific bodies at the local, national, and international level. The students and early-career researchers are an important pillar of change. They are the ones who are pushing towards more sustainable practices and are ready to take the reins of this transformation process themselves, bringing challenges and chances together.

05.03.02 Progress in achievements

Strategy
In order to meet these requirements, a future-oriented university needs to be particularly agile while also contributing to meeting the SDGs. In our **University of Excellence proposal** 'The Integrated Interdisciplinary University of Science and Technology. Knowledge. Impact. Networks', RWTH's goal is to contribute to and help shape a sustainable society. This requires a holistic understanding of sustainability; we can only succeed with the transformation to a sustainable society for future generations if the three dimensions of environment, economy, and society are tackled at the same time. With its fundamental and application-oriented research in a variety of fields, RWTH is making significant contributions to sustainable development.

RWTH, therefore, has pooled its scientific expertise in an interdisciplinary research environment of **eight cross-faculty profile areas** to work on solving the great social challenges of our time in interdisciplinary teams using innovative approaches. In these profile areas, scientists from the different disciplines work together to create a solid

foundation for societally relevant innovations based on the findings from fundamental and applied research. They coordinate their research activities, use state-of-the-art infrastructures, and create large research networks with national and international partners from science and industry.

In addition to the profile areas interdisciplinary teams are working on the major societal challenges including the new **Centre for Circular Economy (CCE)** and the **Centre for Sustainable Hydrogen Systems (CSHS)**. The CCE pursues a multidisciplinary and networked approach to a circular economy and combines the expertise from all RWTH faculties both strategically and regarding content, to foster large-scale projects and joint teaching activities. With the creation of the CSHS, an infrastructure was established to coordinate hydrogen projects and make them more visible. The aim is to substitute fossil fuels to achieve decarbonisation. This infrastructure is further promoted in teaching and research as well as in the university's knowledge transfer activities.

Continuing Education – Skills Development – Early-Career Researchers
Motivated, highly qualified, and satisfied employees are essential to ensuring excellent research and teaching. The university's staff development goals, processes, and measures are designed, among other things, to help identify excellent researchers early on and encourage them to stay at RWTH. They also facilitate the expansion of structured skills training concepts and equal-opportunity employment conditions and help enhance employees' quality of working life. These measures should furthermore encourage RWTH employees to identify with the university and have a lasting effect on their transferable skills development.

The offers for transferable skills training and career development are largely pooled in Department 12 – Staff Development and Talent Management – and are structured based on the target group.
The newly implemented RWTH **Centre for Young Academics** is the umbrella organisation for all activities supporting early-career researchers from their doctoral studies to the postdoctoral phase to qualification periods for future professorial appointments. As part of its holistic approach to the promotion of these young talents, RWTH Aachen believes one of its core responsibilities is to teach cross-disciplinary skills and offer early-career researchers ideal framework conditions.

Cooperation and Transfer
At the core of the research conducted at RWTH is the university's agile governance mindset with its particular ability to modernise, react quickly, and collaborate with various partners. As a result of these collaborations, research generated at the university has a direct path to concrete (industrial) fields of application and products, allowing for the creation of agile feedback and development processes. RWTH is currently setting up a technology incubation program designed to help talented and motivated individuals to set up impactful technology companies. With over 75 RWTH start-ups every year, numerous partner companies, over 190 inventions, and a strong network, the **RWTH Innovation Entrepreneurship Centre** offers the necessary resources and expertise to support founders and inventors, with the company RWTH Innovation GmbH serving as the operational structure. A physical platform has also been set up in the form of the **Collective Incubator**, where students can experience entrepreneurship first hand.

**Efficient High-Performance Computing – CLAIX Good Practice Example**

he information technology sector is now responsible for a higher annual share of global greenhouse gas emissions than the aviation sector. Efficient high-performance computing combines sustainability in research and operation in the Modelling and Simulation Sciences profile area. That is why energy efficiency was an important factor when purchasing the Cluster Aix-la-Chapelle (CLAIX) high-performance computer, funded by the federal and state governments, with the system installed achieving an energy-saving advantage of around 25% compared to less efficient models, because of an open-air-cooled water circuit for the direct cooling of the computers. This is equivalent to a saving of around 600 metric tons in CO_2 emissions annually (the Cluster's power consumption is currently approximately 700 kW).

RWTH CLAIX high-performance computer [photo: IT Center]

05.04 Teaching and Learning -

A Holistic Education for the Decision-Makers of the Future
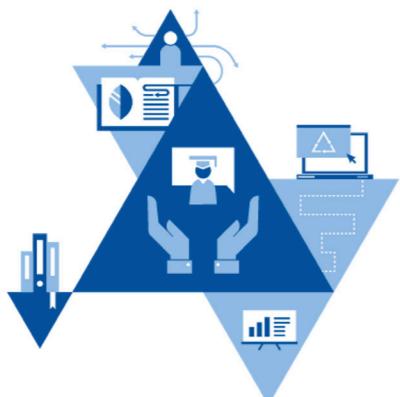
"Our goal is to make our teaching more sustainable, to anchor the topic of sustainability in all courses of study, and to focus more strongly on empowering our learners and instructors to use innovative ideas to drive the development of solutions."
[RWTH Sustainability Mission Statement]

05.04.01 Challenges

As an educational institution, RWTH has a duty to provide its students not only with an academic education but also with every opportunity for them to develop into individuals who can think holistically. This particularly applies to using a reflective and level-headed approach when addressing complex and urgent questions relating to sustainability, which is also what students are demanding from the university.

On the one hand, we need to discuss and reflect where we are already acting in a sustainable manner. On the other hand, we need to work together to initiate changes that allow for sustainable study. Students learn about the responsibility they carry regarding future generations and how they can develop solutions to global problems in their respective disciplines by way of technical and non-technical solutions. Sustainability aspects will furthermore be integrated into existing curricula.
The aim is to use incentives to promote this process and create space for a dialogue at the university and beyond, in order to support necessary collective action.

05.04.02 Progress in achievements

Sustainability is a guiding theme of the teaching strategy at RWTH. Guiding themes set out principles for specific teaching goals and competency profiles as we improve existing degree programs and introduce new ones. They also form the basis of curricula design.
Students should be given the tools to analyse and participate in transformation processes and questions relating to sustainability in their degree programme but also in their future careers, whether these end up being in research or industry. Both aspects – sustainability and social transformation – require a fusion of theory and practice from the various disciplines.

By creating the **Centre for Teaching and Learning Services (CLS)**, RWTH has established permanent structures where a wide range of services can be pooled to provide academic institutions and employees with the best possible support so they can design courses with an eye on the future, raise the skill levels of teaching staff, and develop innovative teaching, learning, and examination concepts.v

Education for Sustainable Development (ESD) offers a starting point here to incorporate sustainability into university teaching even more. In order to specifically address this issue at RWTH, the **Responsible Research and Innovation (RRI) Hub** was established as part of the proposal in the Universities of Excellence competition. As a driving force and platform for joint action and to help us fulfil our responsibility to society in our role as a University of Excellence, the RRI Hub promotes the societal and sustainable alignment of research, innovation, and teaching at RWTH at the interface of science and society.

In order to live up to its responsibility, RWTH encourages the recent activities to embed sustainability in teaching even more solidly at both a structural and an operational level. On the one hand, this includes supporting or providing incentives for structural developments such as in the Sustainability in Civil Engineering professorship, which was established with the support of the Strategy Fund. Another incentive structure is the **Special Teaching Award for Sustainability**.
On the other hand, internal processes are also continually reviewed and improved regarding sustainability. This includes integrating sustainability figures and indicators into the quality management system for teaching, as well as into standard (student) surveys such as the course evaluations.

Leonardo Project – University-Wide Interdisciplinary Teaching and Learning

In autumn 2008, the Leonardo project was launched on the Senate's initiative. The project involves using interdisciplinary cooperation to enable students to discuss global challenges and develop solutions beyond departmental boundaries. Three fundamental principles apply to encouraging and empowering students to actively shape the future:

Students actively participating in class [photo: Mario Irrmischer]

all students should be able to participate and actively contribute to solving global challenges; interdisciplinary approaches are fundamental to solving future issues; and responsibility for science, research and teaching must be integrated into the university discourse.
Leonardo courses are offered each semester on a wide range of topics focusing on global challenges. Over recent years, there has been a continual increase in the number of sustainability-related topics such as presentations on the UN Sustainable Development Goals or the climate crisis. Far more than 1,000 students participate in the project each semester.
As well as increasing the number of total spots and topics available, there is also a focus on maintaining diverse teaching formats.

05.05 Operations – Promoting a Sustainable Organisation

"Our goal is to make campus operations at RWTH Aachen University more sustainable, reducing our environmental footprint in the spirit of climate neutrality, and to actively foster a culture of responsible and inclusive cooperation."
[RWTH Sustainability Mission Statement]

05.05.01 Challenges

RWTH Aachen University is a **public institution**, which means that the operation of RWTH's infrastructure and all organisational aspects are subject to the regulations of the State of North Rhine-Westphalia. These legal framework conditions set out the requirements for activities such as procurement, the awarding of service contracts, building and energy management, waste management, and the handling of chemicals and hazardous substances. State-specific regulations also have an impact on the autonomy of universities, such as those stipulated by the Building and Real Estate Management Agency (BLB) for North Rhine-Westphalia, which owns most of the university's buildings and which requires close collaboration in real estate and construction management, including the necessary operational processes. The university would like to ensure that within these conditions not only are sustainability aspects are implemented in RWTH's operations, but also that these operations are structured to facilitate sustainability as a whole.

Although research and teaching at RWTH seeks to address the major global challenges and thus contribute to promoting sustainability, operating a complex and large-scale university infrastructure constitutes a task in its own right when it comes to achieving sustainability. Making the consumption of resources sustainable on a long-term basis is one of the most important tasks of the Central University Administration. The goals are necessarily ambitious to become more sustainable in the future. It is the declared goal to further the environmentally sustainable development of all university operations and shape the present to ensure a worthwhile future.

A challenge within this is the **data situation**, which is not yet fully comprehensive and which will be continuously improved in the future. Especially the data situation regarding the full life cycle of buildings and products. At present, some areas such as the commuting movements of students and employees, and more detailed information on procurement and the resulting emissions are still unknown.

Linking our sustainability-oriented operations with our additional core competencies in teaching, research, knowledge transfer, and student engagement poses an ongoing challenge – but also an opportunity. It allows us to live up to our responsibility as a role model and to use the university campus as a living lab.

Members of the university come from all groups and generations of our society. With open communication and transparent measures, we are attempting to achieve our goal of involving all members of RWTH in this process. We want to make the purpose and value of sustainable solutions comprehensible and apparent for everyone involved.

05.05.02 Progress in achievements

Fields of action
In cooperation and sustainable development, different fields of action of the university operation are focused on: **Buildings and Spaces, Energy Supply, Procurement, Waste Balance & Disposal, Mobility**. Within these areas, a wide variety of projects and measures are implemented at a wide variety of levels, in parallel with strategic developments.

