

Sustainable **TU**Delft

**Vision, Ambition and Action Plan
for a Climate University**

Summary



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Preface

Humankind is facing a big crisis related to climate change, the availability of resources, and liveability on the planet. Taking inclusive climate action, establishing a circular economy, and again increasing biodiversity are the strategies paramount to secure sustainability of our society.

We are TU Delft, a university that delivers ingenious, creative, positive and proactive engineers, designers, planners and scientists. Therefore, to an important extent we can help to shape a brighter future. And we are doing this already. Sustainable development has been at the heart of our community, education, research and operations for a very long time. And it will be even more in the coming decades.

Although we send out masters of science and doctors that have learnt to deal with societal challenges, and although in our research we intend to create impact for a better society, as university we need to do more. We consider this as our responsibility: to not just show the sustainable pathway, but to also pave it, so that other people, organisations, cities and countries can follow. We want to become the climate university of the world.

This is why I am happy and proud that TU Delft decided to start, amongst others, a Climate Action Programme and to appoint a Sustainability Coordinator responsible for the transition towards a fully sustainable organisation. In education and research, as community and in its operations on the campus and beyond.

This report – to be accompanied by a shorter executive summary – is the result of a year's work of the sustainability coordinator, together with more than a hundred other people – students, academic staff, supporting staff, management, external parties – who collaborated in teams on a wide range of sustainability themes. It presents the vision and ambitions for our sustainable university and an action plan to get there.

Informed by this report we will start and continue to implement sustainability measures on the campus, focussing on our ambitious targets in 2030. May it be a source of inspiration and guide for the better future our society needs.

Drs. Marien van der Meer
TU Delft Vice-President for Operations

Introduction

TU Delft has always had sustainable development at the core of its activities. There is a lot of education and research related to aspects of sustainability and innovation for a better world, energy being the dominant theme. Since 2014, The Green Village has gradually grown to a successful field lab and demonstration site for innovation and sustainability. Also in its real estate portfolio, TU Delft has been gradually improving its environmental performance, with the faculty of Architecture and the Built Environment's energy renovation and the realisation of Pulse, TU Delft's first energy-neutral building, as milestones. Nonetheless, as a whole, the TU Delft Campus cannot be called sustainable yet.

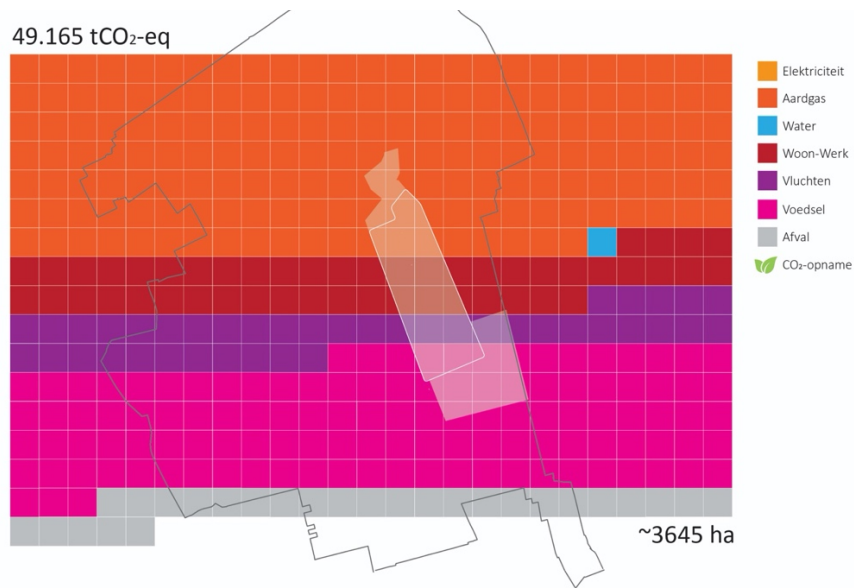
In its Strategic Framework 2018-2024, TU Delft states that it intends to be carbon neutral and circular by 2030. The year 2019 was a turning-point for sustainability. That year's anniversary theme was Climate Action. Following discussions in various media, TU Delft published a position document on climate action¹, and its Campus & Real Estate division (CRE) asked Andy van den Dobbelsteen and Tess Blom to do a carbon analysis of buildings and the energy system of the campus. For a more complete picture of the university's greenhouse gas emissions, the CO₂ Roadmap for TU Delft included travel, food, waste, water and green. It drew a clear picture of the enormous challenge to get to net zero carbon by 2030.

In the same period, Gerrit Kahlman had already been appointed as sustainability coordinator, working closely with the students of GreenTU and with GreenTeams operating at the various faculty buildings. In autumn 2020, Gerrit retired. Andy van den Dobbelsteen was asked to take over the coordinator's role, reporting directly to the Executive Board of TU Delft. This commenced on the 1st of January 2021. Alongside, Deirdre van Gameren was appointed as young researcher to support Andy.

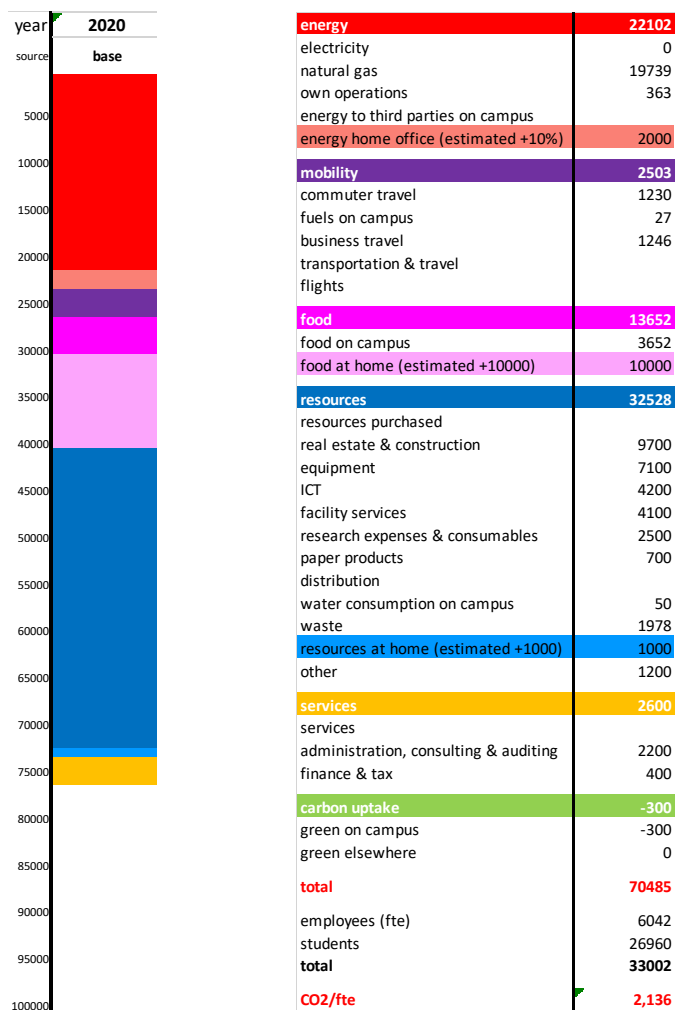
Sustainable TU Delft – Vision, Ambition and Action Plan for a Climate University – is the result of the work that Deirdre and Andy did with their teams in the year 2021. Around a core team representing all faculties, supporting divisions and students, teams focussed on specific themes of the sustainable transition of TU Delft. It became a formidable enterprise, dealing with everything that is done on and from the campus. The report describes the vision and definition of ambitions for sustainability and, most importantly, gives recommendations for concrete structural organisational measures, projects and actions, which all should become part of the TU Delft Campus as a living lab for a sustainable and liveable built environment.

This is the long summary thereof.

¹ <https://www.tudelft.nl/en/tu-delft-climate-institute/tu-delft-position-on-climate-action>



Carbon footprint of TU Delft in the year 2019, expressed as forest area required to sequester all CO₂-equivalent emissions, with the borders of the city of Delft (grey lines) and domain of TU Delft (white patch) underneath



Carbon accounting data for the reference year 2020

Climate university

TU Delft's Rector Magnificus, Tim van der Hagen, expressed his wish to make TU Delft the world's climate university. Considering the vision, ambitions and expertise present on the campus, this should be an attainable goal. If we want it, we will be able to do it.

This report is meant to kickstart sustainability and climate action on the campus. If you have read it until here, you have seen it is full of recommendations. They are all important, but some are essential to the success of making TU Delft the climate university we want it to be.

Carbon footprint

From the study of Blom & Dobbelsteen, it turned out that the annual carbon emission of TU Delft is around 50,000 tons of CO₂-eq, 2018 slightly less than 2017. When Cassandra Tax wrote the formal carbon accounting report of 2018, in line with the CO₂-prestatieladder method, which is compliant with the international Greenhouse Gas Protocol.

The carbon footprint was illustrated by the forest area required to sequester these emissions annually. This comprises around 1.5 times the territory of the city of Delft.

2020 carbon reference

In 2021, Herth & Blok wrote a paper in which the carbon calculations of 2018 had been executed according to another method, particularly focussing on the use of resources and services. In their study, apart from a new dominant source of carbon emissions, some figures were significantly different (i.e. energy and food). As a reference for 2020, from which we can work towards the future, a combination was made of the sources mentioned. The method by Tax was used as the basis, the use of resources by Herth & Blok added.