In many places, we have already succeeded in integrating more sustainable alternatives, e.g. by cultivating wildflower meadows to support biodiversity or switching to LED lighting. Other projects, however, can only be realised in the medium or long term, such as establishing consistent waste separation in the buildings, as this poses major logistical challenges.

Cooperation
Making our consumption of resources sustainable on a long-term basis is one of the most important tasks of the Central University Administration. Therefore, strong cooperation is needed within RWTH and also with other institutions.

Focusing on medium-term goals and participatory design, the internal working group for **Student and Staff Mobility Development** was put in action in 2019, operating until the year 2025. It consists of representatives from all university groups, staff councils, the Representative Council for Staff with Disabilities, different Central University Administration departments as well as the Chair and Institute of Urban and Transport Planning (ISB). The Rectorate assigned this group the task of developing a long-term and sustainable mobility concept and encouraging students and staff to switch to more sustainable means of transport, such as by expanding the network of charging stations for electric cars and increasing the number of secure bicycle spaces.

But also, beyond the university, RWTH is working to develop strong local connections, e.g. including the Building and Real Estate Management Agency of North Rhine-Westphalia, FH Aachen University of Applied Sciences, and the ***City of Aachen***. One aim of these collaborations is to build further climate-friendly public buildings in Aachen. To this end, scientific expertise from our faculties is translated into practical applications in the campus operations. As mentioned in the sustainability mission statement: *"We are committed to making our university more sustainable and to **creating the necessary framework conditions** for this – both within RWTH and with regional, national, and international partners (...) and ensure that policymakers create the necessary prerequisites and framework conditions that enable, demand, and foster our journey to becoming a more sustainable university."*

As a concrete example, RWTH is participating in the 'Climate-neutral state administration' project of the state of North Rhine-Westphalia and is engaging with different networks and projects with stakeholders from all groups, such as student initiatives, the Studierendenwerk, universities, non-university research partners, and WIrtschaftsunternehmen.

Strategy

RWTH wants to be a **climate-neutral university by 2030**. RWTH has committed itself to this goal by signing the Race to Zero. More than 1,000 universities from 68 different countries have pledged to join, impacting over 10 million students in total. The initiative, led by the Alliance for Sustainability Leadership in Education and Second Nature, is supported by the United Nations Environment Programme (UNEP). By signing the Race to Zero, RWTH has pledged to:

• Achieve climate neutrality by 2030.
• Develop a climate protection plan to achieve this goal.
• Implement initiatives to achieve this goal, in line with the climate protection plan.
• Publish public reports on progress toward the goal as well as on actions taken.

The first **sustainability report** of RWTH is a core component of the sustainability process and transparently presents how, for example, energy consumption and the number of business trips has developed in recent years. In addition to the explanation of the structures and the transparent communication of responsibilities, the collection of data and the calculation of greenhouse gas emissions at RWTH Aachen University based on this data were particularly important.

Data collection and measures derivation – Good Practice Example

In total, the annual greenhouse gas emissions resulting from the operations of RWTH currently amounts to **over 68.000 metric tons of CO2-equivalent**, which corresponds to 110 kilos per square meter of effective area or 1.2 metric tons per university member.
The data was collected using a greenhouse gas calculation tool developed by start-up company CO2OP. The start-up emerged from the Hochschule für Technik Stuttgart as part of a start-up grant programme. The tool follows the specifications of the internationally recognised Greenhouse Gas Protocol standard. The emissions data currently available can be found in the appendix of the sustainability report.

The consumption data from 2020 provide the data basis for these figures. In the areas of business travel and vehicle fleet, we have used data from 2019 in order to reduce distortions resulting from the coronavirus pandemic. Comprehensive data is available in the appendix.

Total Emissions
68.920 t

Vehicle Fleet	Business Trips	Heat	CHP	Electricity
183 t	6,429 t	14,962 t	18,484 t	28,668 t
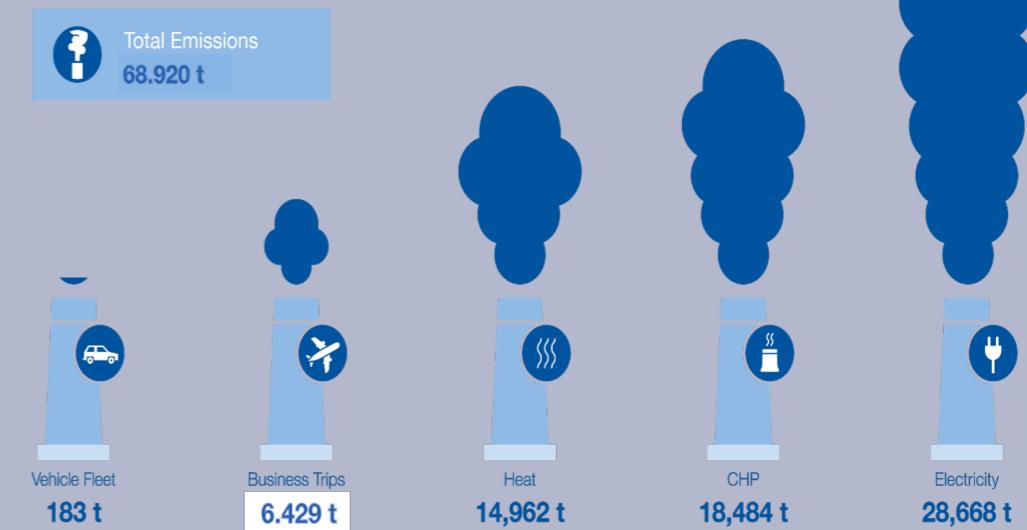
Greenhouse gas emissions in tons of CO2-equivalents (Excerpt) [Source: Own representation based on calculations with the greenhouse gas calculation tool of the start-up company CO2OP]

In order to collect and calculate the data, the Sustainability and University Governance staff unit was in **intensive exchange with various internal organisational units as well as external partners**, such as energy suppliers or the university's contracted travel agencies.

In order to make RWTH more sustainable in this area, in accordance with the Greenhouse Gas Protocol, more comprehensive data collection regarding greenhouse gas emissions is planned for the future. The aim is to consider as many environmental impacts as possible to holistically tackle environmental sustainability. At the same time, the university is actively working on reducing its greenhouse gas emissions in line with its goal to become a carbon-neutral university by 2030. In the pursuit of this goal, individual measures are being critically reviewed and scrutinised during discussions at the university.

Kita Melaten
One such example is the suggestion to combine social and ecological aspects in building projects, such as within the new building project 'Kita and Office Building Melaten'.
The future sustainable day-care centre will not simply offer 120 childcare places in 8 groups; compared to the use of conventional building materials, the hybrid wood construction results in a reduction of CO2 emission within the building process by approximately 60%. In addition, the use of photovoltaics on the roof enables the direct use of renewable energy and there is no longer any need for connection to the district heating network.

The compact design (cube shape and optimisation of the building envelope) also leads to reduced energy requirements during the operation of the building. For this purpose, the energy efficiency standard KfW 40 EE is followed, resulting in a saving in annual energy consumption of approximately 60%.

The sustainable Kita Melaten day-care building on the RWTH campus [image: Department 10.0 – Facility Management]

05.04 Lessons learned

RWTH has made the first steps towards strengthening its efforts to create a more sustainable institution and thus to contribute to a more sustainable society. Together, RWTH and the other IDEA League universities will not only be able to build a sustainable future for themselves, but also contribute to a worthwhile future for the next generations.

A few lessons learned:

Networking within the university and beyond enables the concrete use of existing expertise, creates synergies, and provides motivation and best-practice examples for imitation.
• Transparent communication and accessibility of all information are elementary prerequisites for (internal and external) cooperation.
• A participative and transparently communicated strategy process should be supported with clear goal setting at the highest management level.
• Concrete measures and projects should be implemented in parallel to the strategy process.
• There is great potential in the university (expertise, commitment, motivation) – together we can implement this great challenge of sustainable development.

06 ETH Zurich

06.01 Approach

ETH Zurich is a place where tradition and innovation are inherently linked. The university's lasting success can be attributed to a culture of empowerment fostered throughout its history and the ability to anticipate and adapt to new requirements. Sustainability has a long tradition at ETH Zurich, not only in research and education, but in all aspects of university life. The university's comprehensive approach to sustainability, which encompasses environmental, social, and economic aspects, has guided its strategic development throughout. It is aiming for net zero greenhouse gas emissions by 2030 and supporting this transformation process with research and teaching projects

ETH Zurich is convinced that universities not only have a great opportunity, but also a responsibility towards society to develop innovative solutions for the challenges facing mankind. They should support their implementation, and thereby help prepare the path towards sustainable development of present and future generations. With its comprehensive approach to sustainability, ETH Zurich is contributing in many ways to achieving the United Nation's Sustainable Development Goals.

ETH Zurich is committed to sustainability in the four core areas of (1) Research, (2) Education, (3) Campus, and (4) Dialogue with society. For each of these four areas, the university has defined a strategic field of action:

06.01.01 Research

Through its research activities, ETH Zurich furnishes the scientific and technical knowledge required for a sustainable society. In addition to the broad spectrum of cutting-edge research in the academic departments, ETH Zurich can draw on the interdisciplinary and transdisciplinary expertise of its various competence centres to address major societal challenges such as energy supply, the sustainable design of living spaces, food security and climate change. By promoting the entrepreneurial activities of its researchers, ETH Zurich is strongly committed to knowledge transfer for the benefit of society.

Case study: ETH Spin-off Synhelion – Carbon-neutral fuel made from sunlight and air

Researchers from ETH Zurich have developed a novel technology that produces liquid hydrocarbon fuels exclusively from sunlight and air. For the first time ever, they demonstrate the entire thermochemical process chain under real field conditions. The new solar mini-refinery is located on the roof of ETH's Machine Laboratory building in Zurich.

The Synhelion research plant, located on the roof of the ETH building on Sonneggstrasse [photo: ETH Zurich / Alessandro Della Bella]

Carbon-neutral fuels are crucial for making aviation and maritime transport sustainable. ETH researchers have developed a solar plant to produce synthetic liquid fuels that release as much CO_2 during their combustion as previously extracted from the air for their production. CO_2 and water are extracted directly from ambient air and split using solar energy. This process yields syngas, a mixture of hydrogen and carbon monoxide, which is subsequently processed into kerosene, methanol, or other hydrocarbons. These 'drop-in' fuels are ready for use in the existing global transport infrastructure.

Aldo Steinfeld, Professor of Renewable Energy Carriers at ETH Zurich, and his research group developed the technology. "This plant proves that carbon-neutral hydrocarbon fuels can be made from sunlight and air under real field conditions," he explained. "The thermochemical process utilises the entire solar spectrum and proceeds at high temperatures, enabling fast reactions and high efficiency." The research plant at the heart of Zurich advances ETH's research towards sustainable fuels.

A small demonstration unit with big potential
The solar mini-refinery on the roof of ETH Zurich proves that the technology is feasible, even under the climate conditions prevalent in Zurich. It produces around one decilitre of fuel per day. Steinfeld and his group are already working on a large-scale test of their solar reactor in a solar tower near Madrid, which is carried out within the scope of the EU project Sun-

to-Liquid. The solar power plant is presented to the public in Madrid at the same time today as the mini-refinery in Zurich.

The next project goal is to scale the technology for industrial implementation and make it economically competitive. "A solar plant spanning an area of one square kilometre could produce 20,000 litres of kerosene a day," said Philipp Furler, Director (CTO) of Synhelion and a former doctoral student in Steinfeld's group. "Theoretically, a plant the size of Switzerland – or a third of the Californian Mojave Desert – could cover the kerosene needs of the entire aviation industry. Our goal for the future is to efficiently produce sustainable fuels with our technology and thereby mitigate global CO_2 emissions."

How the new solar mini-refinery works
The process chain of the new system combines three thermochemical conversion processes. First, the extraction of CO_2 and water from the air. Second, the solar-thermochemical splitting of CO_2 and water. Third, their subsequent liquefaction into hydrocarbons. CO_2 and water are extracted directly from ambient air via an adsorption/desorption process. Both are then fed into the solar reactor at the focus of a parabolic reflector. Solar radiation is concentrated by a factor of 3,000, generating process heat at a temperature of 1,500 degrees Celsius inside the solar reactor. At the heart of the solar reactor is a ceramic structure made of cerium oxide, which enables a two-step reaction – the redox cycle – to split water and CO_2 into syngas. This mixture of hydrogen and carbon monoxide can then be processed into liquid hydrocarbon fuels through conventional methanol or Fischer–Tropsch synthesis.

06.01.02 Education

ETH Zurich trains the next generation of specialists and experts to ensure they actively integrate sustainability aspects into their professional lives. Over the past decades, ETH has not only developed internationally acclaimed study programmes and other teaching formats but has also established new departments and institutes to teach sustainability knowledge to its students. Moreover, ETH Zurich is keen to encourage intellectual agility by providing its students with the tools that will enable them to tackle socially and ethically relevant aspects in their studies, in their professional careers and as responsible members of society.

Case study: ETH Week – Collaborative Learning by Design

ETH students [Photo: ETH Zurich / Alessandro Della Bella]

The ETH Week is a key project of the Critical Thinking Initiative with the goal to foster independent thinking and responsible acting. It promotes interdisciplinary collaboration by building on disciplinary expertise and gives students the opportunity to analyse and reflect important societal problems related to the United Nations Sustainable Development Goals (SDGs). Following the Design Thinking process, they envision novel technologies, products, services, or business cases related to the annual topic.

Since the first edition in 2015, the ETH Week brings together students from all faculties and departments. They work in interdisciplinary teams in an environment that facilitates creativity, curiosity, and innovation. Instead of handing them a concrete task, they are asked to define their own challenge and think of forward-looking solutions. The curriculum integrates scientific methods with design thinking as core elements of the concept of the week. In addition, especially trained tutors accompany the teams and are responsible for aligning the fast-paced process with team dynamics.

Each year, the ETH Week is organised with a different thematic focus, therefore involving changing content partners who are responsible for framing the topic in such a way that it is accessible while providing a wide range of perspectives. The themes covered so far include water, energy, manufacturing, or health.

Other key partners from different departments and staff units of ETH Zurich are responsible for training the tutors, designing the process, and implementing the complex logistics of the week. In addition, as many of the students return to become tutors or facilitators, the ETH Week is truly engaged in strengthening an interdisciplinary network across faculty, students, and staff.

06.01.03 Campus

On campus, ETH Zurich lives and promotes the principles of sustainable development with respect to social, environmental, and financial aspects. As an employer, ETH Zurich aims to provide the best possible working conditions, including enabling and maintaining a diverse, participatory, and respectful environment. The university endeavours to serve as a 'living lab' that develops, implements and tests pioneering solutions that conserve natural resources and reduce environmental impacts. As a publicly funded university, sustainability is also among the core principles of ETH Zurich, in terms of financial planning and investment strategy.

Case study: Anergy Grid at Campus Hönggerberg –
a dynamic underground storage system
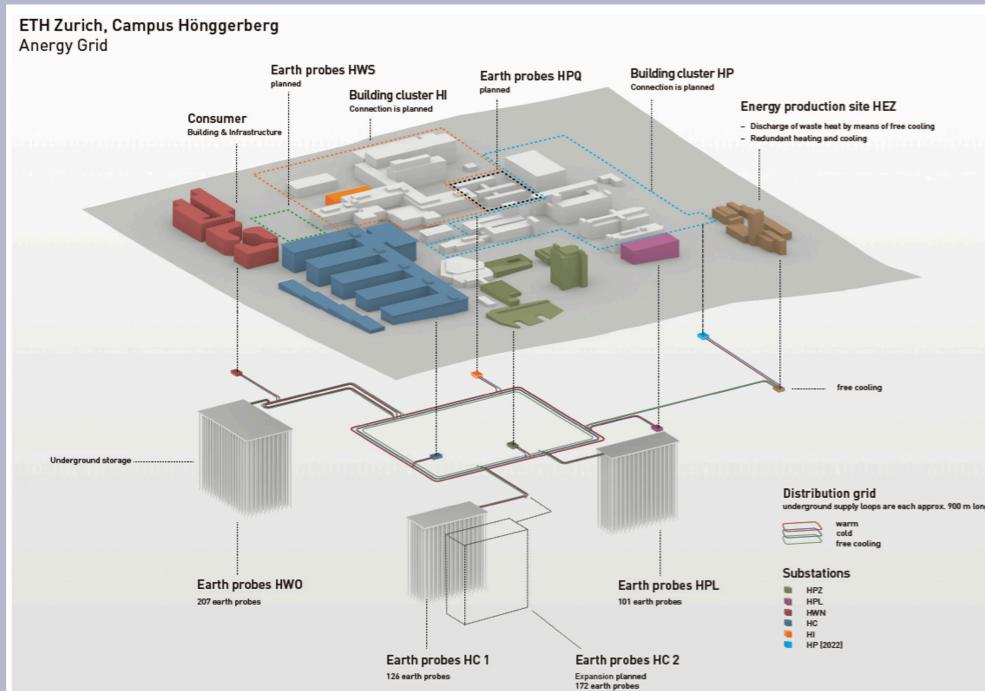
ETH Zurich's Hönggerberg campus is almost a residential neighbourhood in its own right. Here, over 12,000 students and staff occupy more than 30 buildings and consume almost 77 gigawatt hours of energy (electricity and heat) per year, of which around 22 gigawatt hours are for heating alone. Until 10 years ago, heat was generated almost entirely from natural gas. In 2006, ETH Zurich's Executive Board itself set a target of a 50 percent reduction in the campus' CO_2 emissions by 2020. This represents a saving of 5,000 tonnes of CO_2 per year. The Anergy Grid – a dynamic underground storage system – will massively reduce the central heat and cold production in the HEZ energy production site in the long run and make a significant contribution to achieving the above goals. This is achieved by an intelligent networking of heating sources and sinks in combination with a seasonal shift. In this way, the fossil energy demand and thus CO_2 emissions are reduced. Simultaneously, a stabilisation of the heating demand is realised by means of a technical and construction efficiency increase. The cooling demand can also be stabilised in medium term, but it increases again due to the new buildings.

Development of the Anergy Grid
The Anergy Grid at Campus Hönggerberg has been in operation since 2013 and it is being continuously expanded. In the year 2019, the system consisted of three underground storages and five substations, which supply 14 building clusters with heat and cooling. Three additional underground storages are being planned to assure that further new and renovated buildings can be supplied from the Anergy Grid.

Simple but clever
What makes this system, which is essentially based on conventional technologies such as the heat pump, a flagship project? The idea behind the dynamic underground storage system is simple, but ingenious: while some buildings have to be heated in winter, others, especially those housing servers or laboratory equipment, emit heat throughout the year and need to be cooled. So far, the waste heat has dissipated unused. With the underground storage system, excess heat is now stored 150-200 meters deep in the ground with the help of water-filled geothermal probes to be used for heating in winter. In cool months, the temperature of the water circulating in the underground storage drops because heat is extracted. In summer, the process can be reversed by using the cooler water to cool the buildings.

Swiss Energy Prize for the Anergy Grid
On 9 January 2020, ETH Zurich received the Swiss energy prize Watt d'Or 2020 for the anergy grid and thus the seal of quality for energy excellence.

06.01.04 Dialogue

ETH regularly informs the public about its latest research findings. It makes its scientific knowledge publicly available to make a significant contribution to the public debate around sustainable development. In accordance with its mandate, ETH Zurich has developed a range of formats and communication tools to provide information to the public in an accessible and comprehensible way. The university also provides several services for the federal government and makes its expertise available for decisions to be taken based on scientific facts.

Case study: Public Lecture Series on the Sustainable Development Goals

The lectures series 'Sustainable Development Goals in Context' offers ETH students and faculty as well as the public a chance to understand the United Nation's (UN) Sustainable Development Goals (SDG) from an inter- and transdisciplinary perspective. It is a platform for open and critical debate with experts working in the field on how ETH Zurich contributes to the achievement of these global targets.

The 17 SDGs proclaimed by the UN as part of the 2030 Agenda have become iconic. However, their operationalisation is often less well understood. This problem gave the impetus in the summer of 2019 to design a public lecture series and launch it in the spring semester of 2020. Due to the success of the format, a second edition and a third edition took place in the years after,

2021 and 2022 respectively. Initially conceptualised for physical presence, the lecture series was shifted to the virtual space due to the Covid-19 pandemic in March 2020. This instantly made the lectures available to listeners globally, from places as diverse as Bangladesh, Norway, Singapore, Turkey, Ghana, and Togo. So far, the format has attracted 1000+ participants from 30+ countries.

The basic framework is easily explained: under the title of 'The SDGs in Context', a 14-week programme invites faculty members from all departments of ETH Zurich as well as various external partners, including decision-makers from industry, start-ups, student organisations, politics, administration, NGOs, and civil society. The programme is designed to be accessible to everybody: students can attend the programme and write a blog post to earn credit points, and the general (global) public can join the series for free.

The lectures are structured along six fields of deep transformation [cf. Sachs et al. 2019] that serve as building-blocks in achieving the SDGs: (1) education, gender, and inequality, (2) sustainable cities and communities, (3) climate change, decarbonisation and sustainable industry, (4) sustainable food, land, and water, (5) health, well-being, and demography; and (6) digital revolution for sustainable development. Using that framework to cluster the SDGs into thematic areas helped to explore interconnections, since many transformations involve more than one of the 17 SDGs. Exploring them through the lens of grand challenges such as health or decarbonisation helps students and other participants to understand the very complex system of criteria, measures, and goals involved.