Ambitions

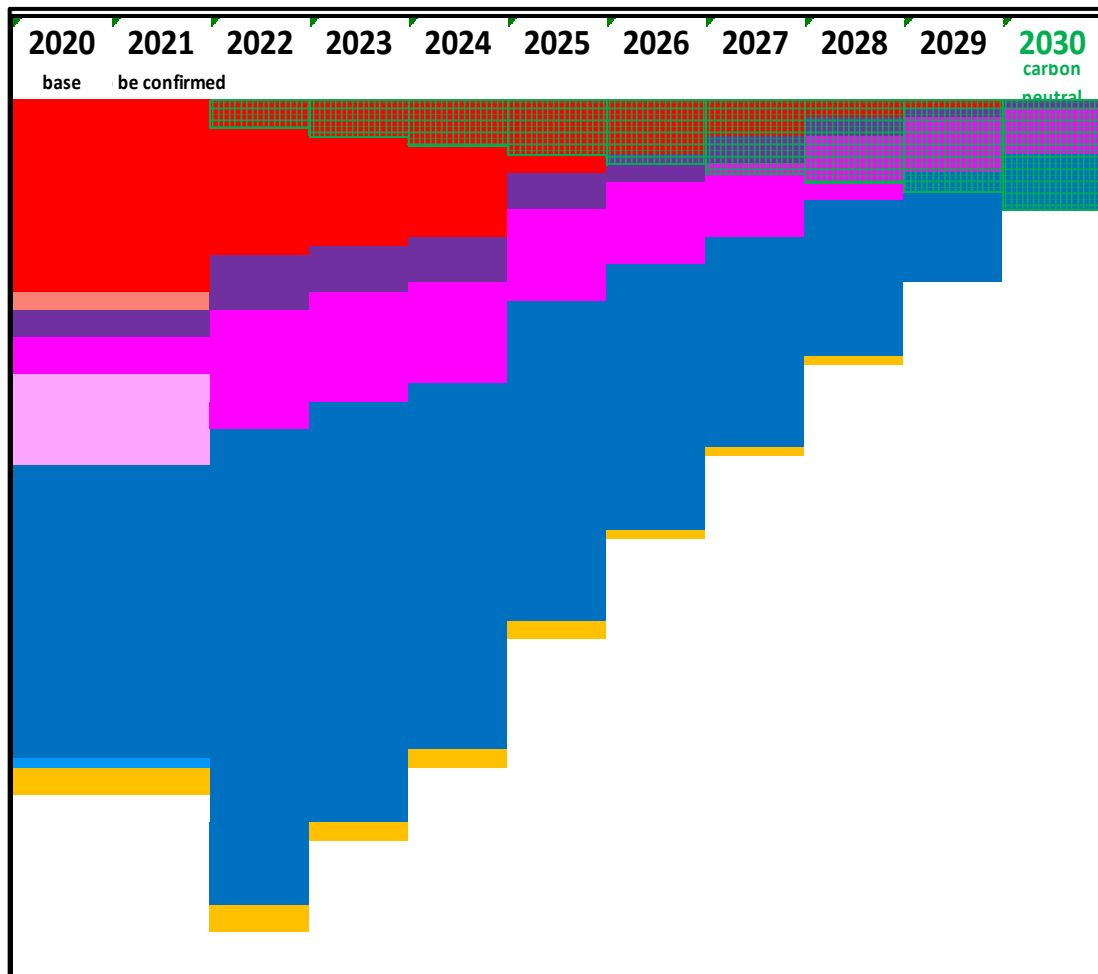
TU Delft aims to be a university operating in a completely sustainable manner, on and from the campus. All activities will be carbon neutral and the campus will be circular, climate adaptive and contributing to the quality of life of its users and nature. TU Delft's sustainability performance will be continuously measured, adjusted when needed and justified by annual reporting. Thus, TU Delft wants to be an exemplar for the rest of the world, regarded for its pioneering role in a world in transition to a sustainable state.

The desired future

The TU Delft Campus will be a thriving, bustling community that studies, researches and works for a better world. The campus will boast innovative and sustainable projects, pilots and activities, often exposed in living lab settings. Everyone using the campus will be part of the experiments taking place, learning from innovative technology and novel processes. The newest ideas, techniques and processes will be tested here, and since they are sometimes of an experimental nature, they may go wrong, only to be improved in an enhanced version. TU Delft has a unique proposition to develop (research) projects that both contribute to the sustainable campus assignment as well as take away barriers that unlock the potential of sustainable innovations in society.

TU Delft's sustainability ambitions
TU Delft will be:

- **Carbon neutral, by 2030**
 referring to all TU Delft related activities done on and from the campus
- **Circular, by 2030**
 related to all resource and waste flows going through the campus
- **Climate-adaptive, by 2030**
 dealing with heat, drought, excessive rainfall, floods and extreme weather
- **Contributing to quality of life, increasingly so**
 aiming at biodiversity, safety, health, comfort, inclusiveness and happiness
- **Exposing its excellence and sustainable character on campus**
 accommodating and demonstrating living labs and innovative projects



Carbon emission reduction towards the year 2030

Sustainability ambitions of TU Delft

Carbon-neutral campus

Everything done on and from the campus, as part of activities of TU Delft, need to be carbon neutral by 2030. This means that in the period of a year no CO₂ or other greenhouse gases are net emitted as a result of activities and facilities (scopes 1, 2 and 3). By 2030, all energy for electricity and heat comes from renewable sources, 50% of which generated on campus.

Circular campus

By 2030, TU Delft intends to have a circular campus. This means that activities on and from the campus form part of the circular economy. New materials, products or services are procured or contracted on the basis of sustainable, circular processes. Both procurement and construction projects follow circular guidelines. The lifespan of available raw materials is maximised without harmful emissions to the environment.

Climate-adaptive campus

The climate is already changing rapidly. Therefore, the TU Delft Campus should be climate adaptive, ready for different circumstances, as expected by the meteorological institutes. This means that the urban plan and buildings should be better prepared for hot summers, for more precipitation on average, but long periods of drought too, and for extreme weather conditions, storms in particular.

A campus contributing to quality of life

The TU Delft Campus offers a high-quality, health working and learning environment in which health and well-being are at the core. Quality of life can also refer to plants and animals on the campus. Therefore, improving the ecological value of the campus and increasing biodiversity is a deliberate goal of the sustainability action plan

A campus exposing its excellence and sustainable character

Campus as a living lab: the TU Delft Campus must become a place where every user forms part of the experiments taking place. The Green Village already facilitates early testing of innovations in a protected environment; more sustainability-related living labs should be introduced on the campus. In addition, the campus can serve as an innovative ecosystem, a place where the sociological transition can be shaped.

Why 2030 already?

As a frontrunner university focussed on innovation and sustainability in science, engineering, design, planning and governance, TU Delft considers its responsibility to demonstrate how becoming sustainable can be achieved, so that other organisations can learn from it. Furthermore, the biggest challenge arguably is the way to get there. That transition process is full of barriers, while scaling up requires acceleration. TU Delft wants to remove bottlenecks and barriers that stand in the way of making society more sustainable.

Most important interventions

Effectiveness

TU Delft needs to take serious steps before 2030, eight years from now. Therefore, effectiveness is key: how are we going to get there fastest? Effective measures have a great improvement potential, or can be applied to a large share of the system considered. The most effective measures have a great improvement potential and relate to all places on the campus. Hereafter, we will discuss the most effective reductions in carbon emissions.

Sustainable procurement: as soon as possible

Half of the emissions of TU Delft relate to the products (stationary, equipment, furniture, ...) and services (hired externals) it procures. From now on, all items bought should stand the test of sustainability, circularity in particular. Furthermore, getting the full supply chain of products 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 be in compliance with TU Delft's climate and sustainability goals.

Geothermal heat

For the campus' district heating system, TU Delft will have to get the geothermal well operative as new source of high-temperature (HT) 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, the mid-temperature (MT) return flow supplying most buildings on the campus.

Or all-electric?

Without the geothermal well installed, TU Delft has to shift to a system based on electricity. This is also the case of a hydrogen network, because hydrogen would have to be produced with redundant renewable power. A logical alternative to geothermal heat would be a low-temperature (LT) network fed by various sources and boosted by heat pumps. Therefore, most buildings on campus would have to be renovated.

Energy renovation

An absolute no-regret measure for any heat system is the renovation or transformation of existing buildings on the campus. Buildings with the highest energy use per square metre should be tackled first. Apart from the renovation of the buildings mentioned, the roll-out of photovoltaics (PV) on campus needs to start as soon as possible.

Kluyver area: exemplar of TU Delft's sustainable ambitions

The Kluyver area needs to become everything that TU Delft aims to be: energy positive, circular, climate adaptive and nature inclusive.

Food & beverage: continue to improve the sustainability of food

TU Delft must only offer healthy, sustainable food: local, seasonal, organic, animal-friendly, more plant- and less animal-based. The first action taken was the introduction of the vegetarian 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. This policy should be extended to other restaurants, food trucks and distribution points. Behaviour can be influenced by adjusting the prices of food, based on its carbon impact.

Mobility: make the campus fossil free, and travel sustainably

A code of conduct for travel will help students and staff to make sustainable decisions. Its strategy will be: avoid travelling, reduce travelling, plan travelling smartly, use the most sustainable mode of transport. Teleworking and teleconferencing are an important step to avoid travel and reduce emissions due to mobility. Internationally, the rule will be 'trains, not planes', unless there are no reasonable options.

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 should be promoted and stimulated. Facilities for bikes and electric vehicles should be improved.