The lecture series increased awareness for the SDGs and provided fundamentals for an inter- and transdisciplinary understanding of the SDGs, including best practice examples, provided participants with knowledge on dimensions and discourses around sustainability, and presented potential role models for students to contribute to sustainable development during their studies or research, as graduates on the job market, and as members of the society.

06.02 Managing sustainability at ETH Zurich

The University President, together with the other Board members of ETH Zurich, is responsible for the strategic orientation of sustainability across ETH Zurich. A dedicated faculty member is elected as the Associate Vice President for Sustainability for a term of four to eight years. Their tasks are to identify relevant topics, to negotiate and network internally and externally, to represent ETH with its sustainability contributions nationally and internationally, and to respond to media requests.

Safety, Security and the Health and Environment (SSHE) department
Management and implementation primarily fall under the responsibility of ETH Sustainability and the Safety, Security and the Health and Environment (SSHE) department. The Engineering and Systems department is focussing on campus sustainability and other building and infrastructure related topics. ETH Diversity works towards equal opportunities at all levels of the organisation.

ETH Sustainability
ETH Sustainability is the central hub for coordinating sustainability activities at ETH Zurich. Its aim is to increase ETH Zurich's contribution to sustainable development and to make it available and visible both internally and externally. ETH Sustainability supports initiatives, projects, and individuals who contribute to enhancing sustainability at the university. In the organizational structure of ETH Zurich, ETH Sustainability is embedded in the Office of the President. The SSHE department is responsible for safety and security as well as the health of the ETH community members. SSHE advises them on how to deal with risks and hazards to protect people, infrastructure and the environment and assists in implementing measures.

International partners
ETH Zurich combines strong connections at the regional and national levels with a global outlook and network. To promote sustainable development in Switzerland and beyond, ETH Zurich maintains strong links with international partner institutions and actively contributes to the exchange in global alliances such as the IDEA League, the International Alliance of Research Universities (IARU), the International Sustainable Campus Network (ISCN), or the Global University Leaders Forum (GULF) of the World Economic Forum (WEF).

In 2021, ETH Zurich signed the Race to Zero campaign and since 2022 it is member of the Sustainable Development Solution Network (SDSN) at the global and national level.

07 Politecnico di Milano

07.01 Approach

Sustainable development at university as a shared governance challenge
The general objective underlying the establishment of a Sustainability Governance in the University is to spread the culture of sustainability contributing to create, in view of the third and fourth mission, a society that incorporates and promotes the principles of sustainability by pursuing and achieving the Sustainable Development Goals at global, national and local level.
The governance of sustainability at the Politecnico di Milano (PoliMi) is the result of a collaborative effort carried out with extensive input from the university community. In order to draw up the overall sustainability strategy and the different reports on sustainability and the SDGs implementation, a listening phase was launched across the whole PoliMi community, involving students, faculty and technical/administrative staff. The listening phase had a twofold purpose: firstly, it was aimed at spreading a pervasive awareness, not only of sustainability topics but also of the role that everyone has or can play with regard to the challenges of sustainable development, with particular reference to environmental topics; secondly, it aimed to collect existing sensitivities and requests (suggestions, existing and planned work) of the community, in order to enrich the work and define objectives in line with their resources. In short, the areas of environmental sustainability are to be found in the daily management of the University, in the promotion of institutional activities also towards external stakeholders, in teaching and research.

The sustainability pathway: 10 years of commitment
In the ten years of PoliMi's formal and substantial commitment to sustainability issues, important steps have been taken towards institutional recognition and a significant reduction in the use of resources. This has enabled the university to achieve important goals in environmental performance, awareness and involvement of the PoliMi community.

Steps in environmental sustainability governance at PoliMi

2011:
• Launch of the University Project "Città Studi Sustainable Campus", jointly with the University of Milan
• Joining the International Sustainable Campus Network (ISCN)
2012:
• Establishment of the University Energy Commission (EC)
• Appointment of the "Sustainable Campus" project programme manager
2013:
• Establishment of the University Sustainability Service (SSA)
• Appointment of the Risk and Radiation Commission
• Renewal of appointment of university mobility manager

2015:
• Participation in the work of setting up the Network of Universities for Sustainable Development (RUS) and subsequent membership, with the position of member of the Coordination Committee, still held today, as well as coordinator of two Working Groups (Climate Change; Resources and Waste)
2016:
• Appointment of the Energy Manager
2017:
• Rector's delegation for Building, Spaces and Sustainability
• Rector's delegation for University Environmental Sustainability Project
• Launch of the VIVIPOLIMI project
2019:
• Approval by the Academic Senate of the University's CO2 Mitigation Plan
• Endorsement of the CRUI RUS Manifesto: From "Universities for Sustainability" to "Sustainability in Universities"
2020:
• Signing of the RUS open letter for the transition of the university to a resilient model
• Rector's delegation for Management of University Waste, excluding radioactive and asbestos-containing waste.
2021:
• Publication of the first Environmental Sustainability Report and the SDGs at Polimi Report
2022:
• Launch of a new Taskforce for Sustainable Development at the Politecnico di Milano

07.02 Challenges

Commitment letter

Politecnico promotes the culture of sustainable development in all its institutional activities, in teaching and research. Working in partnership with society and helping it to achieve sustainable development goals at global, national and local levels is an integral component of the University's mission, firmly embedded in both the relevant community context and the international academic setting.

At Politecnico we face the challenge of sustainable development, strengthened by our identity and values as a polytechnic school. Indeed, we believe in the value and effectiveness of the contribution that the design and creative culture as well as the problem-solving ability, typical of a polytechnic approach, can give to the urgent and global challenges posed by the United Nations 2030 Agenda.

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We have been doing this with growing commitment for many years on at least four fronts: environmental sustainability, promotion of responsible research, international cooperation and equal opportunities. This is evidenced by the policies that have been developed over time.

Nevertheless, we believe that the efforts made over the last ten years must be further consolidated. Politecnico wishes to take responsibility for new projects and new investments. Global challenges are increasingly urgent and sometimes, as has been the case in the last two years, unpredictable. In this evolving context, the role and responsibility of higher education and scientific research are crucial, as they are capable of generating high-level innovation and knowledge that can be used to support both immediate decisions and longer-term policies and strategies. These considerations highlight the importance of our contribution as a university, as a place of

research and teaching, a campus, a place of work and study; and the call for a joint, collaborative effort by the entire Politecnico community to direct our work and research towards a fairer society is ever clearer.

Our commitment to sustainable development is not a mere administrative act or the response to a passing trend. We believe it to be our duty. We are fully aware that pursuing sustainable development goals within the university entails a high cost in terms of economic resources, work and energy; but only by staking on research and education can this cost become an investment for the future of the society we are called upon to build and to which we belong.

Ferruccio Resta
Rector

Emilio Faroldi
Vice Rector for Building, Spaces and Sustainability

Eugenio Morello
Delegate for Environmental Sustainability of the University

Achieving effective governance for sustainability at university

Ensuring shared governance
Investigating the field of environmental sustainability at the university requires a vertical breakthrough within a broader and more integrated vision of governance for the sustainable development of the Politecnico, which the university has begun to address as set out in the objectives of the 2020-2022 Strategic Plan. Therefore, the work contributes to laying the foundations (a sort of preview) for a broader and more integrated work covering all aspects of the 2030 Agenda, i.e. the 17 SDGs. Above all, the report provides a scientific method for strategic planning of sustainability at the university. This method promotes a collaborative and dynamic approach to the drafting of a document, trying to involve the Politecnico community, with the aim of striving for co-authorship and the active contribution of all interest groups and components of the university's governance.

Taking informed decision through data collection
One of the main challenges is that of planning and making future decisions based on the knowledge of current environmental performance, risks (understood as threats but also opportunities), the resources available for their improvement and the limitations encountered, as well as the trends in processes taking place at the university and in society. Reconstructing the overall picture of the sustainability performances requires a broad and holistic view anchored in the Sustainable Development Goals (SDGs) in the various institutional, research management and teaching activities that are now an essential reference and a universal language for a collaborative dialogue between institutional partners.

University community involvement and partnerships for sustainability
The dissemination of knowledge of the Sustainable Development Goals (SDGs) has become an imperative for the university, specifically since the Rector's Decleration to the Environmental Sustainability of the University, which has given particular impetus to the activities of internal mapping of teaching and research related to the SDGs and, subsequently, to the implementation of activities and awareness campaigns on various topics.

Enhancing the Partnership for sustainability
With the aim of pursuing SDG17 (Partnerships for the Goals), Polimi aims at improving its societal impact, according to the 'firth mission' principles.

Disseminating Sustainability in Research
At Politecnico we face the challenge of sustainable development, strengthened by our identity and values as a polytechnical school. Indeed, we believe in the value and effectiveness of the contribution that design, creative culture and problem-solving ability, typical of a 'polytechnical approach', can give to the urgent and global challenges posed by the United Nations 2030 Agenda.

Disseminating Sustainability in Teaching
It is a broader objective of the university to ensure that the culture of sustainability permeates the various educational opportunities, both in curricular teaching and in complementary activities:
• Raising awareness among professors through engagement activities, such as the POLIMI4SDGs mapping campaign, aimed at building awareness of the role each professor can play towards the Sustainable Development Goals.
• Characterising specific educational processes, such as the two new Laurea Specialistica (Specialised Master's) in 'Food Engineering' and 'Mobility Engineering', launched in 2019.
• Offering Master's degrees in sustainability management, measurement & reporting and applying sustainability principles, e.g. to the construction of buildings and infrastructure or to energy.

Funding climate actions: mitigation and adaptation measures on our campuses
In order to take informed decisions, building the necessary knowledge forms the base for the assumption by Politecnico di Milano's governing bodies of formal commitments to contain climate-changing emissions.

Mitigation
The university's Mitigation Plan was approved in 2019, and is currently under revision. The University owns most of the buildings and is responsible for their management and renovation. Therefore, measures in energy savings, efficiency, deep energy renovation of the existing building stock, and the pervasive diffusion of in situ renewable energies are a priority.

Adaptation
In addition to mitigation actions, the university has recently paid greater attention to climate change adaptation issues, given that in the Milan context the projected increase in maximum and minimum temperatures by 2050 is expected to be over +2°C in summer and over +1°C in winter[11].
Specifically, the major climatic phenomena affecting the metropolitan territory are:
• the increase in extreme temperatures (with the generation of urban heat islands);
• the intensification of rainfall (with the consequent increase in flooding episodes).
This focus is both on raising our community's general awareness of the issue and on concrete actions on their campuses, in terms of design and management.

Promoting sustainable mobility
One of the main objectives of Politecnico di Milano is to progressively reduce the use of private cars, encouraging the use of public transport or vehicle sharing.

Circular economy: resource and waste management
The conscious and sustainable use of resources is a fundamental step, with the sharing of information on more sustainable products and followed by consideration of materials. The Politecnico not only aims to reduce waste production, as seen in the previous section, but also to improve the efficiency of the waste management and collection system, in accordance with the main challenges identified by the RUS Resources and Waste Working Group[12].

07.03 Progress in achievements

Achieving effective governance for sustainability at university
The organisation of the Politecnico, in line with the provisions of the Articles of Association and the General Regulations of the University, includes the Rector, the Senate, the Board of Governors and the Director General as governing bodies. The Director General is responsible for the financial, technical and administrative management of the university and the coordination of the 9 management structures, the departmental and territorial structures.

Since 2022, a new taskforce for sustainability was established at the central level of the university governance, to embrace a larger vision of sustainability, overarching all the departments and structures of the university. A Steering Committee, a Board Committee and a Sustainability Committee will ensure that the strategy permeates all the teaching, research and institutional activities of the Politecnico (see Figure 1), from strategy to tangible action.

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[11] For more information please refer to the Summary Report of the Regional Climate Change Adaptation Strategy for the Lombardy Region, 2017.
[12] For further details, please refer to the CRUI 2019 position paper, Environment, Waste Mobility and Territory Table.

Steering Committee: Rector, General Director, Rector's Delegates on SDGs-related themes
with the aim of driving the sustainability strategy

Board Committee: Vice Rector, Council of Students President, Rector's Delegate to Budget and Management Control, Head of Sustainability Committee
with the aim of coordinating the university sustainability program

Sustainability Committee: members of units involved in sustainability
**with the aim of translating strategies into action.
It is integrated in and engages with business units and functions**

Figure 1. The new Taskforce for Sustainability established at the Politecnico di Milano in 2022 Figure 1. The new Taskforce for Sustainability established at the Politecnico di Milano in 2022

The University Sustainability Service (Sustainability Unit) within the Campus Life Area coordinates and manages sustainability initiatives and actions in the university, in close synergy with other structures, in particular the Infrastructures, Estates and General Services, the Conservation and Building Services, and the Public Engagement and Communication Area.

The work of discussion and dissemination of environmental sustainability topics in the university has its roots in the Città Studi Sustainable Campus inter-university project, launched in 2011 together with Università degli Studi di Milano. Ten years after the start of this journey and since the establishment in 2013 of the Sustainability Service, a culture of sustainability has been developed, step by step, and has reached more and more people within our community. However, community engagement is an onerous task, to be renewed constantly and with perseverance, as the student population is cyclical and spends a limited amount of time at our university.

University community involvement and partnerships for sustainability
Among others, the university participated in the first edition of the Sustainable Development Festival promoted by the Italian Alliance for Sustainable Development (ASviS), in 2017, to continue in the following years with a schedule of events and activities published not only on the Città Studi Sustainable Campus website but also on the platform of the festival itself, which provided for the involvement not only of the Politecnico community but also of the population.

The dissemination of this and many other initiatives takes place through a variety of information channels, ranging first and foremost from the Città Studi Sustainable Campus website, dedicated to sustainability issues (www.campus-sostenibile.polimi.it), to the related social networks (Facebook, Instagram, Twitter, YouTube), from the Sustainability News (currently not regularly published) to Sustainability Days and ad hoc events.

Types of involvement are:
- Events: seminar activities (also off-campus), information desks, demonstrations, conversations, webinars, field activities, documentary film screenings, shows, etc.
- Ad hoc competitions and awards for graduation thesis on sustainability topics
- Surveys and questionnaires
- Corporate volunteering activities in cooperation with associations
- Citizen science activities in cooperation with associations
- Internships
- Graduation thesis
- Social media
- Newsletters
- Awareness-raising videos
- Support for student associations

Climate change awareness activities
The university also considers it a priority to raise awareness of climate change mitigation and adaptation among the entire community, by implementing and promoting, for this theme, special communication and awareness-raising campaigns, dissemination meetings, the repeated administration of a questionnaire concerning the census of displacement made to the Politecnico Locations, and the involvement of students and professors in the production of graduation thesis on the subject.

Enhancing the Partnership for sustainability
With the aim of pursuing SDG 17 (Partnerships for the Goals), the Politecnico joins a series of networks at the national and international level, committed to spreading the culture of environmental sustainability (see Table 1).

The International Sustainable Campus Network (ISCN) is an international network to support Universities in exchanging information, ideas and best practices for sustainable Campus operations and integrating sustainability into research and teaching. The Politecnico di Milano has been a member of ISCN since 2011.

The Network of Universities for Sustainable Development (RUS), promoted by CRUI - Conference of Italian University Rectors - is the first experience of coordination and sharing among all Italian Universities committed to environmental sustainability and social responsibility.
The Politecnico di Milano is a founding partner of the RUS (2015) and actively participates, also with coordination roles, in the Working Groups (WGs).

	IDEA League – is a strategic alliance between five leading European science and technology universities. Based on the knowledge that it can help shape the future, it aims to join forces and create valuable connections that inspire innovation and the pursuit of ambitious goals. The Politecnico di Milano participates in the activities of the Climate Framework Working Group active since 2020 with the aim of promoting commitment and guidelines for climate planning at the universities joining the league.
	EIT Climate-KIC is a Knowledge and Innovation Community (KIC) that aims to accelerate the transition to a carbon-neutral and climate-resilient society. Supported by the European Institute of Innovation and Technology, Climate-KIC promotes innovation and systemic change: networking with partners from business, academia and the public and non-profit sectors, developing products, systems and services that will have a major impact on the market.
	Italian Industrial Symbiosis Network SUN (Symbiosis Users Network), promoted by ENEA, is the first Italian industrial symbiosis network. The SUN network proposes itself as an Italian reference for operators who want to apply industrial symbiosis at industrial, research and territorial level. The Politecnico, together with ENEA and CNR, is coordinating WG4 - Certification and standards for industrial symbiosis, which aims to publish a support manual for the identification of standards useful in the different phases of implementation of the industrial symbiosis process.
	U-MOB LIFE is a European project financed by the LIFE programme of the European Commission, aimed at creating a university network for the exchange of knowledge and good practices in the field of sustainable mobility, in which the university participates.

Table 1. Main partnerships for the Goals activated at the Politecnico

The Politecnico has also set up several partnerships within the local area. Institutional partnerships in the metropolitan area of Milan include, for example:
• Città Studi Sustainable Campus, which was already explained.
• OFF CAMPUS | Il Cantiere per le Periferie, is an initiative promoted by Polisocial since 2018 with the aim of strengthening the presence of the Politecnico in the city of Milan and the idea of a more responsible University, attentive to social challenges, open and close to territories and communities.
• Riformare Milano (Reforming Milan), a collaboration between the Municipality of Milan and the School of Architecture, Urban Planning and Construction Engineering to rethink Milan's suburbs in institutional teaching courses.
• ForestaMI, the urban forestation project promoted and launched at the Politecnico for the planting of three million equivalent trees in the Milan metropolitan area by 2030.

Collaboration initiatives with local stakeholders include:
• Initiatives shared with Zone 3 in Città Studi and Zone 9 in Bovisa, including the regeneration of Piazza Leonardo da Vinci and the agreement for the use of the square, and the Coltivando initiative at Durando Campus with the vegetable garden shared between the Politecnico community and the neighbourhood.
• Awareness-raising initiatives with environmental associations; these include many activities with Legambiente, Cittadini per l'Aria, FIAB.

Disseminating Sustainability in Research
In 2020, the Politecnico had 187 active Horizon 2020 and third-party research projects dealing with sustainability issues, totalling around €7.5 million from Horizon 2020 funding, and around €6 million from third-party contracts.
In 2020, the Politecnico's various research activities resulted in the publication of 2,131 scientific articles that contribute to the achievement of the Sustainable Development Goals by dealing with topics closely related to Industry, Innovation and Infrastructure (SDG 9), Clean and Affordable Energy (SDG 7), Sustainable Cities and Communities (SDG 11), Health and Well-being (SDG 3), Responsible Consumption and Production (SDG 12), and Combating Climate Change (SDG 13).
Researchers at the Politecnico can count on the support of the library and archive system, as well as on services such as free Open Access publication from more than 3,880 online journals available.

Disseminating Sustainability in Teaching
The understanding and coverage of relevant sustainability issues and challenges take place primarily during the Laurea Triennale (equivalent to Bachelor of Science) and Laurea Magistrale (equivalent to Master of Science) programmes. The Politecnico has around 60% of its courses related to sustainability issues, with an upward trend since 2017 (55.6%). In detail, 36 study programmes, out of a total of 61 offered, aim to embrace the concept of sustainability in architecture and planning, engineering and design.
Alongside the curricular courses, the Politecnico invests in other optional teaching opportunities that are open to the whole community. The Open Educational Resources (OER) and the Massive Open Online Courses (MOOC) promoted through the Polimi Open Knowledge (POK) portal are now a solid activity of the University thanks to the commitment of METID. In 2019, in collaboration with UNIBO, the MOOC called Higher Education for SDGs (HE4SDGs) was activated, the result of joint work of professors and technicians from the two universities engaged on various fronts of sustainable development.

Since autumn 2022, all teaching modules offered at Polimi will report their contribution to the 2030 Agenda in the description of the programme. This allows all instructors to focus on how their teaching mission contributes to the achievement of the goals and, at the same time, gives students the possibility to map their own SDGs' coverage into their curricula.