Internal carbon tax

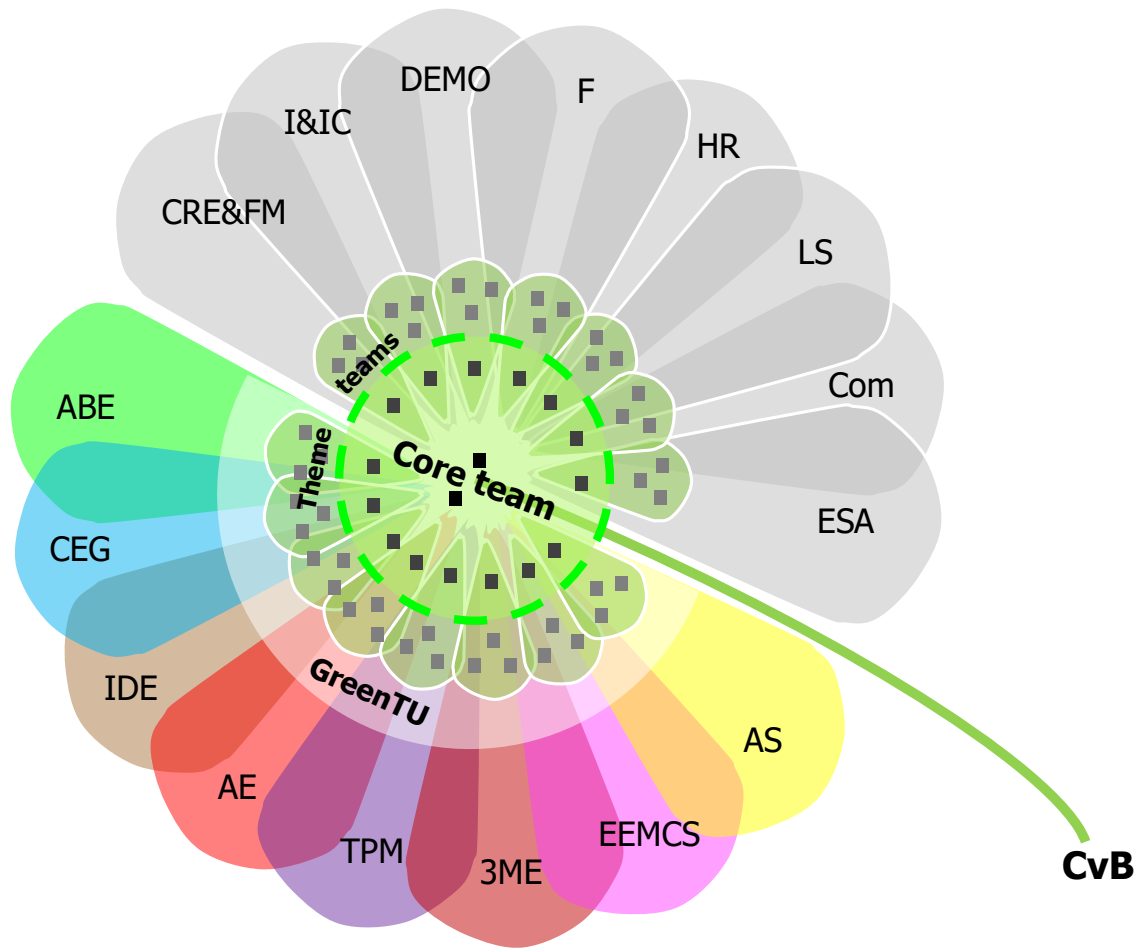
A measure proposed is the introduction of an internal carbon tax to compensate for emissions from flying (and other forms of climate-influencing travel). This internal carbon tax should be based on a carbon price of 150 €/tonne of CO₂-equivalent. Its revenues should be transferred to a fund that will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

IT: reduce processing energy and use AI to improve campus operations

Emissions from energy used by datacentres, server rooms and individual computers should be reduced, e.g. by better programming. On the other hand, ICT, AI and data management should be used better to make the campus smarter, more energy efficient and circular. Therefore, use of this technology needs to be effective.

Compensation: green the campus and compensate 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, also at TU Delft, a certain fraction of present-day's emissions needs to be compensated for. A part of carbon sequestration can be established on the campus, by extending the amount of carbon-absorbing green. In addition, it is proposed to invest the equivalent of 1,000 tonnes of CO₂-eq each year in tree plantation, starting 2022. By the end of 2030, this will have produced a forest sequestering approximately 10% of the emissions of the 2020 reference).



Organisational scheme of the Sustainable TU Delft project

Organisation of the sustainability action plan

The organisation of the sustainability action plan is structured as a flower with petals, representing the university's supporting divisions in grey while coloured petals are the faculties, with a special position for the students of GreenTU and the faculty GreenTeams. The heart of the flower is formed by the Core Team, with representatives, sometimes sustainability coordinators from the supporting divisions and faculties and the TU Delft sustainability coordinatorship. working directly for the Executive Board (CvB).

Theme teams

Next to the Core Team, thirteen specialised and integrative teams focus on specific topics of sustainability. Each team is comprised of employees of influential supporting divisions, academics from with expertise in the respective subject, and students from GreenTU or faculty GreenTeams.

- The **Education for Sustainability** team looks at the implementation of sustainability in education within the faculties, cross faculty and cross university.
- The **Research, Valorisation & Technology Transfer** team is concerned with implementation of sustainability in research, funding for projects, pilots and actions on the campus, and for the technology transfer to society and to find, set up as living labs.
- **Governance** is dealt with by the Core Team, focussing on structural changes to governance, i.e. organisation, policies and management (decision-making) processes.
- The **Social Engagement** team prepares projects, events and actions to engage the entire community of TU Delft Campus.
- The **Communication** team focusses on the website, dashboard and internal and external communication of sustainability-related aspects.
- The **Reporting** team works on carbon accounting reports, sustainability reports and assessment methods needed therefor.
- The **EcoCampus** team works on plans for a greener campus that has a better water management, aiming for increased biodiversity and improved climate adaptivity.
- The **Energy System** team focusses on a sustainable energy system with renewable power generation, thermal energy, sustainable fuels and energy storage.
- The **Construction & Renovation** team looks into renovation of the current building stock and sustainable new construction.
- The **Mobility** team works on a sustainable mobility policy and focusses on commuter, business and student travel, as well as sustainable facilities at the campus.
- The **Food & Beverage** team focusses on the catering at the campus, the environmental footprint of food and sustainable food policy.
- The **Procurement & Waste Management** team is dedicated to a system of circular resource management, and the avoidance of waste, or sustainable processing thereof.
- The **IT, AI & DM** team concentrates on reducing the negative carbon impact of information technology, artificial intelligence and data management, as well as the positive potential of using it in creating a smart campus.

Education for Sustainability

Main proposals

General aims and principles

- To deliver scientists, engineers and designers who can contribute to a better world
- To include sustainability in all forms of education offered by the TU Delft

To be investigated

- Implementing the Green Thread for minors
- Setting a minimum for sustainable BSc and MSc courses, PhDs, post-masters, MOOCs
- Financial support for students who travel sustainably

Projects, pilots and actions

- Sustainability-related projects from TU Delft as business case for JIP
- Honours programme as sustainability input to the studies of excellent students

Education for Sustainability

Education for sustainability develops the knowledge, skills, ethical values, world-views and sense of responsibility necessary for students to act in ways that contribute to a more sustainable world and more sustainable patterns of living. It enables individuals and communities to reflect on ways of interpreting and engaging with the world.

Education for sustainability is future-oriented, focussing on protecting environments and creating a more ecologically and socially just world through informed action. Such actions require systems thinking with consideration of environmental, social, cultural and economic aspects and their interdependence.

Following this definition means that our graduates are able to critically evaluate the impact of engineering solutions on these systems, regarding sustainability in its entirety. A TU Delft graduate is therefore competent to implement their gained skills and knowledge into their engineering practices and subsequently contribute to climate action.

In the near future, TU Delft will have successfully implemented sustainability in the eight educational programme types. Using this definition, gaps in terms of sustainability are identified in education, and lecturers are helped to bridge these gaps by developing a teach the teacher module. The professors and lecturers of any given course play a key role in the adoption of sustainability as a fundamental aspect of their teachings, so they need to be aware and properly informed.

All this will be achieved by following the “Roadmap for Sustainability Education”, which was conceptualised by the Education for Sustainability team. Through this roadmap, students will gain knowledge on the fundamentals of sustainability, receive relevant discipline-specific expertise on sustainability and are granted the opportunity to study and work on sustainability in an interdisciplinary environment.

With the world changing rapidly, having to adapt the education system accordingly seems inevitable. We acknowledge how challenging it is to change curricula, especially those that have been more or less the same for decades. It is believed though that a focus on sustainability should be implemented within all courses, alongside a few specialised courses that dig deep into (new) essential knowledge.

TU Delft will become a brand for sustainable education in all disciplines, connected to exciting student competitions (the former Dreamteams) and research projects, and most interestingly, linked to what is happening on the campus. Students are part of the living labs on campus and most of them include sustainability in their graduation topic.

Research, Valorisation & Technology Transfer

Main proposals

General aims and principles

- To include sustainability strongly in the **research profile** of TU Delft
- To develop interdisciplinary research related to all UN **Sustainable Development Goals**
- To integrate sustainability research with **education, campus and community**
- To **communicate** about sustainability research both within and outside TU Delft
- To create a strong **research community** focussing on sustainability-related research
- To implement **living labs** related to innovative sustainability research projects

To be investigated

- Defining what can be considered **sustainability research** and what not
- Making an **inventory** of all current sustainability-related research
- Developing a broad **interdisciplinary research agenda** involving all faculties

Projects, pilots and actions

- **Connecting** the sustainability research topics with student projects
- Explicitly including the **campus as a living lab** in the research agenda
- **Communicating** sustainability research via newsletters, website and (social) media
- Sustainability-focussed **seminars** for researchers, students and PhD students

Research, Valorisation & Technology Transfer

In the near future, TU Delft will have established a strong research profile regarding sustainability, related to all United Nations (UN) Sustainable Development Goals (SDGs). This research is strongly integrated with education on sustainability and climate action, the sustainable campus and social engagement. The focus on sustainability in research and the results of this research are clearly communicated to both the TU Delft research and student community and the outside world.

The university plays a leading role nationally and internationally in valorisation, especially in technology transfer. TU Delft delivers ground-breaking scientific, technical, design solutions that contribute to a better society. The university facilitates multiple start-ups, consortia, field labs, entrepreneurships in education and partnerships with governments and other knowledge institutions which are key to accelerating (sustainable) innovation. This is all coordinated by the TU Delft Innovation & Impact Centre (I&IC), which has sustainability as one of its core themes.

The university has set up an incubator organisation or foundation to switch quickly between shareholders and stakeholders. In addition, the university applies for green loans for sustainable, innovative investments from sustainable banks. The banks are seen as partners in the campus transition.

Governance

Main proposals

General aims and principles

- To create a **solid foundation** that supports sustainability automatically
- To **embed sustainability** in each part of the organisation
- To use **backcasting** as a general approach for developments

To be investigated

- **Governance & policy review** from the perspective of a sustainable campus
- Implementing **total cost of ownership (TCO)** in all financial decisions
- Using a **carbon price of € 150** per tonne of CO₂-eq in financial systems and decisions
- Creating a **Sustainability Fund**, to be filled with internal carbon taxes
- Revealing **current research initiatives and living labs** already in place
- Defining a **living lab methodology** for campus projects

Projects, pilots and actions

- Sustainability budget for **living labs** and for **test pilots and projects**
- TCO pilot with a **big investment scheme** (Kluyver area)
- Carbon pricing pilot in new **construction** project (Kluyver area)
- Carbon pricing pilot in the **geothermal heat** project
- Carbon pricing pilot in new **supplier contract**
- Carbon pricing pilot in **waste management**
- Carbon pricing and nitrogen pilot in **campus greening** project
- True pricing pilot in one or more **faculty restaurants**
- **Circular contracting** pilot

Governance

In the near future, TU Delft will have become an entirely sustainable organisation, not only by the measures implemented on the campus, but also in the way the university is organised. TU Delft will be governed with financial and regulative incentives that steer processes towards sustainability automatically. This governance will bring about human energy and creativity among the community.

On the campus

For people working and studying at TU Delft contributing to a better world means acting wherever you have influence, starting at home and on the campus. Education, research, operations on the campus are compliant with TU Delft's societal function and sustainability ambitions. TU Delft is a great and inspiring place to be, and students, PhD candidates and guest researchers line up to spend some years at this sustainable university.

Sustainability targets to all levels

Sustainable targets are included in yearly agreements made with faculties and supporting divisions. With the sustainability dashboard, these goals can be made visible via screens in every building. All parts of the organisation define Key Performance Indicators (KPIs). These KPIs provide insight into performance, which helps to make better decisions.

The management level

There is a sense of urgency for sustainability in the boards or management teams (MTs) of all faculties and supporting divisions, sustainability being a standard item on the agenda of MTs. In most cases, someone is responsible for the implementation and control of sustainability goals. BVMs (decision preparation memorandi) and project briefs will have a sustainability paragraph.

Total cost of ownership 2

In order to support sustainable decisions, suited financial assessment and control tools will be in place. Perhaps the most important change in financial attitude is achieved by TCO (total cost of ownership), including costs and benefits of exploitation and considering the residual value of a building or product. In fact, TCO will have become TCO₂, including capitalisation of environmental impact.

Internal carbon clearance

TU Delft is investigating to include its own carbon tax to support sustainable decisions in great investment schemes (new buildings, contracts, programmes) but also in every-day business of travel modes and food. Internal carbon clearance can be used as shadow price, as internal carbon fee or trading system, or in combination with purchasing offsets. The last option frees money for sustainable investments such as for responsible student travel, living labs on the campus and pilots within faculties and with external parties.

Social Engagement

Main proposals

General aims and principles

- To create a **resilient community** on campus, focussing on diversity and inclusiveness
- To involve **all students, staff, external companies and visitors** using the campus
- To use **different strategies and media** for different target groups
- To **change the usual way** of thinking and standards
- To stimulate **sustainable behaviour**
- To give more floor to **motivated people** (frontrunners)
- To **take away barriers** for sustainable choices
- To **communicate** actively about sustainability, the goals and steps

To be investigated

- **Preferences and ambitions** of the TU Delft community in regards to sustainability
- **Barriers** towards more sustainable behaviour
- Determining the **carbon emission budget** per person, faculty or supporting division
- Creating **guidelines** for sustainability on campus and at home
- Introducing **apps** that stimulate sustainable behaviour
- Implementing a **reward system** for sustainable behaviour
- Implementing **sustainability awards**, e.g. for student projects, suppliers and staff
- Developing **green gifts**, such as TU Delft tiles and miniature faculty buildings

Projects, pilots and actions

- Getting the **new sustainability policy and projects** started in September 2022
- Providing **open and earnest information** about sustainability features and processes
- Using the **sustainability website** to engage the community
- Using **displays and posters** in the buildings to engage the community
- Using the **EcoCampus** projects to create awareness about sustainability
- Presenting and discussing **sustainability reports, documents and handbooks**
- Organising **workshops, lectures, debates, shark tanks and hackathons**
- Introducing a sustainable futures **philosophy café**

Social Engagement

The future campus community is a resilient community, which focusses on diversity and inclusiveness, bridging between people on campus through sustainability. Togetherness is a key term: we have to innovate together, no one can do this on their own. The 'Impact for a better society' strategy of TU Delft will have been realised by strengthening the campus community. TU Delft, as a sustainable community and as a sustainable campus, sets an example for people within its organisation but also for people outside. The university is known as the leading university with climate action and sustainability implementation in all its actions and projects.

The first big step was taken in September 2021, when the previous draft of this document was communicated with the whole community. When the community returned to campus after the corona crisis, the new policy was picked up and accepted relatively easily. Guidelines were set in place that made it easier to reject unsustainable practices, and sustainability was included in TU Delft's code of conduct, acknowledged by the community.

By approaching each target group with a bespoke plan, the entire community has now become aware of the impact of their actions on sustainability. Employees and students have their own personal carbon emission budgets. Within these boundaries, they can decide what to spend it on, e.g. travel, food, equipment. The community of TU Delft knows that they work for a sustainable organisation, have therefore consciously chosen the university, and have the same conscientious, innovative mentality. The entire community is motivated and stimulated to share their ideas for further improvement. A yearly 'shark tank' is organised to centralise this. Students can win awards with their assignments, design studios and projects, in order to stimulate continuous innovation and sustainable development in the study domains. People who live and work on or near the campus are regularly involved in small scale living labs that give them opportunities to engage with new ideas and to improvise and innovate along with researchers.

The university actively shows and communicates research conducted on campus, in regards to sustainability in particular, which steps have been taken and the lessons learnt. The entire community is informed by using multiple media platforms, some of them interactive. Information is also actively shared in the buildings through information screens and posters. The entire community at TU Delft subscribes to the sustainability goals of TU Delft and behaves accordingly. Mistakes from the past, such as the squandering of energy in buildings after closing time, disposables, short service lives of equipment and fossil transportation have vanished and led to a more lively and liveable campus.

The university and its community together have ensured that TU Delft has become the most sustainable university in the world.

Communication

Main proposals

General aims and principles

- To profile TU Delft as **Climate University**
- To support **communication** around sustainability projects and processes
- To support activation and community building around **sustainable behaviour**

To be investigated

- Developing **sustainability dashboards** (see Chapter 09, Reporting)
- A **corporate policy** for all sustainability topics, including the SDGs and climate action

Projects, pilots and actions

- Getting a new **sustainability website** started
- Setting up an **activity calendar** with important communication moments
- Coordination of multiple **communication platforms**
- Communication about sustainability through the **#BetterTUgether programme**
- Communication about **big projects and researches**, e.g. the flagship projects
- Communication about **smaller news items** related to sustainability
- Communication to create **awareness and behavioural change**

Communication

In the near future, the communication division and the sustainability coordinator and his team will work closely together to ensure that communication on the theme of sustainability runs smoothly.

There are sufficient tools for the communication division to attach sustainability-related themes. The #BetterTUgether programme is also used for this. Both small and large projects and actions are communicated to the inside and outside world. The different media platforms are used correctly and reinforce and complement each other.



Figure 08.02: Example of the draft dashboard

Reporting

Main proposals

General aims and principles

- To gain insight into the **carbon emissions** of activities on and from the campus
- To account for **all activities** that emit greenhouse gases, including scope 3
- To report **progress and ambitions** of TU Delft concerning sustainability
- To **take action and change strategies** where needed, based on the annual reporting