Funding climate actions: mitigation and adaptation measures on our campuses

The CO2 Mitigation Plan
The CO2 Mitigation Plan of Politecnico di Milano presents the methodological framework for the definition and subsequent verification of the University's CO2 emission reduction commitments; it constitutes the necessary knowledge base for the assumption by the university's governing bodies of formal commitments to contain climate-changing emissions, formalised at the Academic Senate (18 February 2019) and the Board of Governors (26 February 2019).
The 2019 edition of the Mitigation Plan takes 2015 as its base year, the first year in which a complete inventory of emission data was made available for all the university's locations, and it contains the first assessment of the University's CO2 emission reduction potential, resulting from ten types of interventions in the energy, building and transport sectors, with time horizons of 2025 and 2030. These time horizons include emission reduction targets of minus 25% and minus 35%, respectively, compared to the base year (2015). The investments already earmarked and planned for the trigeneration plants at the Città Studi and Bovisa campuses, which allow a reduction in CO2 emissions in the production of renewable energy, amount to €4.8 million, while spending on replacing refrigeration units with new high-performance elements and ecogas for 2019, as well as for 2020, amounts to €1 million (see for instance Figure 2).
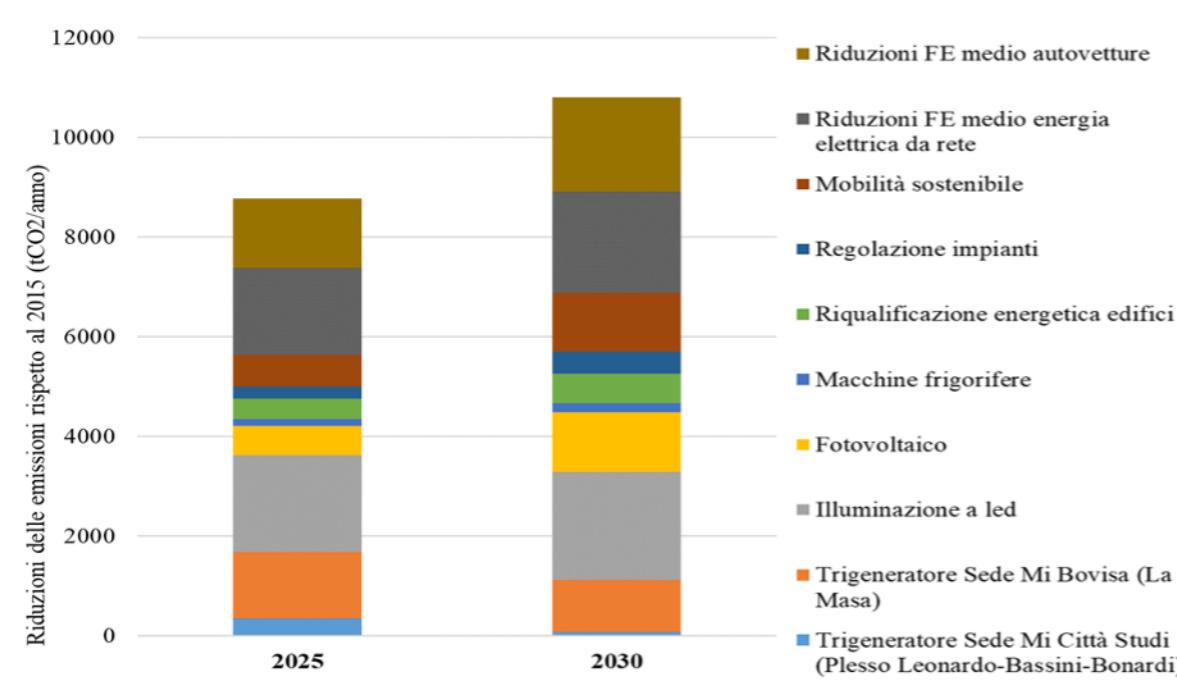

Figure 2. The potential emission reductions (tCO2/year) in the years 2025 and 2030, resulting from the implementation of the ten key actions identified in the Mitigation Plan. Please refer to the Mitigation Plan for further details.

In terms of emissions accounting and strategic mitigation planning for our campuses, the following work has been produced as part of the activities proposed by the RUS Climate Change Working Group, which the University coordinates:

1) The drafting of 'Operational guidelines for the preparation of greenhouse gas emission inventories of Italian universities';
2) The drafting of 'Guidelines for the drafting of CO2 mitigation plans for universities';
3) 'CO2 emission factors for energy consumption and transport for greenhouse gas inventories of Italian universities', Environmental Engineering (IDA) V.6 N.1.

Best practice: Inventories of greenhouse gas emissions in Italian Universities (2019)

The first national meeting of the RUS Climate Change Working Group, organised at the D'Annunzio University of Chieti–Pescara (Ud'A) - had the aim of illustrating both the activities carried out by the Working Group and the experiences gained at several RUS member universities for the creation of their greenhouse gas inventory, highlighting the methodological and practical aspects and the criticalities encountered.

The objective was to analyse and share strengths and weaknesses to increase capacity and effectiveness in designing and implementing GHG emission inventories at the University level, with consistent operational methods across the territory. Therefore, the aim is to achieve a reliable estimate of the emissions of Italian universities in the future, as a necessary basis for formal commitments to reduce them.

Energy saving and low energy buildings
The Politecnico invests in building quality, focussing on the energy efficiency upgrading of existing buildings and the highest standards of performance and sustainability for new construction projects. A forerunner in energy-efficient buildings, thanks to the VELUXlab at Bovisa campus, the Politecnico continues to invest in buildings that meet the most advanced energy efficiency criteria, becoming Nearly-Zero Energy Buildings (NZEB); these include the new Campus Bonardi buildings designed by Renzo Piano and the future ZEN building.

Smart Building

Following a long process of technological adaptation, a continuous monitoring system of many buildings is now in place:
• The installation at Città Studi and Bovisa (La Masa Campus) of Smart Meters and their online monitoring;
• A thermal energy monitoring system for each building and a heating plan for Città Studi and Bovisa Campus (La Masa Campus);
• Installation of advanced automation systems in a number of buildings in order to test, for example, smoke detectors (Città Studi, building 25);
• Implementation at the Piazza Leonardo Campus in Città Studi of a system (micro-grid) for the management of electricity production and consumption in island mode;
• Optimisation of the district heating network in Città Studi: temperature verification to avoid network losses.

Renewable energy

A boost for renewables has recently come from the Mitigation Plan (2019), which recognised the significant contribution of solar energy production potential on the university's roofs. Since 2017, there has been an increasing trend in the production of electricity from renewable sources (around 9% on average per year).
The university is equipped with two types of electricity generation: trigeneration and photovoltaic solar energy from renewable sources. Several buildings also have geothermal systems (heat pumps).
The main source of energy production in Città Studi comes from a trigeneration plant, i.e. a combined cooling, heating and power (CCHP) system. The unit is located on the Leonardo Campus and meets the electricity, heat and partial cooling needs of the Campus. The plant's electricity production is monitored through the online campus metering system. The second trigeneration plant at the Bovisa Campus, with the same electrical power (2MW), is in the design phase and is scheduled to be installed in 2021.

Best practice – VELUXlab Zero-Impact Laboratory

(2011 year of first implementation)

Conceived as an experimental module, VELUXlab is a building that achieves high levels of energy efficiency. The shape and orientation of the building, combined with its bioclimatic architecture and innovative building shell, allow optimal use of solar energy as well as natural lighting and ventilation to ensure comfortable interiors without any energy consumption.
As an active laboratory of Politecnico di Milano, VELUXlab is a true living lab, whose mere presence raises awareness and educates the Politecnico community. Indeed, the building is subject to continuous experiments, the last of which, completed in August 2019, led to it becoming one of the first buildings with a green roof in Milan.

For more information:
VELUX Press - VELUXlab, the zero-impact laboratory of Politecnico di Milano, obtains the ActiveHouse licence

Climate Change Adaptation Strategies

In terms of strategic planning for the adaptation of campuses, the following exploratory work has been undertaken within two of the networks to which the Politecnico di Milano belongs:
1. The drafting of 'Guidelines and good practices for adaptation to climate change in Italian universities', as part of the activities proposed by the RUS Climate Change Working Group, which the University coordinates;
2. The definition of preparatory actions for the launch in 2021 of a planning process for climate adaptation and mitigation through a 'Climate Framework' shared by all the universities, within the framework of the activities carried out by the group dedicated to climate action at IDEA League, which the university has joined.

The first opportunities to introduce the theme of adaptation into spaces were:
• The recent achievements of the University's VIVIPOLIMI project, which implemented green and blue technical solutions in the redevelopment of open spaces. In compliance with the regional law on hydraulic invariance, 4 dispersing wells were drilled in 2019 and 6 dispersing wells in 2020 in order to increase the draining surfaces, and permeable soils were increased in the renovation works of the Leonardo Gardens in the headquarters of Piazza Leonardo da Vinci 32.
• Project activities in open spaces aimed at mitigating climatic stress in extreme summer temperatures, i.e. the provision of new drinking water supply points on campuses, and the creation of new shaded areas. Renzo Piano's project for the regeneration of the Bonardi Campus involves the transformation of 8,000 m2 of open space from a car park to an entirely pedestrian area shaded by 100 new trees.

Promoting sustainable mobility

One of the main objectives of the Politecnico di Milano is to progressively reduce the use of private cars, encouraging the use of public transport or vehicle sharing. The main initiatives taken to achieve this goal are listed below:

- Subsidies for the purchase of public transport season tickets for university employees
- Shared mobility agreements for the Politecnico community in the use of bike, car, scooter sharing, bus and airport shuttle services, scooter rental and car pooling
- PoliCiclo, the university's free cycle workshop service, set up in 2014 and run entirely by volunteer students
- Installation of bicycle racks
- Campus redevelopment, car park cleaning and reorganisation of vehicle parking areas and thanks to projects such as VIVIPOLIMI[13] and Renzo Piano[14], and installation of new infrastructure (covered racks and electric vehicle charging stations)
- Communication and awareness raising through participation in events such as the European Mobility Week or the Sustainable Development Festival
- Networking with local authorities (Municipality of Milan, Metropolitan City of Milan, Lombardy Region), participation in national (RUS, Mobility Working Group) and international networks (European project U-MOB LIFE)

According to the survey on the mobility habits of the Politecnico community, which is the basis for supporting the identification of the initiatives listed above, the mode of transportation used most to access the campuses is public transport (this figure has increased since 2017), which alone covers about half of the displacement (modal division of Figure 3). The share of active mobility is also interesting: 1 in 10 journeys for students and slightly less for staff are made entirely on foot; almost 1 in 10 staff journeys are also made entirely by bicycle (half the proportion for students). For staff, the share of car use for the whole trip is on a par with that of active mobility, with just under 1 in 5 trips made in this way; for students, car use is rather low at 7%. The results of the survey briefly summarised here are the basis for the drafting of the Home-Work Displacement Plan, which is currently in the approval phase, and are also used for the creation of the CO2 emission inventory.
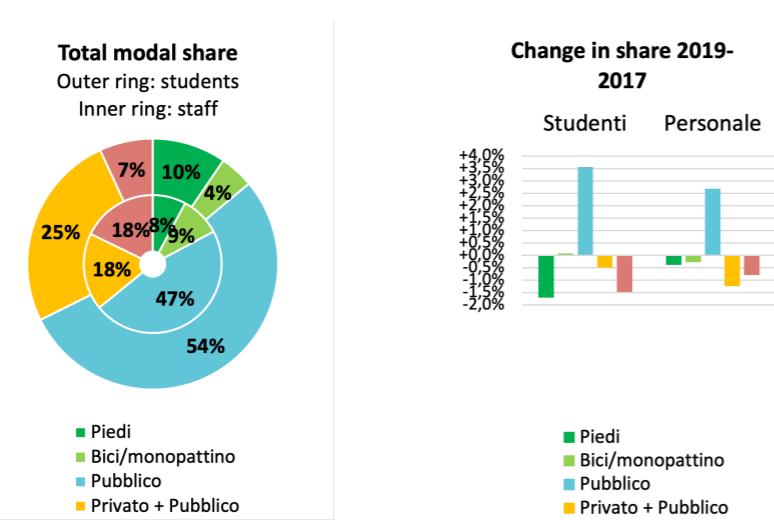

Figure 3. Total modal share 2019 and change from 2017

[13] www.polimi.it/il-politecnico/progetti-di-ateneo/cantieri/vivipolimi/
[14] www.polimi.it/il-politecnico/progetti-di-ateneo/cantieri/nuovo-campus-architettura/

Circular economy: resource and waste management

Water management

With special reference to drinking water, Politecnico di Milano contributes to sustainable water management through the following actions:

1. Interventions on the water infrastructure in the toilets of the campuses, in order to ensure a saving of the resource
2. Installation of drinking water dispensers on campuses, be they drinking fountains (drinking bottles) or water houses, to make the resource accessible to all and reduce the consumption of disposable plastic
3. Awareness-raising during sustainability events and initiatives (World Water Day, Sustainable Development Festival), and through the suggestions in the 'Code of Conduct for a Sustainable Campus', a document resulting from a collaborative discussion of the Politecnico community in 2011, which has since been updated.