To be investigated

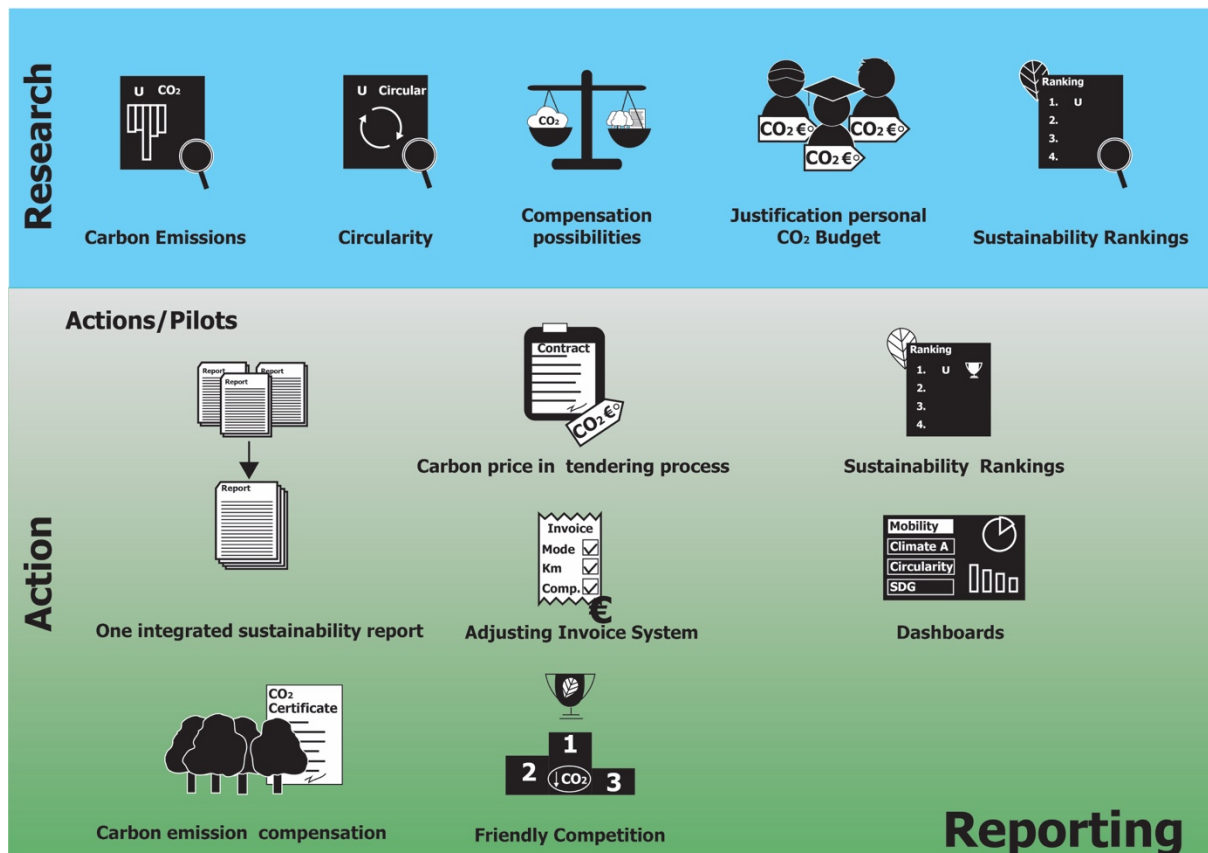
- Selecting appropriate sustainable indicator **assessment methods**
- Clarifying the **carbon emission developments** over previous years
- Determining the influence of **Covid-19** on carbon emissions and other indicators
- Studying **compensation possibilities** for the fraction of unavoidable carbon emissions
- Determining and justifying the **personal carbon budget**
- Gathering data (by survey) to obtain more information about **commuter travel**
- Gaining insight into the travel movement of **suppliers**
- Developing **registration and invoice systems** that support the sustainable transition

Projects, pilots and actions

- Producing the first **integrated sustainability report** of TU Delft, over the year 2021
- Commencing **carbon emission compensation**
- Including the **carbon price** in tendering processes
- Developing **dashboards**: SDG, climate action, circularity, and mobility
- Introducing **competitions** to stimulate change in the TU Delft community

Reporting

In the near future, TU Delft's performance will be visible continuously, through dashboards, online or in the buildings on campus, and the university presents annual reports to justify sustainable investments, progress in carbon emission reductions and plans to enhance this process. The honest reporting process has enabled the university to truly profile itself as a Climate University.



EcoCampus

Main proposals

General aims and principles

- To create a **climate-adaptive** campus
- To increase **water retention** and usage on campus
- To increase the **biodiversity** of trees, other plants, and animals
- To **connect** to green and blue outside the campus

To be investigated

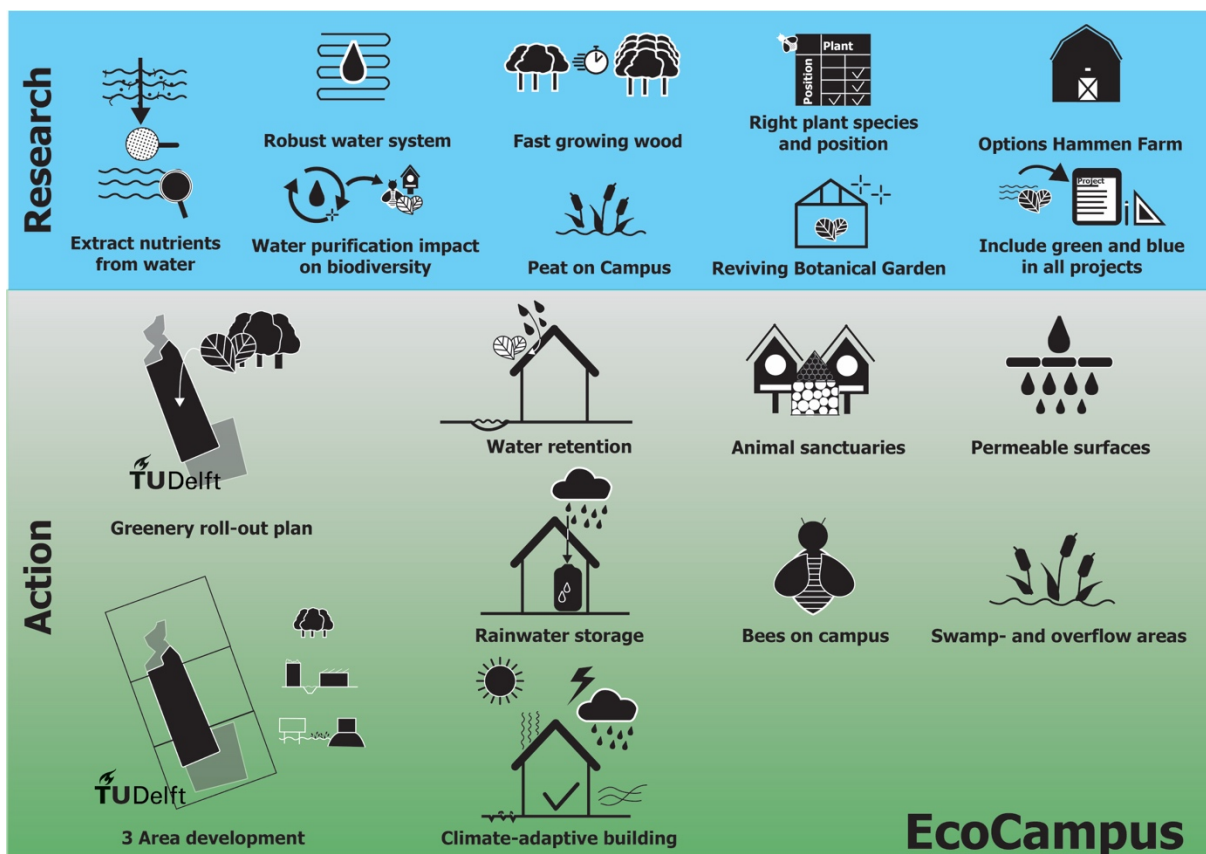
- Investigating the best way to extract **nutrients** from wastewater and open water
- Studying types of **water purification** systems and their impact on biodiversity
- Exploring possibilities of **peat on campus** and its impact on CO₂ and water retention
- Exploring possibilities of **fast-growing wood** as carbon absorber
- Finding the right **plant species and position** for insects and other animals on campus
- Determining how to create a more **robust water system**
- Defining how to **include green and blue** in every project on campus
- Reviving the **Botanical Garden**
- Investigating options for the **Hammen Farm**

Projects, pilots and actions

- **Greenery roll-out plan** for the campus
- **Animal sanctuaries**: bird boxes, bat boxes and insect hotels on campus
- **Bees on campus**: placement of beehives and appointment of a beekeeper
- **Water storage** on campus: underground water storage, swamp areas, overflow areas
- **Permeable surfaces**: green or semi-open terraces, green or semi-open pavement
- **Water retention** on and in buildings: green roofs, polder roofs, sponge roofs, cisterns
- First projects of **rainwater** collection, storage and usage in buildings
- **Aquathermia** pilot: open water, wastewater and drinking water for thermal energy
- **Climate-adaptive building** pilot: a building dealing with heat and water

EcoCampus

In the near future, the TU Delft Campus will be a natural, biodiverse, circular, self-sufficient, climate positive campus where people and nature co-exist. The campus will be embedded and connected to the green and blue structures around it. It will have a high biodiversity and will be an ideal place for trees and other plants, as well as for animals, especially insects. The right conditions have been created for them to ensure that they thrive. The campus has become less affected by flooding, drought and heat. In addition to using nature to become climate adaptive, various innovative projects are being conducted to guarantee this in the future as well. Projects test how to design climate-adaptive buildings, for example on stilts, floating, on mounds, or modular and movable. This is necessary to guarantee the viability of the campus in the future. The campus will become a living lab; researchers and students will see how the built environment is going to change within the next few decades due to climate change. TU Delft will internationally position itself as the place where researchers can test new necessary ways of – for instance – construction.



Construction & Renovation

Main proposals

General aims and principles

- To make buildings on campus jointly **'Paris proof'**
- To make **new buildings** energy producing, circular and climate adaptive
- To **avoid demolition** on campus
- To renovate **existing buildings** to (nearly) zero energy
- To make 50% of buildings on campus **energy neutral**
- To renovate existing buildings in a **circular** fashion
- To make **technical maintenance** circular
- To involve **external parties** on campus in the sustainability plans of TU Delft
- To use **total cost of ownership (TCO)** for financial decisions in building projects
- To create possibilities for (temporary or permanent) **living labs** in all buildings
- To involve **researchers and students** in building projects

To be investigated

- Executing an **energy assessment** of all buildings on campus (WEii)
- Performing a **circularity assessment** of all buildings on campus
- Performing a **comfort and health assessment** of all buildings on campus
- Investigating **external buildings** on campus
- Investigating options for the **Hammen Farm**
- Extending the **24/7 project** to TGV and campus
- Contributing to sustainable renovation of **external buildings** on campus
- Investigating the circular retrofit of the **old TNW building** with new purpose
- Elaborating the **Aula PV** and heat pump system
- Using the **ABE faculty building** as PV slate roof pilot
- Designing experimental **hospitality pavilions** in the Mekelpark

Projects, pilots and actions

- Finishing the **Rotterdamseweg** parking garage project
- Delivering the **ECHO building**
- Making **the Kluyver area** energy-neutral, circular, climate adaptive, with living quality
- Contributing to the sustainable **Firma van Buiten** building project
- Executing recommendations from the **PV on campus** study
- Deliver the **EWI highrise** as circular, energy-producing tower
- Writing **individual action plans** by all faculties and supporting divisions
- Starting up the **Innovation Budget** and commissioning first co-funded projects

Construction & Renovation

In the near future, all new buildings built at TU Delft are carbon-neutral, circular, climate adaptive and contributing to quality of life (nature and health). Existing buildings have been renovated to the highest possible sustainability standards. This means that they meet the set KPIs for climate action. The buildings on campus use a smart, self-learning building management system that optimises the energy demand and supply. This system monitors the performance continuously and makes adjustments when needed. There is also a strong focus on health and comfort, as well as user satisfaction. The problem of cooling has been tackled in several ways. Various innovative techniques are used, both passive and active, such as aquathermal energy from open water, absorption cooling, and plants on for example facades and roofs.