Drinking water dispensers

Since 2016, the Politecnico has invested in the installation of drinking water points, water coolers, located in the buildings housing the teaching facilities, to provide free access to water for our students and to reduce the consumption of disposable plastic. In this regard, a video was created and published on the Città Studi Sustainable Campus YouTube channel encouraging the use of a personal cups/glass instead of the plastic cups normally dispensed by hot drink vending machines.

Awareness-raising initiatives, including the distribution of water bottles

The university has been carrying out awareness-raising activities on the issue of tap water quality for years, combined with a reduction in the use of single-use plastic from 2019 onwards. In addition, at certain events organised by the University Sustainability Service, reusable water bottles bearing the Campus Sustainability logo were distributed free of charge to members of our community. To mark the start of the new 2019-2020 academic year, the Piacenza Regional Campus once again welcomed first-year students of the Mechanical Engineering and Architectural Design degree courses by giving new students a personalised PoliMi water bottle to discourage the use of plastic water bottles. On 27 September 2019, the seminar entitled; 'What kind of water do we drink? The underground journey of Lombardy's water from the glaciers to the plains', was organised by Padania Acque, in collaboration with the Cremona Campus and Water Alliance, was held at the town hall of Cremona. The event was organised as part of the MEET ME TONIGHT (Researchers' Night) initiatives.

Waste reduction and responsible consumption
• Development of the "NO PAPER" project: digitalisation and de-materialisation of administrative processes, both in the teaching context and in the areas of accounting, personnel management, research and, more generally, document management
• Offering catering services in the university with a low environmental impact[15]: catering suppliers have proposed actions and projects to reduce food waste
• Raising awareness of the Politecnico community on the topic of waste reduction[16]
• The university' s participation in national networks on the subject (SUN - Symbiosis Users Network)
• Participation in CIRS (Comitato Interdisciplinare Rifiuti e Salute - Interdisciplinary Committee on Waste and Health)
• Participation at the round table of the Ministry of Environment, representing the Resources and Waste Working Group of the RUS [Network of Universities for Sustainable Development]
• Promoting the activities of the PoliCiclo University cycle workshop
• Creation of a line of POLIMI-branded green products, available both in shops and on the Official Merchandise Politecnico website

Given that the procurement of 'green' products by the university and the conscious and sustainable use of resources is a fundamental first step, the sharing of information on more sustainable products and materials also contributes to a more circular economy, together with a process of awareness raising and information, which also sees the active involvement of the Politecnico community, as in the case of the Cingomma Project.

Waste Management
In order to improve the efficiency of the waste management and collection system, the university has long been equipped with suitable infrastructures for the separate collection of all types of waste produced (some also under specific agreements that allow for the collection of waste produced in the open spaces of the University, accessible to the public), subsequently launching an intense systematic activity of awareness and information in order to create awareness on the issue and thus affect the behaviour, not only of the university community but also, through it, of the wider community of citizens and other stakeholders of the territory.

The following waste management initiatives and infrastructures are highlighted:
• Enhancement Project (2017): internal policies to raise awareness of the need for separate waste collection and to initiate, with specialised companies, the recycling of certain types of materials to make them useful again (e.g. paper, end-of-life equipment and metals such as iron, steel and aluminium).
• Constant renewal, adaptation and integration of infrastructure for the collection of the four standard types of waste at the campuses (paper, plastic and aluminium, glass and general waste), adopting bilingual signs and container colours in accordance with UNI 11686.
• Presence of compactors/shredders in some refreshment areas (corner vending machines).
• The presence of temporary storage facilities organised in areas within the university and differentiated by size and type of waste collected. The Politecnico di Milano produces different types of waste mainly from office, teaching, laboratory and research activities. Some waste (paper, plastic/metal, glass/metal and general waste) is handled by the public collection service and delivered to the large-volume containers located in specific areas of the university (recycling centres) where bulky waste, WEEE and toners are also handled and collected. Other special waste from laboratory and research activities is handled in areas directly identified and managed by the individual production facilities (facility depots). Overall, the Politecnico has 3 recycling centres and 57 facility depots.
• The presence of containers related to some experiments launched by the university to improve the quality of differentiated waste collection, as well as to promote circular economy projects aimed at redirecting material flows towards alternative channels to waste-to-energy, capable of creating the conditions for immediate reuse or recycling with production of new goods/materials.
• Cingomma Project (from 2019): this project collects inner tubes and tyres from different areas of the university (identifiable through an interactive map), which are used to make belts and other items (by an external partner) and sold through the Politecnico Official Merchandise channel.
• Battery Container Project (ERP Italy and AMSA agreement since 2017): 25 specific containers of batteries and accumulators have been placed in different buildings on the campus (identifiable through an interactive map). A specially designed label has been placed on the containers to improve the recycling of batteries and accumulators.
• Project ZeroZeroToner Containers (2020): this project involves the total recycling of spent printer cartridges, which are completely converted into raw and secondary materials, and participation in the Print Releaf programme, which allows the University to take part in one of the global reforestation projects in operation.
• Second Life Furniture Project (2020): an in-house reuse system for furniture that is no longer useful has made it possible to survey more than 1,200 items and relocate 33% of them, thus avoiding disposal. The furniture is mapped by defining its main properties (e.g. size, material, state of repair) and the mapping is forwarded to the facilities that can show their interest in reusing the material.
• Organic Waste Project (since 2020): at the Politecnico, experimentation with the collection of the organic waste fraction, which until now was only present in the university's canteens and cafeterias, was introduced with the aim of promoting and increasing user awareness of separate waste collection. The experimental phase of the project consists of the placement of 26 proprietary containers, widely distributed throughout the two Milan campuses (9 at the Città Studi site and 17 at the Milan Bovisa site), which are easily identifiable and marked with special signs informing and educating users about proper disposal.
• Setting up a new recycling centre (2020): the new recycling centre has the same characteristics as the previous one, replacing the one decommissioned for the redevelopment of the Bassini Campus.

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[15]https://www.polimi.it/fileadmin/user_upload/allegati_bandi/1498579790_
Disciplinare%20Ristorazione%20Campus%20Milanesi.pdf
[16] For example http://www.campus-sostenibile.polimi.it/portamialpolimi

Best practice – Offer of environmentally friendly catering services in the University

The offer expanded in 2020, specifically through:
- the use of hybrid material for cups dispensed from vending machines
- the use of one's own cup at vending machines
- the use of compostable material instead of plastic in bars and self-service restaurants
- the inclusion of the option to buy water in bio-bottles
- the compass box: sale of leftover food at a reduced price at the end of the day
- agreements with food bank to recover surplus food from canteens and catering services

07.04 Lessons Learned

Achieving effective governance for sustainability at university
Sustainability affects all university practices and therefore requires a broad and at the same time fitting governance. In fact, the transition from a purely environmental sustainability concept to a broad vision of sustainable development, promoted by the 2030 Agenda, has accentuated the holistic value of the urgent challenges for the development of society. The breadth of these challenges and the sharing of responsibilities between several sectors and skills raises relevant issues of governance, both in the definition of strategies and in the effectiveness of the related actions. Thanks to a renewed and strong commitment, the Politecnico launched in 2022 a new broad governance model, headed by the central board of the university, but at the same time capable of reaching the whole community. This step required a new form of organisation, with the need to implement horizontal and vertical governance, transversal to all administrative units, research departments and schools.

University community involvement and partnerships for sustainability
With a view to the university's fourth mission, i.e. to co-create solutions with society, and based on the problem solving and design thinking approach that distinguishes us as a technical university, the Politecnico has always promoted collaboration with businesses and civil society. In this openness to society in response to sustainability challenges, it is even more important to enhance and strengthen internal interdisciplinary partnerships. The construction of a common glossary offered by the SDGs therefore makes it possible to strengthen transversal ties in the polytechnic community, not only in interdepartmental research, but also in new forms of collaboration between researchers, students and university staff to work on concrete projects and solutions in our campuses and beyond. Promoting and disseminating internal skills within our community and therefore encouraging internal collaboration to solve the challenges of sustainable development, remains a priority to be encouraged.

Enhancing the Partnership for sustainability
Joining regional, national and international networks and partnerships remains an important source of inspiration and an opportunity for updating in the exchange of knowledge. Dedicating resources to these activities requires a substantial investment. The passionate involvement and proactive commitment shown in this area by members of our community is an encouraging sign and allows us to be present and nurture these partnerships. Facilitating this commitment carried out by individual members, recognising its value and capitalising on activities within the governance of sustainability is our goal.

Disseminating Sustainability in Research
In recent years, in an incremental manner, the issues of sustainability have reached all fields of research, becoming a must, an essential condition in the ability to answer society's questions, attract funding, and have a significant impact on publications. The university promotes the exchange of scientific knowledge on sustainable development and supports interdisciplinary research, also through internal funding programs.

Disseminating Sustainability in Teaching
The penetration of sustainable development issues in teaching activities is essential to train future leaders, both for their profession and in life. The commitment of the Politecnico in the operations of dissemination and mapping of sustainability issues in teaching, launched in 2017, remains a fundamental activity in building the capacity not only of students, but also of teachers, with the aim of redirecting and focussing, as far as possible, on the contents of the teachings to respond to the urgent challenges of society. The evaluation of the sustainability literacy of students, following the policies promoted to increase the themes of sustainability in teaching, remains difficult to grasp and measure. Furthermore, the actual increase in the presence of SDGs in courses risks devaluing the concept of sustainability and generating repetitions of content.

Funding climate actions: mitigation and adaptation measures on our campuses
Climate action remains the most tangible and visible field of the commitment and responsibility of university governance. The Politecnico is the owner and manager of the buildings and spaces and therefore has freedom of action. The measures for climate action are also the costliest (e.g., the deep retrofitting of buildings or implementing new energy systems), and require the ability to attract public and private investments. The Politecnico has excellent scientific and technical skills in the fields of energy, design and maintenance, but it is not easy to activate collaborations between management staff and scholars, thus risking losing important opportunities for cutting-edge experimentation on our campuses. The idea of exploiting our spaces as urban living labs to test innovative and sustainable solutions should therefore be encouraged. Finally, the recent global situation calls for an urgent and more ambitious rethinking of mitigation and adaptation commitments, especially in response to investment scenarios in technological solutions for energy supply.