Research

- Energy assessment
- Circularity assessment
- Comfort & Health assessment
- Investigation external buildings
- Options Botanical Garden
- Options Hammen Farm

Action

- Circular, energy-producing, healthy Kluiver area (TU Delft)
- Finish parking garage Rotterdamseweg
- Circular retrofit old TNW building
- 24/7 project
- ECHO building commissioning
- Aula PV and heat pump system (HP)
- Sustainable renovation external buildings
- Circular, energy-producing EWI highrise
- Sustainable Firma van Buiten + Aquathermia
- ABE PV roof slates
- PV roll-out buildings

Construction & Renovation

Energy System

Main proposals

General aims and principles

- To establish an entirely **sustainable energy system** on campus
- To develop the TU Delft campus as a **smart city** of its own
- To make the campus' energy system **smartly managed and controlled**

To be investigated

- Developing an **energy roadmap** (2025)
- Studying heat grid expansion to other **districts of Delft**
- Studying integration of TU Delft heat network into the **metropolitan region** (MRDH)
- Elaborating a **5th-generation heat/cold network** in the Kluyver area
- Studying energy-saving options with the **datacentres**
- Making an inventory of all **cold potentials** on campus
- Studying **heat-powered cooling**
- Exploring options of a **borehole thermal energy storage** (BTES) pilot on campus
- Exploring options of **wind turbines** on campus
- Exploring options of **CO₂ capture, storage and conversion to e-fuels** on campus
- Determining the potential for **green fuels, e-fuels and hydrogen** on campus
- Exploring options of a **thorium plant** test facility
- Extending the **24/7 project** to TGV and campus
- Developing a TU Delft **energy control room** set-up, with digital twins

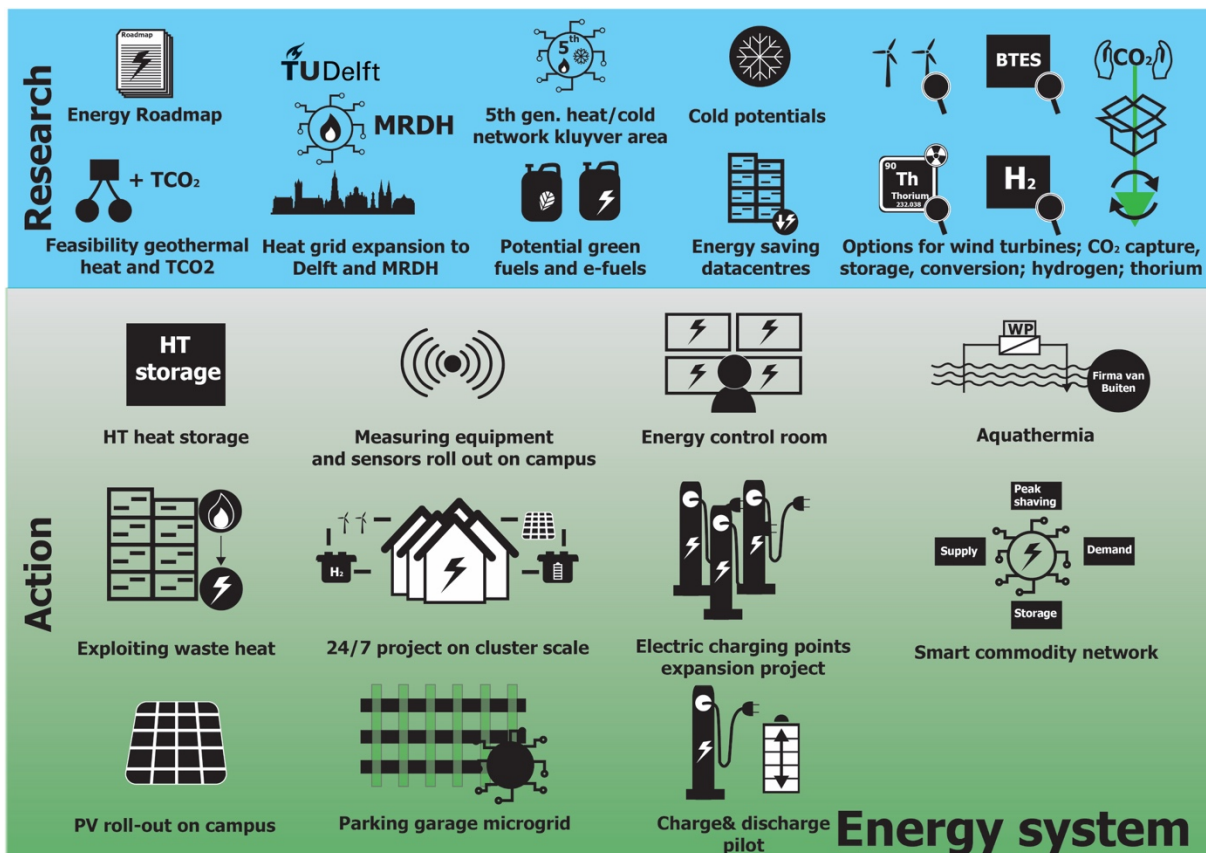
Projects, pilots and actions

- Elaborating the case of **geothermal heat**, including TCO and carbon pricing
- Realising a **HT heat storage** that serves the campus
- Exploiting the NorthC **datacentre waste heat**
- **PV roll-out** on campus
- Electric mobility **charging points** expansion project
- **Charge/discharge pilot** for plug-in electric vehicles
- Rotterdamseweg **parking garage microgrid** pilot
- TU Delft **smart multi-commodity network** design and development
- Roll out of **measuring equipment and sensors**

Energy System

In the near future, more than 50% of all energy used on campus – heat, cold and electricity – will be generated on campus. The Sankey diagram of figure 12.01 illustrates this new situation. To a great extent, on the campus, electricity is generated by PV systems, on roofs, facades, parking garages and in the urban environment. There is a portion of electricity that comes from hydrogen and synthetic methane generated from excess power in summer. There might even be wind turbines of TU Delft Campus South. The remaining electricity demand is bought from wind farms.

The basis of TU Delft’s heat demand is delivered by the geothermal heat system, which is linked to the heat network of the metropolitan region. Only a part of its high-temperature (HT) heat is used on campus itself; the greater part goes to other districts of Delft. The mid-temperature (MT) return temperature of the system is used by a greater number of buildings than HT heat. The largest share of buildings however uses low-temperature (LT) heat from residual heat and environmental sources on campus, which are interconnected through peer-to-peer networks. HT, MT and LT heat² are seasonally stored on campus.



² HT heat: above 65°C; MT heat: 40-65°C; LT heat: 25-40°C; ultra-low temperature (ULT) heat: 15-25°C

Mobility

Main proposals

General aims and principles

- To **avoid and reduce** travel and make it sustainable
- To standardise **online and hybrid** sustainable conferences
- To have **fossil-free, emission-free** transport on campus by 2030
- To **prohibit** flying within the Netherlands and Belgium
- To include an internal **carbon tax** for travel

To be investigated

- Making an inventory of **student travel**
- Exploring options of **electric car** incentives for >30 km commuting
- Starting up international **train ride and bus planning** by travel agency
- Getting **student trips** planned via travel agent pilot
- Using **train-plane connections** for intermediate stops
- Initiating a TU Delft **sustainable travel fund**, financed from internal carbon taxes
- Exploring options for sustainable flying at Rotterdam-The Hague **Innovation Airport**
- Elaborating a **ride-sharing** pilot
- Designing an online **tool** or smart phone app

Projects, pilots and actions

- Writing a **sustainable mobility policy**
- Writing a clear **travel policy** for the tender to select a new travel agency
- Writing and communicating the sustainable travel **code of conduct**
- Elaborating **e-learning facilities** on campus
- Commencing the CEG, AE and ABE **business travel pilots**
- Developing a European **green exchange options** catalogue
- Prolonging the **electric bike project** for 10-30 km commuting to a larger audience
- Expanding the **NS card** project to all employees
- Regulating **car-parking**
- Expanding electric **charging points** on campus
- Designing comfortable and safe **bike parking facilities**
- Commencing the **mobility dashboard** project
- Showcasing the difference in carbon emissions per type of travel, with **infographics**
- **Mapping** travel destinations, travel modes, carbon emissions, travel time and costs
- Finishing the sustainable student travel **video** (GreenTU)
- Re-installing **employee sporting** on campus
- Upscaling the **health coach** programme