Promoting sustainable mobility
Sustainable mobility is one of the areas that most depends on external factors on the campus, i.e. the urban setting in which our campuses are located. The main campuses in Milan enjoy an excellent public transport system and the behaviour of our community already demonstrates a positive uptake. A greater push for cycling will largely depend on upgrading the public - campus access infrastructure.
Generally, the university's experience and actions are mature. They are committed to constantly improving the offer of services and equipment, accompanied by constant monitoring of the habits of their community. The policies to discourage the use of private vehicles and the reduction of parking spaces are confirmed and incremental, as are the investments in shared mobility and the electrification of mobility.
There is room for improvement on the reduction of CO_2 emissions of national and international activities of researchers and teachers. In a local and national context, given the good coverage of rail infrastructure, for local and national journeys, the train is already cheaper than the plane. However, further steps and strategies are being explored.

Circular economy: resource and waste management
Also in terms of circularity, the university strongly depends on the local management context (e.g., waste and water managers) and on national policies. However, it remains important to continuously support the improvement of individual behaviours, through awareness campaigns and the implementation of widespread equipment on campuses (e.g., separate collection, waste recovery and reduction projects, widespread supply of non-bottled drinking water), in order to improve and facilitate new forms of experience towards sustainable lifestyles.

Part C
Getting it done

08 Getting it done

08.01 Science leads the way

Institutions of higher education (IHAs) teach students and do research to develop knowledge. Their approach is scientific, integer and objective, controllable by anyone who has doubts. They know a lot by what they investigate or read from scientific publications. This knowledge must be shared with the people who do not automatically have access to it. And it should be the basis for actions by the IHE itself.
That is what this publication is about.

Action
Science is clear about a lot of environmental problems that threatening the future of the planet and particularly humankind: anthropogenic climate change and its effects, depletion of primary resources, deterioration of biodiversity... Action is need for all these challenges, also within universities and their campuses. IHEs cannot point at others and not do anything themselves. Especially since IHEs can be frontrunners.

Serving the world
Science can also generate solutions for the challenges mentioned. In particular, polytechnical universities and universities of applied science are primarily focussed on – informed by scientific evidence – conceiving and developing approaches, designs, technology and products that help solve societal and environmental issues. So, the largest part of climate action lies in the significance of our work to serve the world.

Being exemplar
In addition, the organisation of our universities can be exemplar to other organisations, cities and countries. If, in line with the Paris Agreement, society needs to be climate neutral by 2050, universities should explore the path towards that goal and be ready well before that date. All IDEA League universities have chosen to go for 2030. That would give us enough time to test, evaluate, and improve the specific approach, design, technology, and products, before wide adoption in wider society.

Scientific process
While acting on the campus, this process can be organised, monitored, and evaluated in a scientific basis. This way, the entire transition to a sustainable university can be a methodological and rigorously scrutinised, transparent process, from which other organisations can learn. Also, the collection of data to determine the current performance and progress (or decline) in environmental performance is part of a process in itself. As the IDEA League universities have noted, not all the needed data is easily available and this could be retrieved from research or cooperative partnerships with suppliers.

Measures based on evidence
Decisions taken for measures that improve the university's environmental performance should be similarly based on scientific evidence and efficacy, to avoid arbitrariness. The eyes of society are on universities, and controversial, improperly supported actions will reflect badly on their image and positioning.
An example of this is the choice for food offered on campus, a topic that can be controversial due to personal preferences and habits. Science indicates that animal-based products have a higher environmentally impact than plant-based alternatives, so should universities ban animal products entirely? The EAT Lancet diet offers a scientifically supported basis for a healthy, balanced diet that has much lower negative planetary impact. In addition, this approach proposes a much smaller share of animal products but does not totally exclude them.

08.02 Agreement on goals

When the working commission of IDEA League presented the sustainability plans of the universities to each other, unsurprisingly it was noticed that all five partners mentioned the same sustainability objectives: becoming carbon neutral, climate adaptive and circular, plus a fourth objective that relates to contributing to biodiversity, liveability, equality, health etc., overarchingly referred to as 'quality of life'. So, one can conclude that these sustainability goals can be adopted more widely.

Foci
The elements that these goals are applied to, differs per university. Some emphasise the importance of education and research, sending out graduates and post-docs into the world, who understand environmental challenges and are capable of developing solutions. This indeed might be the greatest positive impact IHEs can establish, but it does not absolve them from demonstrating on the campus how to deal with these challenges on a daily basis.

Boundary conditions
Some of the IDEA League universities look at challenges holistically and systemically and include everything done on and from, the campus. Others draw a line around their premises and look to preferred suppliers to deal with matters that are under their influence, such as the carbon neutrality and circularity of their products (furniture, finishes, equipment, stationary, building materials...), but even then, they put in effort to stimulate these suppliers to shift to more sustainable products. This is very important: the whole supply chain, including all parties involved and responsible, should be tackled to get to a fully sustainable system.

Contracts and purchases
Contracts and other agreements with partners and suppliers therefore are essential to make a shift from the old system to the new. We need alliances of people, companies, and public institutions to get the great transition done. Therefore, every contract that is renewed, every new purchase is an opportunity to start the change. Alternatively stated: every new contract or purchase that is not in line with the sustainability goals (carbon neutral, circular, climate adaptive, contributing to quality of life) is a missed opportunity, delaying the moment we will be in line with our ambitions. Therefore, starting here and now is essential, also for our credibility.

08.03 Similarities and differences in measures

The approach to sustainable universities and their campuses, as presented in the previous chapters, identifies many similarities in the actions proposed by the IDEA League universities. Differences can also be observed, which can be related to the local circumstances, be they factors of political, legal, socio-cultural, organisational, economic, climatic, technical, or ecological nature. Here we will highlight a few of these similarities, differences and gaps.

Buildings
All universities were putting in effort to improve the energy performance of existing real estate, or to construct carbon-neutral new buildings. Carbon neutral in that sense can be measured in different ways. Commonly it is only related to the use of energy, but as found in several studies, the carbon emissions due to the use of construction materials is getting ever more significant. And this factor is often left out of the equation. So becoming carbon neutral on a larger scale also means that renovation and transformation of existing buildings is better than new construction, and that in both cases, materials used must be carbon neutral or compensated for.

Energy system
All IDEA League universities work on a sustainable energy system for electricity, heating and cooling. The approaches and solutions differ, and this is strongly related to the local climate, existing energy infrastructure and political-legal considerations. What, based on the reference situation, in some countries is considered a sustainable energy source, e.g. natural gas, is 'blacklisted' elsewhere. And while universities in some countries invest largely in solar panels, with others it is less commonplace. And this is not related to north or south. Technical universities tend to better understand the concept of exergy and low-exergy solutions, which is the basis for heating and cooling systems that deliver temperatures closer to the demand level. For sustainability, so buildings are not automatically served by high-temperature (HT) heat or low-temperature (LT) cooling, which opens a wide range of potential renewable energy sources, as compared to fossil fuels or HT geothermal energy.
The message is that each university needs to study its own situation and potential to get to a zero-carbon system, and this will differ for each geographic location.

Mobility and travel
Regarding mobility, all IDEA League universities have a policy installed or underway to limit the negative climate effects of travel, particularly international travel. The overall tendency is to limit flying and promote train travel and other forms of transport mode, if at least travel is really needed. Local commuter travel is tackled too, but the solutions depend strongly on local culture, habits and geographic characteristics. Walking, cycling, electric transport, car-sharing, public transport, these are all promoted, in different ways, by means of a bit of force, financial incentives and nudging. Each university can determine the best way to promote sustainable mobility.

Food
There are big differences between the IDEA League universities regarding the approach to sustainable food. Food offered on campuses can be the most controversial sustainability aspect, due to people's personal preferences, culture, strong opinions about carbon of nitrogen emissions, animal welfare, and required nutrition intake. At the same time,

most European countries have strong economic stakes in agricultural production and food industries. Nonetheless, the science is clear about the climate impact of land use, pig and cattle farming, food miles, refrigeration and freezing at distribution centres, and universities can act based on these (relatively) objective figures. Local, seasonal, organic food has a lower impact, and vegan food has a lower impact compared to animal products. Since food turned out to be equally important to mobility (commuter and business travel) and to energy for heat and cooling, changing food habits is essential to get to zero carbon emissions.

Procurement
At TU Delft, procurement of building materials, furniture, equipment, stationary, and services turned out to be by far the largest contributor to carbon emissions. Therefore, for effectiveness, procurement needs to be tackled first. However, this part of operations of an institute of higher education is usually hardest to register. So, this element starts with a proper administration of everything present at the campus and of everything purchased. All parts of the organisation should work with the R-ladder: refuse, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, recover. The selection of goods procured can be altered to more sustainable (circular instead of linear, biobased, recycled, reusable instead of disposable) alternatives, but in many cases, there are few alternatives to a common product. Think of equipment, computers, phones, etc. In these cases – in fact, in all cases – agreements need to be made with suppliers who then must go up the supply chain and get their suppliers and manufacturers to produce the right product. Universities therefore should set up alliances with their partners and suppliers to reduce the environmental impact of procurement.

Waste management
All IDEA League universities are engaged in policies for sustainable waste management, from the reduction of waste to waste separation and proper processing of waste generated. The solutions differ: sometimes waste separation is a good option, especially when fractions are well indicated and used in a disciplined way; other times waste is binned in such a messy way, that professionally separating afterwards is a better option.
More important to realise is that waste or the reduction thereof, starts with procurement. Procurement & waste management therefore should be one joint item on the sustainability agenda; circular procurement includes a circular solution for waste.

Community engagement, and more
An important factor to make the transition to a sustainable campus a success, is the involvement of the entire community of an institute of higher education. One person can inspire, start and lead the transition process, but without support of students, academics and other staff at the campus, little will be established. Therefore, all IDEA League universities spend ample time on engaging their community and local stakeholders. In all universities, green student organisations play an important role to integrate sustainability better in education and in their faculties or departments. Next to local coordinators, these usually are the strongest force to move the community on campus.
Moreover, communication is essential to engage people and get their support, not least because they understand what is happening around them. Organising presentations and discussion meetings, especially at the beginning of a new sustainability transition process, is important, as well as a means to frequently communicate on progress and new projects. A good governance model, which includes all relevant parties and that ensures dissemination to the rest of the campus community, is the foundation of effective climate action or a wider sustainability policy. Support from – or rather: formal commission of – the university's Executive Board makes policy official.

Measuring (is knowing)
There is no point in vowing to get to zero carbon emissions if you do not know where you stand. A reference assessment of the university's environmental performance therefore is essential to know if progress is made, which then needs to be updated at least every year. The IDEA League universities all do something slightly different regarding carbon accounting. Best comparable option is to follow the global greenhouse gas protocol or methods deduced therefrom. Honest annual justification of the university's performance will keep people sharp and seeking for the most effective reductions, which is good. That way, we hope that all universities will be climate neutral and circular by the year of 2030.