Mobility

Commuter and national travel

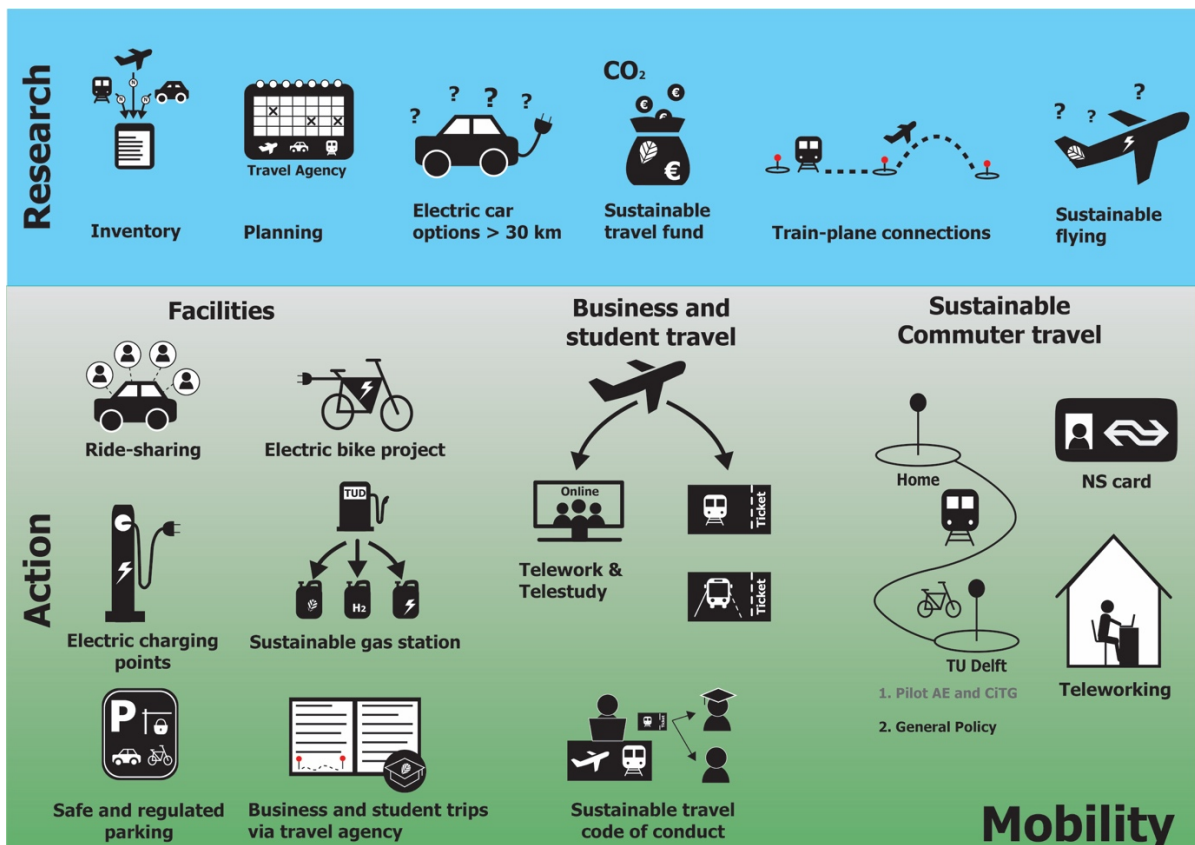
In the near future, after the corona crisis, a certain part of working time will remain to be executed from home. When coming to the TU Delft campus, staff and visitors will do this in a sustainable manner: on foot, by bike or e-bike, public transport, or fossil-free car. Employees of TU Delft have an NS travel card to take the train by default.

International travel

International conferences and project meetings will be online or hybrid by default, also for the inclusion of people who otherwise would not be able to travel. A code of conduct and proper information on sustainable travel helps to guide the decisions about travel. TU Delft supports European train trips and electric car hire. Travelling outside Europe is only done when strictly needed, and then in the most sustainable way. All foreign trips will be booked through the travel agency, which finds the most sustainable alternatives for travel, looking at train and bus rides (and possibly boat trips) first before flights.

Internal carbon tax

TU Delft will impose carbon tax at € 150/tonne of CO₂-eq on non-sustainable travel options. This tax goes into the TU Delft Sustainability Fund, from which sustainable investments are financed, and from which financial support is given to sustainable trips of students.



Food & Beverage

Main proposals

General aims and principles

- To offer **sustainable and healthy** food and beverage at TU Delft
- To offer a **wider range** of food on campus, involving cultural preferences
- To offer sustainable and **circular catering facilities** on campus
- To communicate the **content, origin and environmental impact** of food
- To **support the caterers** in preparing food consciously and helping customers
- To introduce personal **reusable cutlery, plates and cups**
- To solely work with **food suppliers** that subscribe to TU Delft's sustainability goals

To be investigated

- More accurately determining the **carbon impact** update of food and diets
- Making an inventory of food **bought, sold and wasted** in 2019-2021
- **Comparing** unseasonal local food versus seasonal food from afar
- Attuning the **price of food** with its environmental impact
- Determining the environmental impact of **beverage**
- Comparing disposable with reusable and with durable **cutlery and plates**
- Executing local **food preferences** survey on the campus
- Processing **organic waste** to produce compost or biogas
- Exploring **restaurant layout design pilots** for sustainable behaviour
- Exploring options of small, medium and large size **portions** in restaurants
- Exploring food production options with the **Hammen Farm**

Projects, pilots and actions

- Initiating a complete **food and food waste inventory** system
- Starting **sustainability scans** of restaurants and food trucks on campus
- Starting **restaurant pilots**: vegetarian, vegan, 100% organic, carbon pricing
- **Waste coach** pilot, to inform and help customers separate their waste
- Starting a **foodsharing** pilot
- Introducing sustainable **packaging** for transport, in vending machines and restaurants
- Introducing **discount** for people bringing their own durable cutlery
- Setting up a **sustainable Plates, Cups and Cutlery** design challenge
- Starting a **vending machines** pilot: offer, food waste reduction, carbon impact info
- Initiating **water tap points** instead of water tanks
- Starting **food labelling** pilots: content, origin, seasonality, carbon emissions, allergies
- Starting **information boards** in restaurants, coffee bars, near vending machines
- **Communicating** about sustainable food policy and food-related events and projects

Food & Beverage

Vegan basis

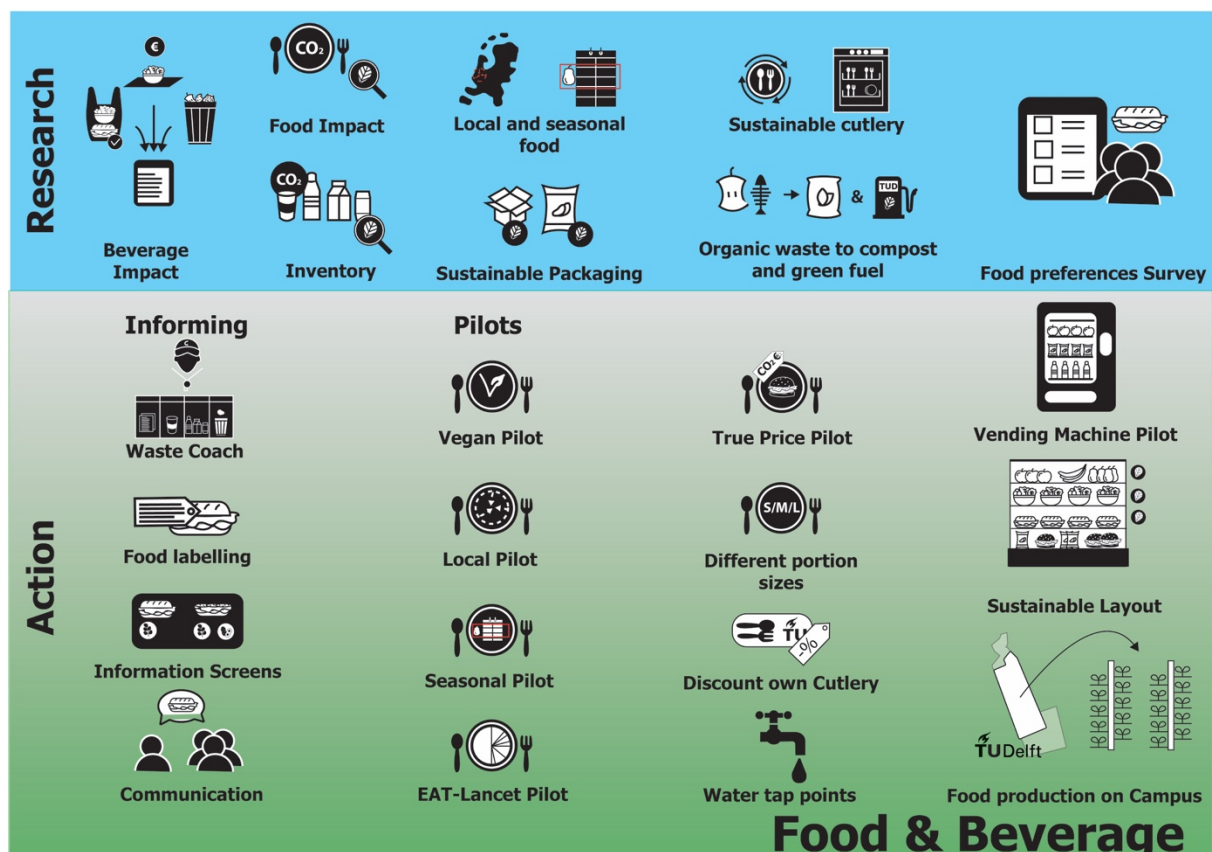
In the near future, the TU Delft Campus will have an entirely sustainable and healthy catering system, in which plant-based food forms the basis and animal products are extras. The CO₂ price is included in the price of the products, which means that vegan products have become cheaper and animal-based products more expensive.

Committed suppliers

TU Delft works with suppliers that commit to its sustainability goals for food and beverage. The caterer offers local, seasonal, and organic food and sustainable, healthy beverages. Food supply is attuned to the wishes and the cultural background of the community. Costumers bring their own plates, cutlery and cups. Several living labs test the sustainable production of food on campus, in synergy with other processes. Sustainability is integrated in the entire process from purchasing to waste treatment. The university communicates about food-related research and events.

Information

CO₂-eq emissions, origin of the product and other environmental information can be seen on products, in restaurants, and near coffee and vending machines. Restaurants, bars, and machines are designed in a way that stimulates to make a sustainable choice.



Procurement & Waste Management

Main proposals

General aims and principles

- To become **circular** in procurement and waste management
- To include a **carbon price** in bidding, assessments and evaluations
- To create **awareness** about circularity and waste management and in all daily actions

To be investigated

- Improving of data collection of **Renewi**
- Exploring the avoidance of **packaging** or sustainable packaging when needed
- Exploring options of shifting from disposables to **durables**
- Studying the possibility of **algae, bio-fermentation** or biorefinery
- Investigating making the entire **supply chain** circular
- Investigating products at the **component and material** level
- Developing a **matrix** with products on one side and measures on the other side
- Developing a system to calculate **carbon emissions** for all categories

Projects, pilots and actions

- Supporting Finance with including sustainability in the **procurement strategy**
- Developing an **Internal Central Database** and Internal Central Marketplace
- Determining a place for a **physical central marketplace**
- Including circularity **from the start**, in the tender and contracts
- Getting suppliers and the university to use the **r-ladder**
- **Centralising** procurement of all products
- Contracting **sustainably sourced products**
- **Separating waste flows** in all parts of the campus
- **Stopping paper bins** in restaurants
- **Measuring** all waste collected at Renewi

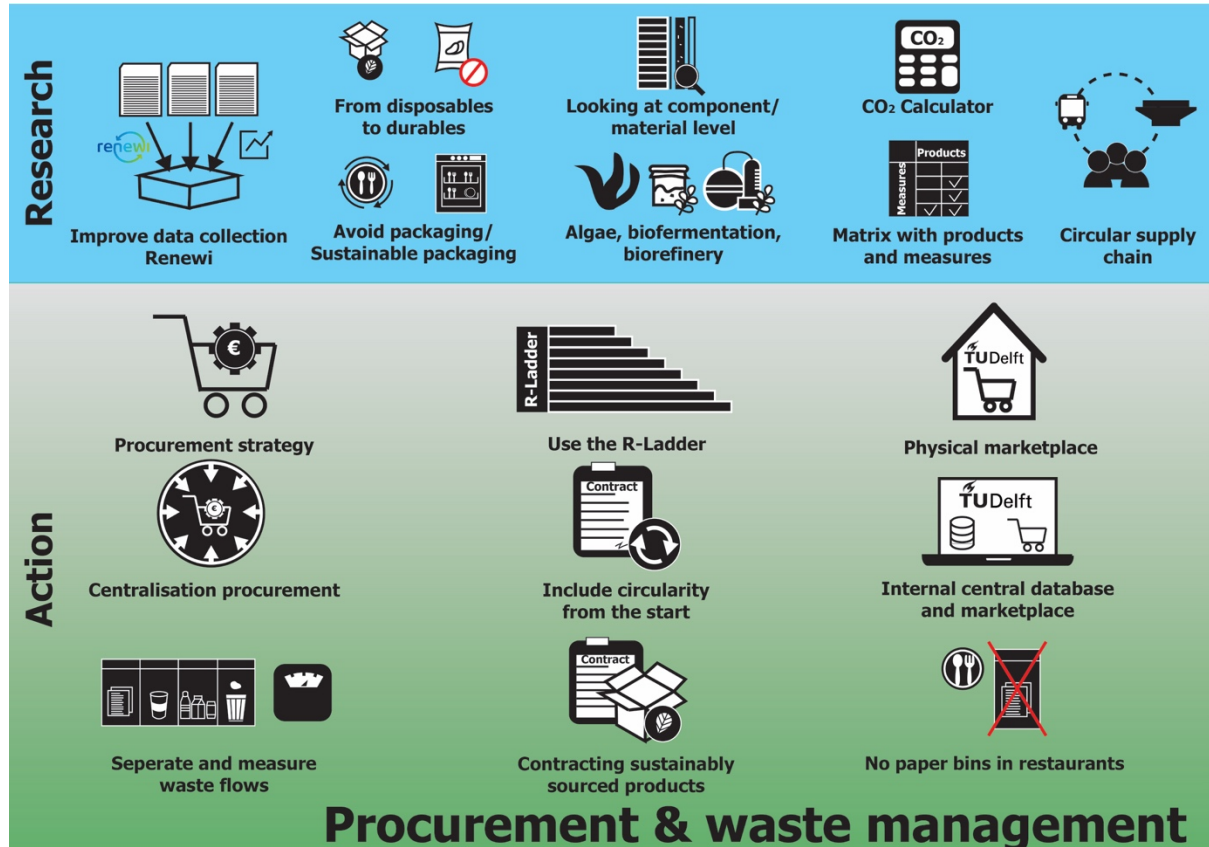
Procurement & Waste Management

Circular Strategies

In the near future, TU Delft will have an effective circular procurement and waste management strategy. Circularity is immediately included from the start, in tenders and in contracts. Suppliers take their products back when these do not meet the requirements anymore. Circular waste management is used for all the products that cannot be taken back by the supplier and for the products that were purchased before circular contracts were drawn up. The R-ladder is used to reduce the amount of waste and to make sure all steps are taken before the materials and components in the products become waste.

Product management on campus

Suppliers deliver environmental information about their products, such as the embodied carbon. The carbon price is processed in the value of the products and services. In order to get a grip on products on campus, TU Delft will have an Internal Central Database (ICD) and Internal Central Marketplace (ICM). These databases enable complete knowledge of what TU Delft has, where it can be found, and in what condition it is. This system will be combined with a centralised procurement system, making it possible to exchange products between faculties and services, reducing new purchases and waste.



IT, AI & Data Management

Main proposals

General aims and principles

- To use IT and AI smartly to **measure carbon emissions**
- To use IT and AI smartly to **make processes more energy-efficient**
- To use IT and AI smartly to **measure data** from living labs and pilot projects
- To **keep track** of the amount and type of (big) data stored
- To focus on the **quality of data**, smart data, not on requiring all data
- To use and design **energy-efficient codes** and software
- To educate **conscious programmers** using energy-efficient codes and software
- To manage **servers and data centres** sustainably

To be investigated

- Determining the exact **energy usage and carbon emissions** from the use of IT and AI
- Creating algorithms for a **sustainable website**
- Implementing ICT and AI in **mobility**
- Studying different forms of **backup power**: flywheel utilities, hydrogen, batteries
- Redesigning the **TU Delft website** to make it more user-friendly and sustainable

Projects, pilots and actions

- Implementing the **Brains for Buildings** programme in more buildings (sub-metering).
- **Linking education** to research projects
- Installing smart **server management**
- Creating a **circular hand-in policy** for e-waste

IT, AI & DM

Smart Campus

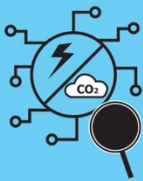
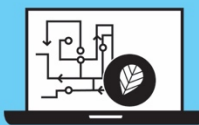




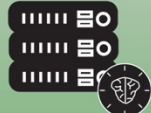

In the near future, the TU Delft Campus will work as a smart city. The university will be critically using information technology (IT), artificial intelligence (AI) and data management (DM), as well as Internet of Things (IoT) and Internet of Nature (IoN), in an effective way, monitoring energy use and assessing impact. The university will also keep track of the amount, kind and usefulness of (big) data stored. Data acquisition is well attuned to what is needed.

Monitoring of living labs

In order to learn from living labs and new projects on campus, IT and AI are essential in measuring data. They are also essential for circular resource management, to get control over resource flows. A flow model will be available after an inventory of all resources on the campus.

Energy-conscious programming

In addition to using energy-efficient codes and software, TU Delft also focusses on educating and deploying conscious programmers who write energy-efficient codes and software. Electricity is saved by efficient programming and computation and waste heat reused in the energy system of the campus.

Research			
	Exact energy usage and carbon emissions related to ICT and AI	Algorithms for a sustainable website	Implementing ICT and AI in mobility
	Action		
Circular hand-in policy for e-waste		Different forms of backup power	Implement Brains for Buildings (sub-metering) in more buildings
			
Redesign the TU Delft website to make it more energy efficient	Smart server management	Link education to research projects	
ICT, AI & Data management			

Follow-ups

Faculty and supporting division action plans

Faculties and supporting divisions have been asked to make their own sustainability action plans, based on this report before you. The respective deans and local sustainability coordinators will be responsible for them, in attunement with TU Delft's sustainability coordinator. Also, these plans need to be translated into planning schemes and financial consequences.

Continue with the theme teams

As TU Delft sustainability coordination, we propose to continue with the teams that have worked on the various themes discussed in this report. Most people involved have expressed interest to remain involved, new students and staff have joined and together they will elaborate the plans in detail, including time planning and financial schemes.

Elaborate the projects, pilots and actions proposed

As already said, the proposals made in this report need to be elaborated in more detail, connected to a time plan and to a financial scheme (when applicable). We propose to do this with the theme teams, including students and academic and supporting staff, and to prepare – together with Strategic Development – BVMs for interventions that require approval by the Executive Board.

Finish the education report

At the moment of writing, GreenTU is finishing an education report that analyses the various educational programmes at TU Delft and how these can be enhanced to include urgent themes of sustainability better. This will be done with our support and with the active involvement of the Pro Vice Rector for Joint Educational Affairs. The report is due to be finished in spring 2022, shortly after this sustainability report.

Start research on identified topics

As presented in almost every chapter of this report, there are aspects or elements of plans that require further investigation. This will be done in the coming period, or a research scheme will be set up for the coming years, together with the theme teams.

A different category refers to the monitoring of projects, pilots and actions already ongoing. To measure and learn from these projects is of great importance for future success.

Get things started in the year 2022

In normal cases, implementing change in an existing system or situation would encounter a lot of opposition, but the corona crisis has created a window of opportunity to introduce a lot of sustainability measures in a period when students and staff return after almost two years of (partial) exclusion from the campus. The new policy therefore can be best put into place at the beginning of the new year.